

### **Tree species classification using structural features derived from terrestrial laser scanning**

Fast and automated collection of forest data, such as species composition information, is required to support climate mitigation actions. Recently, there have been significant advances in the use of terrestrial laser scanning (TLS) instruments, which facilitate the capture of detailed forest structure. However, for tree species recognition the structural information from TLS has mainly been used to complement spectral information. TLS-only classification studies have been limited in size and diversity of plot forest types. In this paper, we investigate the potential of TLS for tree species classification. We used quantitative structure models to determine 17 structural tree features. These features were computed for 758 trees of five tree species, including two understory species, of a 1.4 hectare mixed deciduous forest plot. Three classification methods were compared: k-nearest neighbours, multinomial logistic regression and support vector machine. We assessed the potential underlying causes for structural differences with principal component analysis. We obtained classification success rates of approximately 80%, however, with producer accuracies for three of the five species ranging from 0 to 60%. Low producer accuracies were the result of a high intra- and low inter-species variability. These effects were, respectively, caused by a high size-dependency of the structural features and a convergence of structural traits across species as a result of the individual tree position in the forest canopy and shade tolerance. Nevertheless, the producer accuracies could be improved through sensitivity vs. specificity trade-offs, with over 50% for all species being obtainable. The high intra -and low inter-species variability complicate the classification. Furthermore, the classification performance and best classification method greatly depend on its targeted application. In conclusion, this study proves the added value of TLS for tree species classification but also shows that TLS opens up potential for testing and further development of ecological theory.

#### **General information**

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MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Inverse Problems, Universiteit Gent, National Physical Laboratory, University of Oxford, CSIRO Energy Centre, NERC National Centre for Earth Observation (NCEO), UCL Department of Geography

Contributors: Terryn, L., Calders, K., Disney, M., Origo, N., Malhi, Y., Newnham, G., Raunonen, P., Åkerblom, M., Verbeeck, H.

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### **High-Power 1.5 $\mu\text{m}$ Tapered Distributed Bragg Reflector Laser Diodes for Eye-Safe LIDAR**

A high-power InAlGaAs/InP tapered distributed Bragg reflector laser diode with narrow linewidth emission at 1.5 $\mu\text{m}$  is reported. The laser has a monolithic waveguide architecture comprising a third-order grating section for longitudinal mode selection, an index-guided gain section for lateral mode filtering, and a gain-guided tapered section for power scaling. An output power of 770 mW is reported for continuous wave operation at room temperature. In pulsed mode, the laser delivered a peak power of 4.6 W with a full width at half-maximum spectral linewidth of only 250 pm. In addition to the narrow linewidth and high-power features, the emission wavelength exhibits a temperature dependent shift of only 0.1 nm/ $^{\circ}\text{C}$ . The parameters achieved suggest that these laser diodes would enable the realization of compact LIDAR systems with improved signal-to-noise ratio, owing to the high output power and the possibility to use narrow passband filters at receiver side, which is enabled by the narrow and temperature-stable emission spectrum. The wavelength range around 1.5 $\mu\text{m}$  also enables LIDAR systems with high output powers while maintaining eye safety, ultimately leading to improved system performance.

#### **General information**

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MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: ORC

Contributors: Aho, A. T., Viheriälä, J., Koskinen, M., Uusitalo, T., Reuna, J., Guina, M.  
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ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

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#### Bibliographical note

INT=phys,"Koskinen, Mervi"

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Research output: Contribution to journal > Article > Scientific > peer-review

#### **Fusionsense: Emotion classification using feature fusion of multimodal data and deep learning in a brain-inspired spiking neural network**

Using multimodal signals to solve the problem of emotion recognition is one of the emerging trends in affective computing. Several studies have utilized state of the art deep learning methods and combined physiological signals, such as the electrocardiogram (EEG), electroencephalogram (ECG), skin temperature, along with facial expressions, voice, posture to name a few, in order to classify emotions. Spiking neural networks (SNNs) represent the third generation of neural networks and employ biologically plausible models of neurons. SNNs have been shown to handle Spatio-temporal data, which is essentially the nature of the data encountered in emotion recognition problem, in an efficient manner. In this work, for the first time, we propose the application of SNNs in order to solve the emotion recognition problem with the multimodal dataset. Specifically, we use the NeuCube framework, which employs an evolving SNN architecture to classify emotional valence and evaluate the performance of our approach on the MAHNOB-HCI dataset. The multimodal data used in our work consists of facial expressions along with physiological signals such as ECG, skin temperature, skin conductance, respiration signal, mouth length, and pupil size. We perform classification under the Leave-One-Subject-Out (LOSO) cross-validation mode. Our results show that the proposed approach achieves an accuracy of 73.15% for classifying binary valence when applying feature-level fusion, which is comparable to other deep learning methods. We achieve this accuracy even without using EEG, which other deep learning methods have relied on to achieve this level of accuracy. In conclusion, we have demonstrated that the SNN can be successfully used for solving the emotion recognition problem with multimodal data and also provide directions for future research utilizing SNN for Affective computing. In addition to the good accuracy, the SNN recognition system is requires incrementally trainable on new data in an adaptive way. It only one pass training, which makes it suitable for practical and on-line applications. These features are not manifested in other methods for this problem.

#### General information

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Organisations: BioMediTech, Auckland University of Technology, University of Los Andes, Aalto University

Contributors: Tan, C., Ceballos, G., Kasabov, N., Subramaniyam, N. P.

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ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

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FusionSense Emotion Classification 2020

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URLs:

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Research output: Contribution to journal > Article > Scientific > peer-review

### **Optically induced crossover from weak to strong coupling regime between surface plasmon polaritons and photochromic molecules**

We demonstrate optically induced crossover from a weak to a strong coupling regime in a single photonic system consisting of propagating surface plasmon polaritons (SPPs) on a planar silver film and ultraviolet (UV)-switchable photochromic molecules. A gradual increase is observed in the vacuum Rabi splitting upon increasing UV exposure, along with intriguing behavior, where the reflectivity initially decreases due to increased losses at the weak coupling regime, and then increases due to the emergence of strongly coupled modes and the associated band gap formation at the resonance frequency of the uncoupled states. This work explicitly demonstrates the optical tunability of the degree of hybridization of the SPP and exciton modes, spanning the range from weak to intermediate and finally to the strong coupling regime.

#### **General information**

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Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, Ita-Suomen yliopisto

Contributors: Asamoah, B. O., Mohamed, S., Datta, S., Karvinen, P., Rekola, H., Priimagi, A., Hakala, T. K.

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ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

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#### **Bibliographical note**

EXT="Rekola, Heikki"

Source: Scopus

Source ID: 85090383053

Research output: Contribution to journal > Article > Scientific > peer-review

### **ClothFace: A Batteryless RFID-Based Textile Platform for Handwriting Recognition**

This paper introduces a prototype of ClothFace technology, a battery-free textile-based handwriting recognition platform that includes an e-textile antenna and a  $10 \times 10$  array of radio frequency identification (RFID) integrated circuits (ICs), each with a unique ID. Touching the textile platform surface creates an electrical connection from specific ICs to the antenna, which enables the connected ICs to be read with an external UHF (ultra-high frequency) RFID reader. In this paper, the platform is demonstrated to recognize handwritten numbers 0-9. The raw data collected by the platform are a sequence of IDs from the touched ICs. The system converts the data into bitmaps and their details are increased by interpolating between neighboring samples using the sequential information of IDs. These images of digits written on the platform can be classified, with enough accuracy for practical use, by deep learning. The recognition system was trained and tested with samples from six volunteers using the platform. The real-time number recognition ability of the ClothFace technology is demonstrated to work successfully with a very low error rate. The overall recognition accuracy of the platform is 94.6% and the accuracy for each digit is between 91.1% and 98.3%. As the solution is fully passive and gets all the needed energy from the external RFID reader, it enables a maintenance-free and cost-effective user interface that can be integrated into clothing and into textiles around us.

#### **General information**

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MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group, Computing Sciences, Research group: Machine Learning Group MLG, Research group: Vision, Research group: Inverse Problems  
Contributors: He, H., Chen, X., Mehmood, A., Raivio, L., Huttunen, H., Raumonon, P., Virkki, J.

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ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: deep learning, human-machine interaction, passive UHF RFID, textile electronics, user interface, wearables

Electronic versions:

ClothFace A Batteryless RFID-Based 2020

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URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009167026>

Source: Scopus

Source ID: 85090182156

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#### High-Power 760 nm VECSEL Based on Quantum Dot Gain Mirror

We report high-power second-harmonic generation of 760 nm laser light from optically-pumped vertical-external-cavity surface-emitting laser based on quantum dot active medium. The laser generates 1.2 W in fundamental transverse mode with fixed linear polarization. The emission wavelength can be continuously tuned from 738 to 778 nm by using an intra cavity birefringent filter for fundamental radiation without readjustment of phase-matching angle of the nonlinear crystal. The result constitutes a viable alternative for applications requiring broadly tunable high brightness lasers in the 700-800 nm range.

#### General information

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Organisations: Physics, Research group: ORC, LakeDiamond SA, Ecole Polytechnique Fédérale de Lausanne, Université de Rennes

Contributors: Nechay, K., Mereuta, A., Paranthoen, C., Brevalle, G., Levallois, C., Alouini, M., Chevalier, N., Perrin, M., Suruceanu, G., Caliman, A., Kapon, E., Guina, M.

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Source: Scopus

Source ID: 85087421916

Research output: Contribution to journal > Article > Scientific > peer-review

#### Edge-enhanced optical parametric generation in periodically poled LiNbO<sub>3</sub>

We demonstrate enhanced optical parametric gains occurring at the edge of periodically poled LiNbO<sub>3</sub> (PPLN) regions. Experiments performed in MgO-doped PPLN samples, pumped at 532 nm with parametric signal outputs around 800 nm

and 1550 nm, exhibit good agreement with numerical simulations of the nonlinear wave dynamics in the system, based on the assumption of an average refractive index increase  $\Delta n = 5.3 \times 10^{-5}$  in the PPLN region. Excitation in proximity to the PPLN edge with a pump power of 8.1 mW results in a 3.6-fold output power increase with respect to parametric generation inside the PPLN area.

#### General information

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Organisations: Physics, Research group: ORC, KTH Royal Institute of Technology

Contributors: Prytz, N. B., Qvarngård, D., Härkönen, A., Guina, M., Gallo, K.

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ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

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Research output: Contribution to journal > Article > Scientific > peer-review

#### Selective hydrogen production at Pt(111) investigated by Quantum Monte Carlo methods for metal catalysis

This rapid communication gives the salient points and results of the theoretical investigation of a chemical reaction for efficient selective hydrogen production. The clean fuel produced is a sustainable energy source. Accurate methods based on quantum theory are used because the changing electronic structure is a probe that monitors reactions. The reaction between water and carbon monoxide is used industrially with metal catalysts, usually platinum. There is a considerable economic and environmental challenge underpinning this fundamental investigation where bond dissociation plays an essential role. A bond dissociation process is often the limiting step of reaction rates for industrial catalysis. Most mainstream quantum approaches fail to a greater or lesser degree in the description of this process. The present work advocates a promising alternative: the initial analysis of statistical data generated by the Quantum Monte Carlo (QMC) method demonstrated very stringent statistical accuracy for essential information on hydrogen production via the water-gas shift reaction with platinum catalyst. The transition state structure is obtained from QMC force constants and illustrated here. It corresponds to water OH-stretch concerted with Pt-H bond formation, whilst the OH oxygen atom begins to interact with the CO carbon. The present QMC evaluation of the corresponding activation barrier is low:  $17.0 \pm 0.2$  kcal/mol. It is close to the experimental apparent activation energy of 17.05 kcal/mol. This method is applicable to a wide range of similar systems.

#### General information

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Organisations: Physics, Institute Pascal

Contributors: Sharma, R. O., Rantala, T. T., Hoggan, P. E.

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ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Physical and Theoretical Chemistry

Keywords: heterogeneous catalysis, low activation barrier, metal surface, quantum Monte Carlo calculation

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Research output: Contribution to journal > Article > Scientific > peer-review

### **Zinc-indiffused MgO:PPLN waveguides for blue/UV generation via VECSEL pumping**

We present the design and characterization of a zinc-indiffused periodically poled lithium-niobate ridge waveguide for second-harmonic generation of ~390 nm light from 780 nm. We use a newly developed, broadband near-infrared vertical external-cavity surface-emitting laser (VECSEL) to investigate the potential for lower-footprint nonlinear optical pump sources as an alternative to larger commercial laser systems. We demonstrate a VECSEL with an output power of 500 mW, containing an intracavity birefringent filter for spectral narrowing and wavelength selection. In this first demonstration of using a VECSEL to pump a nonlinear waveguide, we present the ability to generate 1 mW of ~390 nm light with further potential for increased efficiency and size reduction.

#### **General information**

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Organisations: Physics, Research group: ORC, University of Southampton, United Kingdom

Contributors: Gray, A. C., Woods, J. R., Carpenter, L. G., Kahle, H., Berry, S. A., Tropper, A. C., Guina, M., Apostolopoulos, V., Smith, P. G., Gawith, C. B.

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Research output: Contribution to journal > Article > Scientific > peer-review

### **Low-noise octave-spanning mid-infrared supercontinuum generation in a multimode chalcogenide fiber**

We demonstrate the generation of a low-noise, octave-spanning mid-infrared supercontinuum from 1700 to 4800 nm by injecting femtosecond pulses into the normal dispersion regime of a multimode step-index chalcogenide fiber with 100  $\mu\text{m}$  core diameter. We conduct a systematic study of the intensity noise across the supercontinuum spectrum and show that the initial fluctuations of the pump laser are at most amplified by a factor of three. We also perform a comparison with the noise characteristics of an octave-spanning supercontinuum generated in the anomalous dispersion regime of a multimode fluoride fiber with similar core size and show that the normal dispersion supercontinuum in the multimode chalcogenide fiber has superior noise characteristics. Our results open up novel perspectives for many practical applications such as long-distance remote sensing where high power and low noise are paramount.

#### **General information**

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MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Ultrafast Optics, Research group: Nonlinear Fiber Optics

Contributors: Eslami, Z., Ryczkowski, P., Salmela, L., Genty, G.

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Source ID: 85085675757  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Lensless hyperspectral phase imaging in a self-reference setup based on Fourier transform spectroscopy and noise suppression**

A novel phase retrieval algorithm for broadband hyperspectral phase imaging from noisy intensity observations is proposed. It utilizes advantages of the Fourier transform spectroscopy in the self-referencing optical setup and provides additional, beyond spectral intensity distribution, reconstruction of the investigated object's phase. The noise amplification Fellgett's disadvantage is relaxed by the application of a sparse wavefront noise filtering embedded in the proposed algorithm. The algorithm reliability is proved by simulation tests and by results of physical experiments for transparent objects. These tests demonstrate precise phase imaging and object depth (profile) reconstruction.

#### **General information**

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Contributors: Shevkunov, I., Katkovnik, V., Egiazarian, K.  
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<http://urn.fi/URN:NBN:fi:tuni-202007096350>  
Source: Scopus  
Source ID: 85086505435  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Hyperspectral phase imaging based on denoising in complex-valued eigensubspace**

A novel algorithm for reconstruction of hyperspectral 3D complex domain images (phase/amplitude) from noisy complex domain observations has been developed and studied. This algorithm starts from the SVD (singular value decomposition) analysis of the observed complex-valued data and looks for the optimal low dimension eigenspace. These eigenspace images are processed based on special non-local block-matching complex domain filters. The accuracy and quantitative advantage of the new algorithm for phase and amplitude imaging are demonstrated in simulation tests and in processing of the experimental data. It is shown that the algorithm is effective and provides reliable results even for highly noisy data.

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Contributors: Shevkunov, I., Katkovnik, V., Claus, D., Pedrini, G., Petrov, N. V., Egiazarian, K.  
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Research output: Contribution to journal > Article > Scientific > peer-review

### Temporal ghost imaging with random fiber lasers

Ghost imaging in the time domain has opened up new possibilities to retrieve ultrafast waveforms. A pre-requisite to ghost imaging in the time domain is a light source with random temporal intensity fluctuations that are fully uncorrelated over the duration of the temporal waveform being imaged. Here, we show that random fiber lasers are excellent candidates for ghost imaging in the time domain. We study the temporal correlations of the intensity fluctuations of a random fiber laser in different operating regimes and compare its performance in temporal ghost imaging configurations with that of a conventional multi-mode cavity-based fiber laser. Our results demonstrate that random fiber lasers can achieve superior performance for ghost imaging as compared to cavity-based fiber lasers where strong correlations at the cavity round-trip time can yield artefacts for waveforms of long duration.

### General information

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MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Ultrafast Optics, Sichuan University, University of Electronic Science and Technology of China

Contributors: Wu, H., Han, B., Wang, Z., Genty, G., Feng, G., Liang, H.

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Research output: Contribution to journal > Article > Scientific > peer-review

### Instabilities in a dissipative soliton-similariton laser using a scalar iterative map

Numerical simulations of a dissipative soliton-similariton laser are shown to reproduce a range of instabilities seen in recent experiments. The model uses a scalar nonlinear Schrödinger equation map, and regions of stability and instability are readily identified as a function of gain and saturable absorber parameters. Studying evolution over multiple round trips reveals spectral instabilities linked with soliton molecule internal motion, soliton explosions, chaos, and intermittence. For the case of soliton molecules, the relative phase variation in the spectrum is shown to be due to differences in nonlinear phase evolution between the molecule components over multiple round trips.

### General information

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Organisations: Physics, UMR 6174  
Contributors: Meng, F., Lapre, C., Billet, C., Genty, G., Dudley, J. M.  
Number of pages: 4  
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ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
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Research output: Contribution to journal › Article › Scientific › peer-review

#### High-dimensional quantum gates using full-field spatial modes of photons

Unitary transformations are the fundamental building blocks of gates and operations in quantum information processing, allowing the complete manipulation of quantum systems in a coherent manner. In the case of photons, optical elements that can perform unitary transformations are readily available only for some degrees of freedom, e.g., wave plates for polarization. However, for high-dimensional states encoded in the transverse spatial modes of light, performing arbitrary unitary transformations remains a challenging task for both theoretical proposals and actual implementations. Following the idea of multi-plane light conversion, we show that it is possible to perform a broad variety of unitary operations at high quality by using only a few phase modulation planes. More importantly, we experimentally implement several high-dimensional quantum gates for up to five-dimensional states encoded in the full-field mode structure of photons. In particular, we realize cyclic and quantum Fourier transformations, known as Pauli X -gates and Hadamard  $\hat{H}$ -gates, respectively, with an average visibility of more than 90%. In addition, we demonstrate near-perfect "unitarity" by means of quantum process tomography, unveiling a process purity of 99%. Last, we demonstrate the benefit of the two independent spatial degrees of freedom, i.e., azimuthal and radial, and implement a two-qubit controlled-NOT quantum operation on a single photon. Thus, our demonstrations open up new paths to implement high-dimensional quantum operations, which can be applied to various tasks in quantum communication, computation, and sensing schemes.

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Organisations: Physics, Austrian Academy of Sciences, University of Ottawa, Canada  
Contributors: Brandt, F., Hiekkamäki, M., Bouchard, F., Huber, M., Fickler, R.  
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High-dimensional quantum gates 2020  
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<http://urn.fi/URN:NBN:fi:tuni-202003302959>  
Source: Scopus  
Source ID: 85079614867  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Single exposure lensless subpixel phase imaging: Optical system design, modelling, and experimental study**

Design and optimization of lensless phase-retrieval optical system with phase modulation of free-space propagation wavefront is proposed for subpixel imaging to achieve super-resolution reconstruction. Contrary to the traditional super-resolution phase-retrieval, the method in this paper requires a single observation only and uses the advanced Super-Resolution Sparse Phase Amplitude Retrieval (SR-SPAR) iterative technique which contains optimized sparsity based filters and multi-scale filters. The successful object imaging relies on modulation of the object wavefront with a random phase-mask, which generates coded diffracted intensity pattern, allowing us to extract subpixel information. The system's noise-robustness was investigated and verified. The super-resolution phase-imaging is demonstrated by simulations and physical experiments. The simulations included high quality reconstructions with super-resolution factor of 5, and acceptable at factor up to 9. By physical experiments 3  $\mu\text{m}$  details were resolved, which are 2.3 times smaller than the resolution following from the Nyquist-Shannon sampling theorem.

#### **General information**

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Organisations: Computing Sciences, Research group: Computational Imaging-CI

Contributors: Kocsis, P., Shevkunov, I., Katkovnik, V., Egiazarian, K.

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Publication date: 17 Feb 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 28

Issue number: 4

ISSN (Print): 1094-4087

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.379785

Source: Scopus

Source ID: 85079348632

Research output: Contribution to journal > Article > Scientific > peer-review

### **Precise length definition of active GaAs-based optoelectronic devices for low-loss silicon photonics integration**

The length variation associated with standard cleaving of III-V optoelectronic chips is a major source of loss in the integration with the micron-scale silicon-on-insulator waveguides. To this end, a new, to the best of our knowledge, approach for precise definition of the III-V chip length is reported. The method employs lithography and wet etching of cleave marks outside the active III-V waveguides. The marks follow a specific crystallographic orientation and are used to initiate and guide the cleaving process. Besides minimizing the air gap between the butt-coupled III-V and Si waveguides and hence minimizing the coupling losses, the use of precisely defined length significantly improves the integration yield owing to the increased length uniformity. We apply this technique to defining the lengths of GaAs-based semiconductor optical amplifiers and demonstrate length control with an accuracy better than 250 nm per facet. This variation is more than 1 order of magnitude smaller than with the traditional cleaving methods, resulting in improvement of coupling by several dBs.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: ORC, VTT Technical Research Centre of Finland

Contributors: Tuorila, H., Viheriälä, J., Zia, N., Cherchi, M., Harjanne, M., Isoaho, R., Aalto, T., Guina, M.

Number of pages: 4

Pages: 943-946

Publication date: 15 Feb 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 45

Issue number: 4

ISSN (Print): 0146-9592

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.382109

Source: Scopus

Source ID: 85079361695

Research output: Contribution to journal › Article › Scientific › peer-review

### **Comparative Analysis of Injection Microdisk Lasers Based on InGaAsN Quantum Wells and InAs/InGaAs Quantum Dots**

**Abstract:** The results of comparative analysis of the spectral and threshold characteristics of room-temperature injection microdisk lasers of the spectral range  $1.2 \times \mu\text{m}$  with different active regions, notably, InGaAsN/GaAs quantum wells or InAs/InGaAs/GaAs quantum dots are presented. It is found that microlasers of a comparable size with quantum wells possess a larger laser generation threshold when compared with microlasers with quantum dots. At the same time, the latter are characterized by a noticeably smaller fraction of emitted power corresponding to laser modes. The jump to lasing via an excited-state optical transition is also characteristic for them. Microdisk lasers based on InGaAsN alloy do not have these disadvantages.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Russian Academy of Science, St. Petersburg State Polytechnical University, Ioffe Physico-Technical Institute

Contributors: Moiseev, E. I., Maximov, M. V., Kryzhanovskaya, N. V., Simchuk, O. I., Kulagina, M. M., Kadinskaya, S. A., Guina, M., Zhukov, A. E.

Number of pages: 5

Pages: 263-267

Publication date: 1 Feb 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Semiconductors

Volume: 54

Issue number: 2

ISSN (Print): 1063-7826

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics

Keywords: microlaser, nitrogen-containing semiconductors, quantum dots, quantum wells

DOIs:

10.1134/S1063782620020177

Source: Scopus

Source ID: 85081636724

Research output: Contribution to journal › Article › Scientific › peer-review

### **Goos-Hänchen and Imbert-Fedorov shifts for epsilon-near-zero materials**

We investigate the reflection of a Gaussian beam impinging upon the surface of an epsilon-near-zero (ENZ) medium. In particular, we discuss the occurrence of Goos-Hänchen and Imbert-Fedorov shifts. Our calculations reveal that spatial shifts are significantly enhanced owing to the ENZ nature of the medium, and that their value and angular position can be tuned by tuning the plasma frequency of the medium.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Università dell'Aquila

Contributors: Nieminen, A., Marini, A., Ornigotti, M.

Publication date: 28 Jan 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Optics

Volume: 22

Issue number: 3

Article number: 035601

ISSN (Print): 2040-8978

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: beam shifts, Epsilon-near-zero, physical reflection

DOIs:

10.1088/2040-8986/ab6ae7

Source: Scopus

Source ID: 85080149323

Research output: Contribution to journal › Article › Scientific › peer-review

### **Sequential Collinear Photofragmentation and Atomic Absorption Spectroscopy for Online Laser Monitoring of Triatomic Metal Species**

Industrial chemical processes are struggling with adverse effects, such as corrosion and deposition, caused by gaseous alkali and heavy metal species. Mitigation of these problems requires novel monitoring concepts that provide information on gas-phase chemistry. However, selective optical online monitoring of the most problematic diatomic and triatomic species is challenging due to overlapping spectral features. In this work, a selective, all-optical, in situ gas-phase monitoring technique for triatomic molecules containing metallic atoms was developed and demonstrated with detection of PbCl<sub>2</sub>. Sequential collinear photofragmentation and atomic absorption spectroscopy (CPFAAS) enables determination of the triatomic PbCl<sub>2</sub> concentration through detection of released Pb atoms after two consecutive photofragmentation processes. Absorption cross-sections of PbCl<sub>2</sub>, PbCl, and Pb were determined experimentally in a laboratory-scale reactor to enable calibration-free quantitative determination of the precursor molecule concentration in an arbitrary environment. Limit of detection for PbCl<sub>2</sub> in the laboratory reactor was determined to be 0.25 ppm. Furthermore, the method was introduced for in situ monitoring of PbCl<sub>2</sub> concentration in a 120 MWth power plant using demolition wood as its main fuel. In addition to industrial applications, the method can provide information on chemical reaction kinetics of the intermediate species that can be utilized in reaction simulations.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Applied Optics, Tampere University, University Central Hospital Kuopio, Valmet Automation Oy, Universidad Nacional Autónoma de México

Contributors: Viljanen, J., Kalmankoski, K., Contreras, V., Sarin, J. K., Sorvajärvi, T., Kinnunen, H., Enestam, S., Toivonen, J.

Number of pages: 14

Publication date: 18 Jan 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors (Basel, Switzerland)

Volume: 20

Issue number: 2

Article number: 533

ISSN (Print): 1424-8220

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: absorption, combustion, kinetics, lead, photofragmentation

Electronic versions:

Sequential Collinear Photofragmentation 2020

DOIs:

10.3390/s20020533

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202003252864>

#### **Bibliographical note**

INT=phys,"Kalmankoski, Kim"

INT=phys,"Sarin, Jaakko K."

Source: Scopus

Source ID: 85078213348

Research output: Contribution to journal › Article › Scientific › peer-review

### **Multiphoton microscopy of the dermoepidermal junction and automated identification of dysplastic tissues with deep learning**

Histopathological image analysis performed by a trained expert is currently regarded as the gold-standard for the diagnostics of many pathologies, including cancers. However, such approaches are laborious, time consuming and contain a risk for bias or human error. There is thus a clear need for faster, less intrusive and more accurate diagnostic solutions, requiring also minimal human intervention. Multiphoton microscopy (MPM) can alleviate some of the drawbacks specific to traditional histopathology by exploiting various endogenous optical signals to provide virtual biopsies that reflect

the architecture and composition of tissues, both in-vivo or ex-vivo. Here we show that MPM imaging of the dermoepidermal junction (DEJ) in unstained fixed tissues provides useful cues for a histopathologist to identify the onset of non-melanoma skin cancers. Furthermore, we show that MPM images collected on the DEJ, besides being easy to interpret by a trained specialist, can be automatically classified into healthy and dysplastic classes with high precision using a Deep Learning method and existing pre-trained convolutional neural networks. Our results suggest that deep learning enhanced MPM for in-vivo skin cancer screening could facilitate timely diagnosis and intervention, enabling thus more optimal therapeutic approaches.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Nonlinear Optics, University Politehnica of Bucharest, Carol Davila University of Medicine and Pharmacy

Contributors: Huttunen, M. J., Hristu, R., Dumitru, A., Floroiu, I., Costache, M., Stanciu, S. G.

Number of pages: 14

Pages: 186-199

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: Biomedical Optics Express

Volume: 11

Issue number: 1

ISSN (Print): 2156-7085

Original language: English

ASJC Scopus subject areas: Biotechnology, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/BOE.11.000186

Source: Scopus

Source ID: 85078941474

Research output: Contribution to journal > Article > Scientific > peer-review

#### Neuromorphic Photonics with Coherent Linear Neurons Using Dual-IQ Modulation Cells

Neuromorphic photonics aims to transfer the high-bandwidth and low-energy credentials of optics into neuromorphic computing architectures. In this effort, photonic neurons are trying to combine the optical interconnect segments with optics that can realize all critical constituent neuromorphic functions, including the linear neuron stage and the activation function. However, aligning this new platform with well-established neural network training models in order to allow for the synergy of the photonic hardware with the best-in-class training algorithms, the following requirements should apply: i) the linear photonic neuron has to be able to handle both positive and negative weight values, ii) the activation function has to closely follow the widely used mathematical activation functions that have already shown an enormous performance in demonstrated neural networks so far. Herein, we demonstrate a coherent linear neuron architecture that relies on a dual-IQ modulation cell as its basic neuron element, introducing distinct optical elements for weight amplitude and weight sign representation and exploiting binary optical carrier phase-encoding for positive/negative number representation. We present experimental results of a typical IQ modulator performing as an elementary two-input linear neuron cell and successfully implementing all-optical linear algebraic operations with 104-ps long optical pulses. We also provide the theoretical proof and formulation of how to extend a dual-IQ modulation cell into a complete N-input coherent linear neuron stage that requires only a single-wavelength optical input and avoids the resource-consuming Wavelength Division Multiplexing (WDM) weighting schemes. An 8-input coherent linear neuron is then combined with an experimentally validated optical sigmoid activation function into a physical layer simulation environment, with respective training and physical layer simulation results for the MNIST dataset revealing an average accuracy of 97.24% and 94.37%, respectively.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Aristotle University of Thessaloniki

Contributors: Mourgias-Alexandris, G., Totovic, A., Tsakyridis, A., Passalis, N., Vyrsokinos, K., Tefas, A., Pleros, N.

Number of pages: 9

Pages: 811-819

Publication date: 2020

Peer-reviewed: Yes

Early online date: 2019

#### Publication information

Journal: Journal of Lightwave Technology

Volume: 38

Issue number: 4

ISSN (Print): 0733-8724

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: All-optical signal processing, neural networks, neuromorphic computing, neuromorphic photonics, optical neural network accelerators

DOIs:

10.1109/JLT.2019.2949133

### **Bibliographical note**

EXT="Tefas, Anastasios"

Source: Scopus

Source ID: 85079482912

Research output: Contribution to journal > Article > Scientific > peer-review

### **Full-field mode sorter using two optimized phase transformations for high-dimensional quantum cryptography**

High-dimensional encoding schemes have emerged as a novel way to perform quantum information tasks. For high dimensionality, temporal and transverse spatial modes of photons are the two paradigmatic degrees of freedom commonly used in such experiments. Nevertheless, general devices for multi-outcome measurements are still needed to take full advantage of the high-dimensional nature of encoding schemes. We propose a general full-field mode sorting scheme consisting of only up to two optimized phase elements based on evolutionary algorithms that allows for joint sorting of azimuthal and radial modes. We further study the performance of our scheme through simulations in the context of high-dimensional quantum cryptography, where sorting in different mutually unbiased bases and high-fidelity measurement schemes are crucial.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Austrian Academy of Sciences, University of Ottawa, Canada, University of Ulm Medical Center, Centro S3, Max Planck Institute for the Science of Light, Friedrich-Alexander-Universität Erlangen-Nürnberg

Contributors: Fickler, R., Bouchard, F., Giese, E., Grillo, V., Leuchs, G., Karimi, E.

Number of pages: 7

Publication date: 2020

Peer-reviewed: Yes

### **Publication information**

Journal: Journal of Optics (United Kingdom)

Volume: 22

Issue number: 2

Article number: 024001

ISSN (Print): 2040-8978

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: mode demultiplexing high-dimensional quantum information, quantum cryptography, transverse spatial modes

Electronic versions:

Fickler\_2020\_J.\_Opt.\_22\_024001

DOIs:

10.1088/2040-8986/ab6303

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202003202782>

Source: Scopus

Source ID: 85079689477

Research output: Contribution to journal > Article > Scientific > peer-review

### **Spectral invariance and scaling law for nonstationary optical fields**

We develop a scaling law for a class of statistically nonstationary scalar optical fields, which ensures spectral invariance on their propagation into the far zone of a planar source. The invariance involves the constraint that the normalized far-zone spectrum must be the same in every direction of observation, as well as equal to the normalized area-averaged source spectrum. Thus, it additionally represents an extension of the earlier work by Wolf on stationary fields [Phys. Rev. Lett. 56, 1370 (1986)PRLTAO0031-900710.1103/PhysRevLett.56.1370] that assumed the normalized source spectrum as independent of position. We present examples of both nonstationary and stationary fields that satisfy the scaling law and extended spectral invariance.

### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, Luoyang Normal University, University of Eastern Finland  
Contributors: Ding, C., Koivurova, M., Setälä, T., Turunen, J., Friberg, A. T.  
Number of pages: 7  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Physical Review A  
Volume: 101  
Issue number: 3  
Article number: 033808  
ISSN (Print): 2469-9926  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1103/PhysRevA.101.033808  
Source: Scopus  
Source ID: 85082680273  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Harmonic mode-locking fiber ring laser with a pulse repetition rate up to 12 GHz

We experimentally demonstrate a harmonically mode-locked Er-doped fiber laser. The distinctive feature of the laser is highly stable pulse trains generated via self-starting hybrid mode-locking triggered by frequency-shifting and nonlinear polarization evolution. An intra-cavity tunable bandpass filter allows getting a pulse repetition rate up to 12 GHz with local adjustment of the wavelength.

#### General information

Publication status: E-pub ahead of print  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, Research group: Nanophotonics, Ulyanovsk State University, St. Petersburg State Polytechnical University, ITMO University  
Contributors: Korobko, D. A., Stoliarov, D. A., Itrin, P. A., Odnoblyudov, M. A., Petrov, A. B., Gumenyuk, R. V.  
Number of pages: 6  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Optics and laser technology  
Volume: 133  
Article number: 106526  
ISSN (Print): 0030-3992  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering  
Keywords: Fiber lasers, Harmonic mode-locking, High-repetition pulse trains  
DOIs:  
10.1016/j.optlastec.2020.106526  
Source: Scopus  
Source ID: 85089483506  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Controlling the plasmon resonance via epsilon-near-zero multilayer metamaterials

Localized plasmon resonance of a metal nanoantenna is determined by its size, shape and environment. Here, we diminish the size dependence by using multilayer metamaterials as epsilon-near-zero (ENZ) substrates. By means of the vanishing index of the substrate, we show that the spectral position of the plasmonic resonance becomes less sensitive to the characteristics of the plasmonic nanostructure and is controlled mostly by the substrate, and hence, it is pinned at a fixed narrow spectral range near the ENZ wavelength. Moreover, this plasmon wavelength can be adjusted by tuning the ENZ region of the substrate, for the same size nanodisk (ND) array. We also show that the difference in the phase of the scattered field by different size NDs at a certain distance is reduced when the substrate is changed to ENZ metamaterial. This provides effective control of the phase contribution of each nanostructure. Our results could be utilized to manipulate the resonance for advanced metasurfaces and plasmonic applications, especially when precise control of the plasmon resonance is required in flat optics designs. In addition, the pinning wavelength can be tuned optically, electrically and thermally by introducing active layers inside the hyperbolic metamaterial.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, Research group: Metaplasmonics  
Contributors: Habib, M., Briukhanova, D., Das, N., Yildiz, B. C., Caglayan, H.  
Number of pages: 8  
Publication date: 2020  
Peer-reviewed: Yes

### Publication information

Journal: Nanophotonics  
Volume: 9  
Issue number: 11  
Article number: 20200245  
ISSN (Print): 2192-8614  
Original language: English  
ASJC Scopus subject areas: Biotechnology, Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering  
Keywords: epsilon near zero, hyperbolic metamaterial, localized surface plasmon, pinning effect  
Electronic versions:  
Controlling the plasmon resonance 2020  
DOIs:  
10.1515/nanoph-2020-0245  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202008316784>

### Bibliographical note

INT=phys,"Briukhanova, Daria"  
INT=phys,"Das, Nekhel"  
INT=phys,"Yildiz, Bilge Can"  
Source: Scopus  
Source ID: 85089689543  
Research output: Contribution to journal > Article > Scientific > peer-review

### Features of correlation measurements of the parameters of pulsed hyperspectral optical fields using an asymmetric interferometer

Differences in correlation measurements of the parameters of pulsed hyperspectral optical fields using symmetric and asymmetric interferometers are considered. It is shown analytically that the resulting cross-correlation function is sensitive to phase perturbations in the original wave field. The considered setup, which contains a telescopic reflective 4f system of parabolic mirrors in one arm, demonstrates that in the case of an asymmetric interferometer, the presence of aberrations leads to degradation of the reconstructed image, whereas in the case of symmetric interferometers these aberrations do not affect the result.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, Research group: Computational Imaging-CI, ITMO University  
Contributors: Kulya, M. S., Katkovnik, V. Y., Egiazarian, K., Petrov, N. V.  
Number of pages: 4  
Pages: 679-682  
Publication date: 2020  
Peer-reviewed: Yes

### Publication information

Journal: Quantum Electronics  
Volume: 50  
Issue number: 7  
ISSN (Print): 1063-7818  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering  
Keywords: correlation measurements, hyperspectral fields, symmetric and asymmetric interferometers  
DOIs:  
10.1070/QEL17292



Source: Scopus

Source ID: 85090382756

Research output: Contribution to journal › Article › Scientific › peer-review

### **Stabilization of passive harmonic mode locking in a fiber ring laser**

We propose the model of a harmonically mode-locked soliton fiber ring laser based on the nonlinear polarization rotation taking into account the gain depletion and recovery effects. It is shown that a specific timing jitter could arise in such lasers, since the pulses in the cavity are not strongly identical. To suppress the jitter and stabilize the harmonic mode-locking operation, a method using a small frequency shift followed by the laser radiation filtering is described. The performed numerical simulation shows that the proposed method is able to provide extremely stable harmonic mode locking in a soliton fiber ring laser.

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Ulyanovsk State University

Contributors: Gumenyuk, R. V., Korobko, D. A., Zolotovskii, I. O.

Number of pages: 4

Pages: 184-187

Publication date: 23 Dec 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 45

Issue number: 1

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2019): CiteScore 7.2 SJR 1.788 SNIP 1.613

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.45.000184

Source: Scopus

Source ID: 85077516756

Research output: Contribution to journal › Article › Scientific › peer-review

### **Environmental monitoring with distributed mesh networks: An overview and practical implementation perspective for urban scenario**

Almost inevitable climate change and increasing pollution levels around the world are the most significant drivers for the environmental monitoring evolution. Recent activities in the field of wireless sensor networks have made tremendous progress concerning conventional centralized sensor networks known for decades. However, most systems developed today still face challenges while estimating the trade-off between their flexibility and security. In this work, we provide an overview of the environmental monitoring strategies and applications. We conclude that wireless sensor networks of tomorrow would mostly have a distributed nature. Furthermore, we present the results of the developed secure distributed monitoring framework from both hardware and software perspectives. The developed mechanisms provide an ability for sensors to communicate in both infrastructure and mesh modes. The system allows each sensor node to act as a relay, which increases the system failure resistance and improves the scalability. Moreover, we employ an authentication mechanism to ensure the transparent migration of the nodes between different network segments while maintaining a high level of system security. Finally, we report on the real-life deployment results.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, St. Petersburg State University of Aerospace Instrumentation, ITMO University, Brno University of Technology, National Research University Higher School of Economics

Contributors: Ometov, A., Bezzateev, S., Voloshina, N., Masek, P., Komarov, M.

Number of pages: 19

Publication date: 2 Dec 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors (Switzerland)

Volume: 19  
Issue number: 24  
Article number: 5548  
ISSN (Print): 1424-8220  
Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: Authentication mechanism, Distributed systems, Environmental monitoring, Security, Wireless sensor network

Electronic versions:

sensors-19-05548-v3

DOIs:

10.3390/s19245548

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001171367>

### **Bibliographical note**

EXT="Komarov, Mikhail"

Source: Scopus

Source ID: 85076920114

Research output: Contribution to journal › Article › Scientific › peer-review

### **Terahertz pulse time-domain holography with balance detection: Complex-domain sparse imaging**

We investigated the peculiarities of the terahertz pulse time-domain holography principle in the case of raster scanning with the balance detection system. The noise in this system represents a Skellam distribution model, which differentiates it from systems based on a photoconductive antenna. We analyzed this Skellam model and provided both numerical and experimental investigations. We found that the variance of the noise in the balance detection system does not depend on the true signal. Complex-domain images obtained in this model are filtered by block-matching algorithms adapted for spatio-temporal and spatio-spectral volumetric data. We presented a new cube complex-domain filter algorithm that uses block matching in all 3D data sets simultaneously in spatial and frequency coordinates. A combination of temporal and complex-domain filters allows us to expand the dynamic range of terahertz frequencies for which we can obtain amplitude/phase information. Experimental data demonstrate an improvement in the quality of the resultant images both in the time domain and complex-spectral domain. The simulation and experimental results are in good agreement.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Computational Imaging-CI, ITMO University

Contributors: Kulya, M., Petrov, N. V., Katkovnik, V., Egiazarian, K.

Pages: G61-G70

Publication date: 1 Dec 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Applied Optics

Volume: 58

Issue number: 34

ISSN (Print): 1559-128X

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.762 SNIP 1.166

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering (miscellaneous), Electrical and Electronic Engineering

DOIs:

10.1364/AO.58.000G61

Source: Scopus

Source ID: 85075613421

Research output: Contribution to journal › Article › Scientific › peer-review

### **Resolution and contrast in terahertz pulse time-domain holographic reconstruction**

Here, we present a comprehensive study of the reconstruction quality in terahertz (THz) pulse time-domain holography. We look into single wavelength reconstructions, as well as broadband recovery enabled by the ultrabroadband nature of radiation and coherent detection enabled by electro-optic or photoconductive sensing. We demonstrate the transverse

resolution dependence for amplitude and phase objects on the solid angle of the inline recorded time-domain THz hologram, and then turn to the contrast of reconstructed binary amplitude objects, and further to longitudinal resolution of phase objects. We show that transverse resolution can reach values comparable to the wavelength of the radiation used, and longitudinally, phase objects can be resolved with even greater precision. We compare the obtained resolution with theoretical estimates and show that THz pulse time-domain holography is a powerful non-contact imaging tool.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, ITMO University, University of Birmingham

Contributors: Turov, A. T., Kulya, M. S., Petrov, N. V., Gorodetsky, A.

Pages: G231-G240

Publication date: 1 Dec 2019

Peer-reviewed: Yes

#### Publication information

Journal: Applied Optics

Volume: 58

Issue number: 34

ISSN (Print): 1559-128X

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.762 SNIP 1.166

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering (miscellaneous), Electrical and Electronic Engineering

DOIs:

10.1364/AO.58.00G231

Source: Scopus

Source ID: 85075600417

Research output: Contribution to journal > Article > Scientific > peer-review

#### Spectral object recognition in hyperspectral holography with complex-domain denoising

In this paper, we have applied a recently developed complex-domain hyperspectral denoiser for the object recognition task, which is performed by the correlation analysis of investigated objects' spectra with the fingerprint spectra from the same object. Extensive experiments carried out on noisy data from digital hyperspectral holography demonstrate a significant enhancement of the recognition accuracy of signals masked by noise, when the advanced noise suppression is applied.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Computational Imaging-CI, ITMO University, University of Ulm Medical Center, University of Stuttgart

Contributors: Shevkunov, I., Katkovnik, V., Claus, D., Pedrini, G., Petrov, N. V., Egiazarian, K.

Number of pages: 10

Publication date: 26 Nov 2019

Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Switzerland)

Volume: 19

Issue number: 23

Article number: 5188

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: Hyperspectral imaging, Noise filtering, Noise in imaging systems, Singular value decomposition, Sparse representation

Electronic versions:

sensors-19-05188-v2

DOIs:

10.3390/s19235188

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912166905>

Source: Scopus

Source ID: 85075511855

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Path-integral description of quantum nonlinear optics in arbitrary media**

We present a method, based on Feynman path integrals, to describe the propagation and properties of the quantized electromagnetic field in an arbitrary, nonlinear medium. We provide a general theory, valid for any order of optical nonlinearity, and we then specialize the case of second-order nonlinear processes. In particular, we show that second-order nonlinear processes in arbitrary media, under the undepleted pump approximation, can be described by an effective free electromagnetic field, propagating in a vacuum, dressed by the medium itself. Moreover, we show that the probability of such processes to occur is related to the biphoton propagator, which contains information about the structure of the medium, its nonlinear properties, and the structure of the pump beam.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, El Oued University, Universität Rostock, Universität Rostock, Albert

Contributors: Difallah, M., Szameit, A., Ornigotti, M.

Publication date: 20 Nov 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A

Volume: 100

Issue number: 5

Article number: 053845

ISSN (Print): 2469-9926

Ratings:

Scopus rating (2019): SJR 1.416 SNIP 0.939

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

[10.1103/PhysRevA.100.053845](https://doi.org/10.1103/PhysRevA.100.053845)

Source: Scopus

Source ID: 85075715771

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Statistical evaluation of barkhausen noise testing (BNT) for ground samples**

Barkhausen noise testing (BNT) is a nondestructive method for investigating many properties of ferromagnetic materials. The most common application is the monitoring of grinding burns caused by introducing locally high temperatures while grinding. Other features, such as microstructure, residual stress changes, hardening depth, and so forth, can be monitored as well. Nevertheless, because BNT is a method based on a complex magnetoelectric phenomenon, it is not yet standardized. Therefore, there is a need to study the traceability and stability of the measurement method. This study aimed to carry out a statistical analysis of ferromagnetic samples after grinding processes by the use of BNT. The first part of the experiment was to grind samples in different facilities (Sweden and Finland) with similar grinding parameters, different grinding wheels, and different hardness values. The second part was to evaluate measured BNT parameters to determine significant factors affecting BNT signal value. The measurement data from the samples were divided into two different batches according to where they were manufactured. Both grinding batches contained measurement data from three different participants. The main feature for calculation was the root-mean-square (RMS) value. The first processing step was to normalize the RMS values for all the measurements. A standard analysis of variance (ANOVA) was applied for the normalized dataset. The ANOVA showed that the grinding parameters had a significant impact on the BNT signal value, while the other investigated factors (e.g., participant) were negligible. The reasons for this are discussed at the end of the paper.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science and Environmental Engineering, Univ of Oulu, Schlumpf Scandinavia AB, Kungliga Tekniska Högskolan KTH

Contributors: Tomkowski, R., Sorsa, A., Santa-Aho, S., Lundin, P., Vippola, M.

Publication date: 1 Nov 2019

Peer-reviewed: Yes

### Publication information

Journal: Sensors (Switzerland)

Volume: 19

Issue number: 21

Article number: 4716

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: ANOVA, Barkhausen noise testing (BNT), Proficiency test, Uncertainty

Electronic versions:

sensors-19-04716-v2

DOIs:

10.3390/s19214716

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911135926>

Source: Scopus

Source ID: 85074321480

Research output: Contribution to journal > Article > Scientific > peer-review

### Near-perfect measuring of full-field transverse-spatial modes of light

Along with the growing interest in using the transverse-spatial modes of light in quantum and classical optics applications, developing an accurate and efficient measurement method has gained importance. Here, we present a technique relying on a unitary mode conversion for measuring any full-field transverse-spatial mode. Our method only requires three consecutive phase modulations followed by a single mode fiber and is, in principle, error-free and lossless. We experimentally test the technique using a single spatial light modulator and achieve an average error of 4.2 % for a set of 9 different full-field Laguerre-Gauss and Hermite-Gauss modes with an efficiency of up to 70%. Moreover, as the method can also be used to measure any complex superposition state, we demonstrate its potential for quantum cryptography applications and in high-dimensional quantum state tomography.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Tampere University, Tampere University

Contributors: Hiekkamäki, M., Prabhakar, S., Fickler, R.

Number of pages: 9

Pages: 31456-31464

Publication date: 28 Oct 2019

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 27

Issue number: 22

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2019): CiteScore 6.7 SJR 1.533 SNIP 1.651

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.27.031456

### Bibliographical note

INT=PHYS,"Hiekkamäki, Markus"

INT=PHYS,"Prabhakar, Shashi"

Source: Scopus

Source ID: 85074434779

Research output: Contribution to journal > Article > Scientific > peer-review

### High Power 1.5um Pulsed Laser Diode with Asymmetric Waveguide and Active Layer Near p-cladding

We report first experimental results on a high-power pulsed semiconductor laser operating in the eye-safe spectral range (wavelength around 1.5  $\mu\text{m}$ ) with an asymmetric waveguide structure. The laser has a bulk active layer positioned very

close to the p-cladding in order to eliminate current-induced nonuniform carrier accumulation in the p-side of the waveguide and the associated carrier losses. Moderate doping of the n-side of the waveguide is used to strongly suppress nonuniform carrier accumulation within this part of the waveguide. Highly p-doped InP p-cladding facilitates low series resistance. An as-cleaved sample with a stripe width of 90 nm exhibits an output power of about 18 W at a pumping current amplitude of 80 A. Theoretical calculations, validated by comparison to experiment, suggest that the performance of lasers of this type can be improved further by optimization of the waveguide thickness and doping as well as improvement of injection efficiency.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: ORC, University of Oulu, Ioffe Physico-Technical Institute, University of York

Contributors: Hallman, L. W., Ryvkin, B. S., Avrutin, E. A., Aho, A. T., Viheriälä, J., Guina, M., Kostamovaara, J. T.

Pages: 1635-1638

Publication date: 15 Oct 2019

Peer-reviewed: Yes

Early online date: 10 Sep 2019

#### Publication information

Journal: IEEE Photonics Technology Letters

Volume: 31

Issue number: 20

ISSN (Print): 1041-1135

Ratings:

Scopus rating (2019): CiteScore 5.5 SJR 0.945 SNIP 1.212

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Radiation, Electrical and Electronic Engineering

DOIs:

10.1109/LPT.2019.2940231

Research output: Contribution to journal > Article > Scientific > peer-review

#### Realization of Free-Space Long-Distance Self-Healing Bessel Beams

A new approach for generating long-distance self-healing Bessel beams, which is based on a ring-shaped (annular) lens and a spherical lens in 4f-configuration, is reported. With this, diffraction-free light evolution of a zeroth order Bessel beam over several meters is shown and available scaling opportunities that surpass current technologies by far are discussed. Furthermore, it is demonstrated how this setup can be adapted to create Bessel beam superpositions, realizing the longest ever reported optical conveyor beam and helicon beam, respectively. Last, the self-healing capabilities of the beams are tested against strong opaque and non-opaque scatterers, which again emphasizes the great potential of this new method.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Friedrich-Schiller-University Jena, UMR 6174, Fraunhofer Institute for Applied Optics and

Precision Engineering IOF, Vacom GmbH, Institute of Applied Physics, Institut für Physik, Universität Rostock, Albert

Contributors: Vetter, C., Steinkopf, R., Bergner, K., Ornigotti, M., Nolte, S., Gross, H., Szameit, A.

Publication date: 1 Oct 2019

Peer-reviewed: Yes

#### Publication information

Journal: Laser and Photonics Reviews

Volume: 13

Issue number: 10

Article number: 1900103

ISSN (Print): 1863-8880

Ratings:

Scopus rating (2019): CiteScore 16.9 SJR 4.014 SNIP 2.903

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics

Keywords: beam-shaping, Bessel-beams, laser-technology, self-healing, telecommunication

Electronic versions:

Vetter\_et\_al-2019-Laser\_&\_Photonics\_Reviews

DOIs:

10.1002/lpor.201900103

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911055743>

Source: Scopus

Source ID: 85073597306

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Observation of PT-symmetric quantum interference

A common wisdom in quantum mechanics is that the Hamiltonian has to be Hermitian in order to ensure a real eigenvalue spectrum. Yet, parity–time (PT)-symmetric Hamiltonians are sufficient for real eigenvalues and therefore constitute a complex extension of quantum mechanics beyond the constraints of Hermiticity. However, as only single-particle or classical wave physics has been exploited so far, an experimental demonstration of the true quantum nature of PT symmetry has been elusive. In our work, we demonstrate two-particle quantum interference in a PT-symmetric system. We employ integrated photonic waveguides to reveal that the quantum dynamics of indistinguishable photons shows strongly counterintuitive features. To substantiate our experimental data, we analytically solve the quantum master equation using Lie algebra methods. The ideas and results presented here pave the way for non-local PT-symmetric quantum mechanics as a novel building block for future quantum devices.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Universität Rostock, Albert

Contributors: Klauck, F., Teuber, L., Ornigotti, M., Heinrich, M., Scheel, S., Szameit, A.

Publication date: 16 Sep 2019

Peer-reviewed: Yes

### Publication information

Journal: Nature Photonics

ISSN (Print): 1749-4885

Ratings:

Scopus rating (2019): CiteScore 58.3 SJR 13.614 SNIP 7.931

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

DOIs:

10.1038/s41566-019-0517-0

Source: Scopus

Source ID: 85073826086

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Short-range supercontinuum-based lidar for temperature profiling

We developed a short-range light detection and ranging system using a supercontinuum (SC) source spectrally tailored to cover the ro-vibrational transition energies of desired components of a flue gas. The system enables remote measurements of the gas parameters, including temperature and concentration which play a key role in the performance of combustion power plants. The technique requires only one inspection window and, thus, can be used in combustion units with limited access. It exploits differential absorption between specific wavelength bands of the gas absorption spectrum. The transmittance of an individual wavelength band is derived from the detected backscattered temporal intensity of the SC pulses. We demonstrate water vapor temperature measurement in the range of 400°C–900°C in a laboratory furnace with the use of only two wavelength bands. Using more than two wavelength bands, the technique can be further extended to simultaneously measure temperature and concentration. By varying the direction of the incident beam in a non-parallel plane, a full 3D profile is also obtainable.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Valmet Automation Oy

Contributors: Saleh, A., Aalto, A., Ryczkowski, P., Genty, G., Toivonen, J.

Number of pages: 4

Pages: 4223-4226

Publication date: 1 Sep 2019

Peer-reviewed: Yes

### Publication information

Journal: Optics Letters

Volume: 44

Issue number: 17

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2019): CiteScore 7.2 SJR 1.788 SNIP 1.613

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.44.004223

Source: Scopus

Source ID: 85071398770

Research output: Contribution to journal › Article › Scientific › peer-review

### High power GaInNAs superluminescent diodes emitting over 400 mW in the 1.2 $\mu\text{m}$ wavelength range

A high-power superluminescent diode emitting over 400 mW in the 1.2  $\mu\text{m}$  range is reported. The active region is based on a single GaInNAs/GaAs quantum well positioned within a low-confinement vertical waveguide and a lateral ridge waveguide geometry, ensuring single transverse mode operation. The peak wall-plug efficiency and the differential efficiency in the linear region were 22.8% and 0.38 W/A, respectively. The full width at half-maximum spectral width for the maximum output power was 22 nm, corresponding to a spectral power density of 19 mW/nm, a threefold increase compared to continuous wave superluminescent diodes based on a quantum dot active region operating in the same wavelength range. Besides exhibiting excellent optical and electrical properties, the GaInNAs active region enhances operation at elevated temperatures. In this respect, an output power of about 210 mW is demonstrated at operation temperatures as high as 60 °C, while 150 mW is still emitted at 70 °C. The unique combination of parameters demonstrated makes these GaInNAs QW-based superluminescent diodes particularly attractive for hybrid integration with silicon photonic circuitry, enabling the demonstration of compact solutions for sensing, optical coherence tomography, and other emerging concepts exploiting photonic integration technology and requiring single transversal mode operation, good efficiency, broadband high spectral power density, and uncooled operation at elevated temperatures.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: ORC

Contributors: Aho, A., Viheriälä, J., Virtanen, H., Zia, N., Isoaho, R., Guina, M.

Number of pages: 4

Publication date: 22 Aug 2019

Peer-reviewed: Yes

#### Publication information

Journal: Applied Physics Letters

Volume: 115

Issue number: 8

Article number: 081104

ISSN (Print): 0003-6951

Ratings:

Scopus rating (2019): CiteScore 7 SJR 1.343 SNIP 1.252

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Radiation

Keywords: Superluminescent diodes, High power, OCT

DOIs:

10.1063/1.5111012

Research output: Contribution to journal › Article › Scientific › peer-review

### Bayesian inversion of a forest reflectance model using Sentinel-2 and Landsat 8 satellite images

The inversion of reflectance models is a generalizable tool to obtain estimates on forest biophysical parameters, such as leaf area index, with theoretically little information need from a study area, instead relying on the knowledge about physical processes in the forest radiation regime. The use of prior information can greatly improve the reflectance model inversion, however, the literature does not yet provide much information on the selection of priors and their influence on the inversion results. In this study, we used a Bayesian approach to invert the PARAS forest reflectance model and retrieve leaf area index from Sentinel-2 MSI and Landsat 8 OLI multispectral satellite images. The PARAS model is based on the theory of spectral invariants, which describes the influence of wavelength-independent parameters on forest radiative transfer. The Bayesian inversion approach is highly flexible, provides uncertainty quantification, and enables the explicit incorporation of prior knowledge into the inversion process. We found that the choice of prior information is crucial in inverting a forest reflectance model to predict leaf area index. Regularizing and informative priors for leaf area index strongly improved the predictions, relative to an uninformative prior, in that they counteracted the saturation effect of the optical signal occurring at high values for leaf area index. The predictions of leaf area index were more accurate for Landsat 8 than for Sentinel-2, due to potential inconsistencies in the visible bands of Sentinel-2 in our data, and the higher spectral resolution.



### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, Aalto University, University of Eastern Finland  
Contributors: Schraik, D., Varvia, P., Korhonen, L., Rautiainen, M.  
Number of pages: 12  
Pages: 1-12  
Publication date: 1 Aug 2019  
Peer-reviewed: Yes

### Publication information

Journal: JOURNAL OF QUANTITATIVE SPECTROSCOPY AND RADIATIVE TRANSFER  
Volume: 233  
ISSN (Print): 0022-4073  
Ratings:  
Scopus rating (2019): CiteScore 5.2 SJR 0.888 SNIP 1.335  
Original language: English  
ASJC Scopus subject areas: Radiation, Atomic and Molecular Physics, and Optics, Spectroscopy  
Keywords: Bayesian inversion, Clumping, Forest reflectance, Landsat 8, Leaf area index, PARAS, Recollision probability, Sentinel-2, Spectral invariants  
Electronic versions:  
1-s2.0-S002240731930175X-main  
DOIs:  
10.1016/j.jqsrt.2019.05.013  
URLs:  
<http://urn.fi/URN:NBN:fi:tty-201907031934>  
Source: Scopus  
Source ID: 85065605532  
Research output: Contribution to journal > Article > Scientific > peer-review

### AlGaAs/AlGaInP VECSELs with Direct Emission at 740-770 nm

An optically-pumped vertical-external-cavity surface-emitting laser (OP-VECSEL) with 3.25-W output power emitting around 750 nm is demonstrated. The gain structure incorporates AlGaAs quantum wells (QWs) and barriers, and AlGaInP claddings. The emission wavelength could be tuned from 740 to 770 nm. The development addresses the need for high brightness lasers at a wavelength range that has proven difficult to reach. The demonstrated structure exhibits polarization-related peculiarities, which cause polarization switching under increased pump power due to mode competition. The presence of birefringence inside the active region is attributed to known long-range ordering within the AlGaInP claddings which causes distorted beam profiles. This influence on laser features has not been reported in VECSELs so far.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics  
Contributors: Nechay, K., Kahle, H., Penttinen, J., Rajala, P., Tukiainen, A., Ranta, S., Guina, M.  
Number of pages: 4  
Pages: 1245-1248  
Publication date: 1 Aug 2019  
Peer-reviewed: Yes

### Publication information

Journal: IEEE Photonics Technology Letters  
Volume: 31  
Issue number: 15  
ISSN (Print): 1041-1135  
Ratings:  
Scopus rating (2019): CiteScore 5.5 SJR 0.945 SNIP 1.212  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering  
Keywords: AlGaAs, AlGaInP, quantum well lasers, semiconductor disk lasers, semiconductor growth, semiconductor laser, vertical-external-cavity surface-emitting lasers (VECSELs)  
DOIs:  
10.1109/LPT.2019.2924289

### **Bibliographical note**

INT=phys,"Rajala, Patrik"

Source: Scopus

Source ID: 85069529749

Research output: Contribution to journal › Article › Scientific › peer-review

### **Influence of pump coherence on the generation of position-momentum entanglement in optical parametric down-conversion**

We examine experimentally how the degree of position-momentum entanglement of photon pairs depends on the transverse coherence of the pump beam that excites them in a process of spontaneous parametric down-conversion. Using spatially incoherent light from a light-emitting diode, we obtain strong position correlation of the photons, but we find that transverse momentum correlation, and thus entanglement, is entirely absent. When we continuously vary the degree of spatial coherence on the pump beam, we observe the emergence of stronger momentum correlations and entanglement. We present theoretical arguments that explain our experimental results. Our results shed light on entanglement generation and can be applied to control entanglement for quantum information applications.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Xiamen University, University of Ottawa, Canada, University of Ulm Medical Center, University of Rochester Institute of Optics

Contributors: Zhang, W., Fickler, R., Giese, E., Chen, L., Boyd, R. W.

Number of pages: 9

Pages: 20745-20753

Publication date: 22 Jul 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Optics Express

Volume: 27

Issue number: 15

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2019): CiteScore 6.7 SJR 1.533 SNIP 1.651

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.27.020745

Source: Scopus

Source ID: 85069963559

Research output: Contribution to journal › Article › Scientific › peer-review

### **Temporal ghost imaging using wavelength conversion and two-color detection**

Ghost imaging constructs an image by correlating two signals: one that interacts with an object but possesses no spatial information, and the other that contains spatial information but does not interact with the object. Ghost imaging can be extended into the time domain by using laser intensity fluctuations to reconstruct an unknown time-varying pattern, but this requires the measurement of laser fluctuations on ultrafast timescales, a significant limitation at wavelengths where ultrafast detectors are not available. We overcome this by using wavelength conversion to shift the probe laser into a spectral region where ultrafast detectors are available, and we apply this technique to image a temporal object at 2  $\mu\text{m}$ . Our results demonstrate that temporal correlation information can be transferred to an arbitrary spectral region, opening possibilities for ultrafast ghost imaging at new wavelengths.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, University of Electronic Science and Technology of China, UMR 6174, Ita-Suomen yliopisto

Contributors: Wu, H., Ryczkowski, P., Friberg, A. T., Dudley, J. M., Genty, G.

Number of pages: 5

Pages: 902-906

Publication date: 20 Jul 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Optica

Volume: 6  
Issue number: 7  
ISSN (Print): 2334-2536  
Ratings:

Scopus rating (2019): CiteScore 18.1 SJR 5.6 SNIP 3.375

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics  
DOIs:

10.1364/OPTICA.6.000902

#### **Bibliographical note**

INT=phys,"Wu, Han"

Source: Scopus

Source ID: 85071154886

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Methods for simultaneous robot-world-hand-eye calibration: A comparative study**

In this paper, we propose two novel methods for robot-world-hand-eye calibration and provide a comparative analysis against six state-of-the-art methods. We examine the calibration problem from two alternative geometrical interpretations, called 'hand-eye' and 'robot-world-hand-eye', respectively. The study analyses the effects of specifying the objective function as pose error or reprojection error minimization problem. We provide three real and three simulated datasets with rendered images as part of the study. In addition, we propose a robotic arm error modeling approach to be used along with the simulated datasets for generating a realistic response. The tests on simulated data are performed in both ideal cases and with pseudo-realistic robotic arm pose and visual noise. Our methods show significant improvement and robustness on many metrics in various scenarios compared to state-of-the-art methods.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Remote Handling Project Team

Contributors: Ali, I., Suominen, O., Gotchev, A., Morales, E. R.

Publication date: 2 Jun 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors (Switzerland)

Volume: 19

Issue number: 12

Article number: 2837

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Hand-eye calibration, Optimization, Robot-world-hand-eye calibration

Electronic versions:

sensors-19-02837-v2

DOIs:

10.3390/s19122837

URLs:

<http://urn.fi/URN:NBN:fi:tty-201909032055>

Source: Scopus

Source ID: 85068904338

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Bioimpedance Sensor Array for Long-Term Monitoring of Wound Healing from Beneath the Primary Dressings and Controlled Formation of H<sub>2</sub>O<sub>2</sub> Using Low-Intensity Direct Current**

Chronic wounds impose a significant financial burden for the healthcare system. Currently, assessment and monitoring of hard-to-heal wounds are often based on visual means and measuring the size of the wound. The primary wound dressings must be removed before assessment can be done. We have developed a quasi-monopolar bioimpedance-measurement-based method and a measurement system to determine the status of wound healing. The objective of this study was to demonstrate that with an appropriate setup, long-term monitoring of wound healing from beneath the primary dressings is feasible. The developed multielectrode sensor array was applied on the wound area and left under the primary dressings

for 142 h. The impedance of the wounds and the surrounding intact skin area was measured regularly during the study at 150 Hz, 300 Hz, 1 kHz, and 5 kHz frequencies. At the end of the follow-up period, the wound impedance had reached the impedance of the intact skin at the higher frequencies and increased significantly at the lowest frequencies. The measurement frequency affected the measurement sensitivity in wound monitoring. The skin impedance remained stable over the measurement period. The sensor array also enabled the administration of periodical low-intensity direct current (LIDC) stimulation in order to create an antimicrobial environment across the wound area via the controlled formation of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>).

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Turku University Hospital, Kaarinantie 700, Åbo Akademi University

Contributors: Kekonen, A., Bergelin, M., Johansson, M., Kumar Joon, N., Bobacka, J., Viik, J.

Publication date: 31 May 2019

Peer-reviewed: Yes

#### Publication information

Journal: Sensors

Volume: 19

Issue number: 11

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: beneath the dressings, bioimpedance, hydrogen peroxide, long-term monitoring, low-intensity direct current, multielectrode, quasi-monopolar, sensor array, wound dressing, wound monitoring, wound stimulation

Electronic versions:

sensors-19-02505-v2

DOIs:

10.3390/s19112505

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201906241904>

Source: Scopus

Source ID: 85067176313

Research output: Contribution to journal › Article › Scientific › peer-review

#### GaInAsSb/AlGa(In)AsSb type I quantum wells emitting in 3µm range for application in superluminescent diodes

In this paper, we present results of Fourier-transformed photoluminescence measurements of quaternary GaInAsSb quantum wells with quinary AlGaInAsSb barriers grown on GaSb substrate, designed for spectral range of mid-infrared. Here, we show an emission shift towards longer wavelength as a result of incorporation of indium into the quantum wells reaching up to 3 µm at room temperature (RT). Additionally, we have observed an additional low-energy photoluminescence signal with maximum wavelength of 3.5 µm at RT, which we have attributed as states localised on the layer interfaces. The activation energy of carriers trapped in those states is estimated to be 35 meV.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: ORC, Physics, Wrocław University of Technology

Contributors: Kurka, M., Dyksik, M., Suomalainen, S., Koivusalo, E., Guina, M., Motyka, M.

Number of pages: 5

Pages: 274-278

Publication date: 1 May 2019

Peer-reviewed: Yes

#### Publication information

Journal: Optical Materials

Volume: 91

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2019): CiteScore 4.4 SJR 0.594 SNIP 1.068

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Science(all), Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Fourier-transformed spectroscopy, MBE, Optical gas sensing, Photoluminescence, Superluminescent diodes  
DOIs:

10.1016/j.optmat.2019.03.036

Source: Scopus

Source ID: 85063381328

Research output: Contribution to journal › Article › Scientific › peer-review

### **Positioning information privacy in intelligent transportation systems: An overview and future perspective**

Today, the Intelligent Transportation Systems (ITS) are already in deep integration phase all over the world. One of the most significant enablers for ITS are vehicle positioning and tracking techniques. Worldwide integration of ITS employing Dedicated Short Range Communications (DSRC) and European standard for vehicular communication, known as ETSI ITS-G5, brings a variety of options to improve the positioning in areas where GPS connectivity is lacking precision. Utilization of the ready infrastructure, next-generation cellular 5G networks, and surrounding electronic devices together with conventional positioning techniques could become the solution to improve the overall ITS operation in vehicle-to-everything (V2X) communication scenario. Nonetheless, effective and secure communication protocols between the vehicle and roadside units should be both analyzed and improved in terms of potential attacks on the transmitted positioning-related data. In particular, said information might be misused or stolen at the infrastructure side conventionally assumed to be trusted. In this paper, we first survey different methods of vehicle positioning, which is followed by an overview of potential attacks on ITS systems. Next, we propose potential improvements allowing mutual authentication between the vehicle and infrastructure aiming at improving positioning data privacy. Finally, we propose a vision on the development and standardization aspects of such systems.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, St. Petersburg State University of Aerospace Instrumentation, ITMO University, Brno University of Technology

Contributors: Ometov, A., Bezzateev, S., Davydov, V., Shchesniak, A., Masek, P., Lohan, E. S., Koucheryavy, Y.

Publication date: 1 Apr 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors

Volume: 19

Issue number: 7

Article number: 1603

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Authentication, Data privacy, GDPR, Intelligent transportation systems, Positioning

Electronic versions:

sensors-19-01603

DOIs:

10.3390/s19071603

URLs:

<http://urn.fi/URN:NBN:fi:tty-201906111889>

Source: Scopus

Source ID: 85064829981

Research output: Contribution to journal › Article › Scientific › peer-review

### **Alpha radiation-induced luminescence by am-241 in aqueous nitric acid solution**

When exposed to air, alpha particles cause the production of light by exciting the molecules surrounding them. This light, the radioluminescence, is indicative of the presence of alpha radiation, thus allowing for the optical sensing of alpha radiation from distances larger than the few centimeters an alpha particle can travel in air. While the mechanics of radioluminescence in air and other gas compositions is relatively well understood, the same cannot be said about the radioluminescence properties of liquids. Better understanding of the radioluminescence properties of liquids is essential to design methods for the detection of radioactively contaminated liquids by optical means. In this article, we provide radioluminescence images of Am-241 dissolved in aqueous nitric acid (HNO<sub>3</sub>) solution and present the recorded radioluminescence spectrum with a maximum between and, and a steep decrease at the short wavelength side of the maximum. The shape of the spectrum resembles a luminescence process rather than Cerenkov light, bremsstrahlung, or other mechanisms with broadband emission. We show that the amount of light produced is about 150 times smaller compared to that of the same amount of Am-241 in air. The light production in the liquid is evenly distributed throughout

the sample volume with a slight increase on the surface of the liquid. The radioluminescence intensity is shown to scale linearly with the Am-241 concentration and not be affected by the HNO<sub>3</sub> concentration.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, University of Helsinki, European Commission Joint Research Centre

Contributors: Kerst, T., Malmbeck, R., Ial Banik, N. L., Toivonen, J.

Publication date: 1 Apr 2019

Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Switzerland)

Volume: 19

Issue number: 7

Article number: 1602

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Alpha radiation, Americium, Liquid phase luminescence, Radioluminescence

Electronic versions:

sensors-19-01602-v2

DOIs:

10.3390/s19071602

URLs:

<http://urn.fi/URN:NBN:fi:ty-201906111890>

Source: Scopus

Source ID: 85064822061

Research output: Contribution to journal › Article › Scientific › peer-review

#### Layered approach for improving the quality of free-viewpoint depth-image-based rendering images

In free-viewpoint rendering systems, one of the most challenging goals is the creation of virtual views based on available color texture (RGB) and depth data. Conventional depth-image-based rendering (DIBR) approaches have assumed that the virtual camera can only be displaced horizontally, thus leading to fairly simple disocclusion artifacts. However, in free-viewpoint DIBR, the virtual camera can be positioned in an arbitrary way and the respective disocclusion artifacts can exhibit complicated anisotropic appearances. Consequently, conventional approaches for compensating disocclusion holes usually fail in such arbitrary camera motion. We present a disocclusion compensation technique based on texture inpainting. We propose a layered representation of both the color and depth images in local foreground, background, and undefined segments (a trimap). This representation allows for employing an efficient alpha-matting approach for reconstructing the underlying opacity layer followed by a background compensation and layered rendering. The performance of the proposed method is evaluated with respect to the state-of-the-art through objective and subjective tests. The achieved results, especially for large camera displacements, outperform the state-of-the-art. Those results assess the effectiveness of the proposed method and highlight the need for new quality metrics able to address the impairments of this type of content.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: 3D MEDIA, University "Roma Tre"

Contributors: Smirnov, S., Battisti, F., Gotchev, A.

Publication date: 27 Feb 2019

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Electronic Imaging

Volume: 28

Issue number: 1

Article number: 013049

ISSN (Print): 1017-9909

Ratings:

Scopus rating (2019): CiteScore 2 SJR 0.264 SNIP 0.566

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Computer Science Applications, Electrical and Electronic Engineering

Keywords: depth-image-based rendering, inpainting, multiview, quality, RGB+D

DOIs:

10.1117/1.JEI.28.1.013049

### Bibliographical note

EXT="Battisti, Federica"

Source: Scopus

Source ID: 85062623919

Research output: Contribution to journal > Article > Scientific > peer-review

### Experimental realization of wave-packet dynamics in cyclic quantum walks

Quantum walks present novel tools for redesigning quantum algorithms, universal quantum computations, and quantum simulators. Hitherto, one- and two-dimensional quantum systems (lattices) have been simulated and studied with photonic systems. Here, we report the photonic simulation of cyclic quantum systems, such as hexagonal structures. We experimentally explore the wavefunction dynamics and probability distribution of a quantum particle located on a six-site system, along with three- and four-site systems while under different initial conditions. Various quantum walk systems employing Hadamard, C-NOT, and Pauli-Z gates are experimentally simulated, where we find configurations capable of simulating particle transport and probability density localization. Our technique can potentially be integrated into small-scale structures using microfabrication, and thus would open a venue towards simulating more complicated quantum systems comprised of cyclic structures.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Ottawa, Canada, Austrian Academy of Sciences

Contributors: Nejadsattari, F., Zhang, Y., Bouchard, F., Larocque, H., Sit, A., Cohen, E., Fickler, R., Karimi, E.

Number of pages: 7

Pages: 174-180

Publication date: 20 Feb 2019

Peer-reviewed: Yes

### Publication information

Journal: Optica

Volume: 6

Issue number: 2

ISSN (Print): 2334-2536

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Scopus rating (2019): CiteScore 18.1 SJR 5.6 SNIP 3.375

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OPTICA.6.000174

URLs:

<http://www.scopus.com/inward/record.url?scp=85063372591&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85063372591

Research output: Contribution to journal > Article > Scientific > peer-review

### Phosphate glasses with blue persistent luminescence prepared using the direct doping method

Phosphate glasses with the composition  $(90\text{NaPO}_3-(10-x)\text{Na}_2\text{O}-x\text{NaF})$  (mol%) with  $x = 0$  and  $10$  were prepared with blue persistent luminescence (PeL) using direct particles doping method. Commercial  $\text{CaAl}_2\text{O}_4:\text{Eu}^{2+}, \text{Nd}^{3+}$  microparticles (MPs) with blue PeL were added in the glass melt at a lower temperature than the melting temperature. The PeL properties of the glasses were related to the diffusion of Al from the MPs to the glass occurring during the glass preparation, which was found to depend on the temperature at which the MPs are added in the melt and also on the time before casting the melt after adding the MPs. The glass with  $x = 0$  can be prepared with homogeneous PeL if the MPs are added at  $575\text{ }^\circ\text{C}$ . This  $T_{\text{doping}}$  temperature can be reduced to  $550\text{ }^\circ\text{C}$  by replacing  $\text{Na}_2\text{O}$  by NaF in the glass.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Turun Yliopisto/Turun Biomateriaalikeskus

Contributors: Ojha, N., Tuomisto, M., Lastusaari, M., Petit, L.  
Pages: 151-156  
Publication date: Jan 2019  
Peer-reviewed: Yes  
Early online date: 1 Jan 2018

#### Publication information

Journal: Optical Materials

Volume: 87

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2019): CiteScore 4.4 SJR 0.594 SNIP 1.068

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Science(all), Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: CaAlO:Eu,Nd microparticles, Corrosion, Fluorophosphate glass, Persistent luminescence

DOIs:

10.1016/j.optmat.2018.03.063

Source: Scopus

Source ID: 85044951460

Research output: Contribution to journal > Article > Scientific > peer-review

#### Measuring stem diameters with TLS in boreal forests by complementary fitting procedure

Point clouds generated by terrestrial laser scanners (TLS) have enabled new ways to measure stem diameters. A common method for diameter calculation is to fit cylindrical or circular shapes into the TLS point cloud, which can be based either on a single scan or a co-registered combination of several scans. However, as various defects in the point cloud may affect the final diameter results, we propose an automatized processing chain which takes advantage of complementing steps. Processing consists of two fitting phases and an additional taper curve calculation to define the final diameter measurements. First, stems are detected from co-registered data of several scans using surface normals and cylinder fitting. This provides a robust framework for localizing the stems and estimating diameters at various heights. Then, guided by the cylinders and their indicative diameters, another fitting round is performed by cutting the stems into thin horizontal slices and reassessing their diameters by circular shape. For each slice, the quality of the cylinder-modelled diameter is evaluated first with co-registered data and if it is found to be deficient, potentially due to modelling defects or co-registration errors, diameter is detected through single scans. Finally, slice diameters are applied to construct a spline-based taper curve model for each tree, which is used to calculate the final stem dimensions. This methodology was tested in southern Finland using a set of 505 trees. At the breast height level (1.3 m), the results indicate 5.2 mm mean difference (3.2%), -0.4 mm bias (-0.3%) and 7.3 mm root mean squared error (4.4%) to reference measurements, and at the height of 6.0 m, respective values are 6.5 mm (3.6%), +1.6 mm (0.9%) and 8.4 mm (4.8%). These values are smaller compared to most of the corresponding contemporary studies, and outperform the initial cylinder models. This indicates that the applied processing chain is capable of producing relatively accurate diameter measurements, which can, at the cost of computational heaviness, remove various defects and improve the modelling results.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Mathematics, Natural Resources Institute Finland (Luke)

Contributors: Pitkänen, T. P., Raunonen, P., Kangas, A.

Number of pages: 13

Pages: 294-306

Publication date: 2019

Peer-reviewed: Yes

Early online date: 8 Dec 2018

#### Publication information

Journal: ISPRS Journal of Photogrammetry and Remote Sensing

Volume: 147

ISSN (Print): 0924-2716

Ratings:

Scopus rating (2019): CiteScore 11.7 SJR 3.122 SNIP 2.881

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering (miscellaneous), Computer Science Applications, Computers in Earth Sciences

Keywords: Circle fitting, Cylinder fitting, Stem extraction, Taper curve, Terrestrial laser scanning

Electronic versions:

1-s2.0-S0924271618303290-main



DOIs:

10.1016/j.isprsjprs.2018.11.027

URLs:

<http://urn.fi/URN:NBN:fi:tty-201812212897>

Source: Scopus

Source ID: 85057752987

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Optical wireless cochlear implants

In the present contribution, we introduce a wireless optical communication-based system architecture which is shown to significantly improve the reliability and the spectral and power efficiency of the transcutaneous link in cochlear implants (CIs). We refer to the proposed system as optical wireless cochlear implant (OWCI). In order to provide a quantified understanding of its design parameters, we establish a theoretical framework that takes into account the channel particularities, the integration area of the internal unit, the transceivers misalignment, and the characteristics of the optical units. To this end, we derive explicit expressions for the corresponding average signal-to-noise-ratio, outage probability, ergodic spectral efficiency and capacity of the transcutaneous optical link (TOL). These expressions are subsequently used to assess the dependence of the TOL's communication quality on the transceivers design parameters and the corresponding channels characteristics. The offered analytic results are corroborated with respective results from Monte Carlo simulations. Our findings reveal that OWCI is a particularly promising architecture that drastically increases the reliability and effectiveness of the CI TOL, whilst it requires considerably lower transmit power compared to the corresponding widely-used radio frequency (RF) solution.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, Aristotle University of Thessaloniki, Khalifa University, University of Piraeus, Department of Electrical and Computer Engineering

Contributors: Trevlakis, S. E., Boulogeorgos, A. A. A., Sofotasios, P. C., Muhaidat, S., Karagiannidis, G. K.

Number of pages: 24

Pages: 707-730

Publication date: 2019

Peer-reviewed: Yes

### Publication information

Journal: Biomedical Optics Express

Volume: 10

Issue number: 2

ISSN (Print): 2156-7085

Ratings:

Scopus rating (2019): CiteScore 6.7 SJR 1.591 SNIP 1.796

Original language: English

ASJC Scopus subject areas: Biotechnology, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/BOE.10.000707

Source: Scopus

Source ID: 85061526751

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Comparison of single-side and double-side pumping of membrane external-cavity surface-emitting lasers

We studied and compared single-side pumping (SSP) and double-side pumping (DSP) of a semiconductor membrane external-cavity surface-emitting laser (MECSEL). The MECSEL-active region was based on an AlGaAs quantum well structure embedded between two silicon carbide (SiC) wafer pieces that were used as transparent intra-cavity (IC) heat spreaders creating a symmetrical cooling environment. The gain structure targeted emission at 780 nm, a wavelength region that is important for many applications, and where the development of high-brightness high-power laser sources is gaining more momentum. By DSP at 20°C heat sink temperature, we could reduce the laser threshold from 0.79 to 0.69 W of absorbed pump power, while the maximum output power was increased from 3.13 to 3.22 W. The differential efficiency was improved from 31.9% to 34.4%, which represents a record value for SiC-cooled vertically emitting semiconductor lasers. The improvements are enabled by a reduced thermal resistance of the gain element by 9% compared to SSP. The beam quality was measured to be  $M^2 < 1.09$ . Finally, we demonstrate a maximum tuning range from 767 to 811 nm. This wavelength range was not addressed by any MECSEL or vertical external-cavity surface-emitting laser device before and extends the available wavelengths for semiconductor based high-quality beam and high-power laser sources to a wavelength window relevant for quantum technology, spectroscopy, or medicine.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, Research group: ORC, Department of Chemistry and Bioengineering  
Contributors: Kahle, H., Penttinen, J. P., Phung, H. M., Rajala, P., Tukiainen, A., Ranta, S., Guina, M.  
Number of pages: 4  
Pages: 1146-1149  
Publication date: 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters  
Volume: 44  
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ISSN (Print): 0146-9592  
Ratings:

Scopus rating (2019): CiteScore 7.2 SJR 1.788 SNIP 1.613  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OL.44.001146

#### Bibliographical note

INT=phys,"Rajala, Patrik"  
Source: Scopus  
Source ID: 85062214909  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Hyperspectral data denoising for terahertz pulse time-domain holography

We investigated data denoising in hyperspectral terahertz pulse time-domain holography. Using the block-matching algorithms adapted for spatio-temporal and spatio-spectral volumetric data we studied and optimized parameters of these algorithms to improve phase image reconstruction quality. We propose a sequential application of the two algorithms oriented on work in temporal and spectral domains. Experimental data demonstrate the improvement in the quality of the resultant time-domain images as well as phase images and object's relief. The simulation results are proved by comparison with the experimental ones.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, Digital and Display Holography Laboratory, ITMO University  
Contributors: Kulya, M., Petrov, N. V., Tsyarkin, A., Egiazarian, K., Katkovnik, V.  
Number of pages: 21  
Pages: 18456-18476  
Publication date: 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Optics Express  
Volume: 27  
Issue number: 13  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2019): CiteScore 6.7 SJR 1.533 SNIP 1.651  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OE.27.018456  
Source: Scopus  
Source ID: 85068035148  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Flip-chip Wafer-fused OP-VECSELs emitting 3.65 W at the 1.55- $\mu\text{m}$ waveband

Optically-pumped vertical external cavity surface emitting lasers (VECSELs) based on flip-chip gain mirrors emitting at the 1.55- $\mu\text{m}$  wavelength range are reported. The gain mirrors employ wafer-fused InAlGaAs/InP quantum well heterostructures and GaAs/AlAs distributed Bragg reflectors fixed on a diamond heat-sink substrate in a flip-chip geometry, incorporated in a V-cavity configuration. A maximum output power of 3.65 W was achieved for a heat sink

temperature of 11°C and employing a 2.2% output coupler. The laser exhibited circular beam profiles for the full emission power range. This demonstration represents more than 5-fold increase of the output power compared to state-of-the-art flip-chip VECSELs previously reported at the 1.55 μm wavelength range. It opens new perspectives for developing practical VECSEL-based laser systems operating at a wavelength range widely used in many applications.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, CRPP, LakeDiamond SA

Contributors: Mereuta, A., Nechay, K., Caliman, A., Suruceanu, G., Rudra, A., Gallo, P., Guina, M., Kapon, E.

Publication date: 2019

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Journal of Selected Topics in Quantum Electronics

Volume: 25

Issue number: 6

ISSN (Print): 0792-1233

Original language: English

ASJC Scopus subject areas: Ceramics and Composites, Atomic and Molecular Physics, and Optics, Materials Chemistry, Electrical and Electronic Engineering

Keywords: diode pumped, Flip-chip devices, Heating systems, Lasers, Mirrors, Optical pumping, Power generation, Semiconductor lasers, Temperature measurement, Vertical cavity surface emitting lasers, Vertical emitting lasers

DOIs:

10.1109/JSTQE.2019.2922819

Source: Scopus

Source ID: 85067801249

Research output: Contribution to journal > Article > Scientific > peer-review

#### Spatiospectral features of a soliton-assisted random laser in liquid crystals

We report on novel features of random lasers assisted by near-infrared spatial solitons in nematic liquid crystals. Specifically, we study the role of light-induced reorientational waveguides (nematocons) on the spatial and spectral distributions of the laser modes. We show that the spatially spiky character of the laser emission propagating backwards with respect to the pump tends to disappear in the forward direction, due to the soliton confinement of the generated light. Moreover, the spectral features associated with various random laser resonances appear to merge upon guided-wave propagation along the nematocon, making the nematocon-aided random laser a bidirectional device with distinct emission properties at the two opposite outputs.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Nonlinear Optics, University "Roma Tre"

Contributors: Perumbilavil, S., Kauranen, M., Assanto, G.

Number of pages: 4

Pages: 3574-3577

Publication date: 2019

Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 44

Issue number: 14

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2019): CiteScore 7.2 SJR 1.788 SNIP 1.613

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.44.003574

#### Bibliographical note

EXT="Assanto, Gaetano"

Source: Scopus

Source ID: 85069547888

Research output: Contribution to journal > Article > Scientific > peer-review

### **Interferometric autocorrelation measurements of supercontinuum based on two-photon absorption**

We report on interferometric autocorrelation measurements of broadband supercontinuum light in the anomalous dispersion regime using two-photon absorption in a GaP photodetector. The method is simple and low-cost and provides a direct measure of second-order coherence properties, including quantitative information on coherence time and average duration of the supercontinuum pulses as well as on the presence of temporally coherent sub-structures. We report measurements in regimes where the supercontinuum is coherent and incoherent. In the former case, the interferometric measurements are similar to what is observed for mode-locked laser pulses, while in the latter case, the interferometric measurements and coherence properties are shown to have characteristics similar to those of a stationary chaotic light source.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, UMR 6174

Contributors: Toenger, S., Mäkitalo, R., Ahvenjärvi, J., Ryczkowski, P., Närhi, M., Dudley, J. M., Genty, G.

Number of pages: 7

Pages: 1320-1326

Publication date: 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of the Optical Society of America B: Optical Physics

Volume: 36

Issue number: 5

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2019): CiteScore 3.9 SJR 0.851 SNIP 0.964

Original language: English

ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/JOSAB.36.001320

#### **Bibliographical note**

INT=phys,"Mäkitalo, Roosa"

INT=phys,"Ahvenjärvi, Jani"

Source: Scopus

Source ID: 85069553087

Research output: Contribution to journal › Article › Scientific › peer-review

### **Efficient nonlinear metasurfaces by using multiresonant high-Q plasmonic arrays**

We numerically investigate second-harmonic generation from multiresonant plasmonic metasurfaces by designing an array consisting of L-shaped aluminum nanoparticles that simultaneously supports two surface lattice resonances with relatively high quality factors ( $>100$ ). Using an approach based on the nonlinear discrete-dipole approximation, we predict an over million-fold enhancement of the emitted second-harmonic intensity from a particle at the center of the metasurface compared to an individual particle and estimate that conversion efficiencies of around  $10^{-5}$  could be achievable from the surface. Our results are an important step towards making nonlinear metasurfaces practical for nonlinear applications, such as for frequency conversion.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, University of Ottawa, Canada, Tampere University, University of Rochester Institute of Optics

Contributors: Huttunen, M. J., Reshef, O., Stolt, T., Dolgaleva, K., Boyd, R. W., Kauranen, M.

Pages: E30-E35

Publication date: 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of the Optical Society of America B: Optical Physics

Volume: 36

Issue number: 7

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2019): CiteScore 3.9 SJR 0.851 SNIP 0.964

Original language: English

ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/JOSAB.36.000E30

### **Bibliographical note**

INT=phys,"Stolt, Timo"

Source: Scopus

Source ID: 85069551856

Research output: Contribution to journal › Article › Scientific › peer-review

### **Large-scale efficient water harvesting using bioinspired micro-patterned copper oxide nanoneedle surfaces and guided droplet transport**

As the Earth's atmosphere contains an abundant amount of water as vapors, a device which can capture a fraction of this water could be a cost-effective and practical way of solving the water crisis. There are many biological surfaces found in nature which display unique wettability due to the presence of hierarchical micro-nanostructures and play a major role in water deposition. Inspired by these biological microstructures, we present a large scale, facile and cost-effective method to fabricate water-harvesting functional surfaces consisting of high-density copper oxide nanoneedles. A controlled chemical oxidation approach on copper surfaces was employed to fabricate nanoneedles with controlled morphology, assisted by bisulfate ion adsorption on the surface. The fabricated surfaces with nanoneedles displayed high wettability and excellent fog harvesting capability. Furthermore, when the fabricated nanoneedles were subjected to hydrophobic coating, these were able to rapidly generate and shed coalesced droplets leading to further increase in fog harvesting efficiency. Overall, ~99% and ~150% increase in fog harvesting efficiency was achieved with non-coated and hydrophobic layer coated copper oxide nanoneedle surfaces respectively when compared to the control surfaces. As the transport of the harvested water is very important in any fog collection system, hydrophilic channels inspired by leaf veins were made on the surfaces via a milling technique which allowed an effective and sustainable way to transport the captured water and further enhanced the water collection efficiency by ~9%. The system presented in this study can provide valuable insights towards the design and fabrication of fog harvesting systems, adaptable to arid or semi-arid environmental conditions.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Research group: Surface Science, Physics, Research group: Bioinspired Materials and Robotics (BMR)

Contributors: Sharma, V., Yiannacou, K., Karjalainen, M., Lahtonen, K., Valden, M., Sariola, V.

Number of pages: 16

Pages: 4025-4040

Publication date: 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Nanoscale Advances

Volume: 1

Issue number: 10

ISSN (Print): 2516-0230

Ratings:

Scopus rating (2019): CiteScore 1

Original language: English

ASJC Scopus subject areas: Engineering(all), Bioengineering, Atomic and Molecular Physics, and Optics, Materials Science(all), Chemistry(all)

Electronic versions:

large\_scale\_efficient\_water\_harvesting

DOIs:

10.1039/c9na00405j

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911085831>

Source: Scopus

Source ID: 85073635162

Research output: Contribution to journal › Article › Scientific › peer-review

### **Tuning plasmon induced reflectance with hybrid metasurfaces**

Electrically tunable metasurfaces with graphene offer design flexibility to efficiently manipulate and control light. These metasurfaces can be used to generate plasmon-induced reflectance (PIR), which can be tuned by electrostatic doping of

the graphene layer. We numerically investigated two designs for tunable PIR devices using the finite difference time-domain (FDTD) method. The first design is based on two rectangular antennas of the same size and a disk; in the second design, two parallel rectangular antennas with different dimensions are used. The PIR-effect was achieved by weak hybridization of two bright modes in both devices and tuned by changing the Fermi level of graphene. A total shift of 362 nm was observed in the design with the modulation depth of 53% and a spectral contrast ratio of 76%. These tunable PIR devices can be used for tunable enhanced biosensing and switchable systems.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Photonics Laboratory, Balochistan University of Information Technology, Bilkent University

Contributors: Habib, M., Ozbay, E., Caglayan, H.

Publication date: 2019

Peer-reviewed: Yes

#### Publication information

Journal: Photonics

Volume: 6

Issue number: 1

Article number: 29

ISSN (Print): 2304-6732

Ratings:

Scopus rating (2019): CiteScore 2.9 SJR 0.646 SNIP 1.182

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Instrumentation, Radiology Nuclear Medicine and imaging

Keywords: Plasmonics, Surface plasmon, Tunable metasurfaces

Electronic versions:

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10.3390/photonics6010029

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004083140>

Source: Scopus

Source ID: 85063129342

Research output: Contribution to journal > Article > Scientific > peer-review

#### Intense radioluminescence of NO/N<sub>2</sub>-mixture in solar blind spectral region

Luminescence in air induced by alpha particle emitters can be used to optically detect radioactive contamination from distances that surpass the range of the alpha radiation itself. Alpha particles excite nitrogen molecules in air and the relaxation creates a faint light emission. When the composition of the gases surrounding the alpha particle emitter is altered then the luminescence spectrum changes. In this work, we report the creation of an intense light emission in the wavelength regime below 300 nm originating from alpha particle excited nitric oxide (NO). The light yield has been investigated as a function of the NO concentration in an N<sub>2</sub> atmosphere. Unlike the emission from molecular nitrogen, NO emits at wavelengths shorter than 300 nm, where solar background and artificial lighting are negligible, thus enabling optical detection of alpha radiation even under bright lighting conditions. We show that the radioactively induced NO emission reaches its maximum intensity at a concentration of 50 ppm of NO diluted in N<sub>2</sub>. At this concentration, the strongest emission line of NO is about 25 times more intense than the most intense line of N<sub>2</sub> radioluminescence. Lastly, we discuss potential applications and limitations of the technique.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, University of Helsinki

Contributors: Kerst, T., Toivonen, J.

Number of pages: 8

Pages: 33764-33771

Publication date: 24 Dec 2018

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 26

Issue number: 26

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.26.033764

Source: Scopus

Source ID: 85059213995

Research output: Contribution to journal › Article › Scientific › peer-review

### **Towards optical-frequency-comb generation in continuous-wave-pumped titanium-indiffused lithium-niobate waveguide resonators**

Much progress, both experimentally and theoretically, has recently been made towards optical-frequency-comb generation from continuously pumped second-order nonlinear systems. Here, we present observations towards finding an integrated solution for such a system, using a titanium-indiffused lithium-niobate waveguide resonator. These results are compared to the recently developed theory for equivalent systems. The system is seen to exhibit strong instabilities, which require further investigation in order to fully determine the suitability of this platform for stable optical-frequency-comb generation.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Paderborn University, VTT Technical Research Centre of Finland, Laboratory of Photonics, Molecular Science

Contributors: Stefszky, M., Ulvila, V., Abdallah, Z., Silberhorn, C., Vainio, M.

Publication date: 27 Nov 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A

Volume: 98

Issue number: 5

Article number: 053850

ISSN (Print): 2469-9926

Ratings:

Scopus rating (2018): CiteScore 2.84 SJR 1.268 SNIP 0.987

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.98.053850

Source: Scopus

Source ID: 85057526410

Research output: Contribution to journal › Article › Scientific › peer-review

### **Cascaded crystalline raman lasers for extended wavelength coverage: Continuous-wave, third-stokes operation**

The development of high-power laser sources with narrow emission, tunable within the water transmission window around 1.7  $\mu\text{m}$ , is of interest for applications as diverse as medical imaging and atmospheric sensing. Where suitable laser gain media are not available, operation in this spectral region is often achieved via nonlinear frequency conversion, and optical parametric oscillators (OPOs) are a common solution. A practical alternative to OPOs, to avoid birefringent-or quasi-phase-matching requirements, is the use of stimulated Raman scattering within a suitable material to convert a pump source to longer wavelengths via one or more Stokes shifts; however, as this is a  $\chi^3$  nonlinear process, such frequency conversion is usually the preserve of high-energy pulsed lasers. Semiconductor disk lasers (SDLs), on the other hand, have very high-finesse external resonators, suitable for efficient intracavity nonlinear conversion even in continuous-wave (CW) operation. Here we report, to the best of our knowledge, the first continuous-wave third-Stokes crystalline Raman laser and the longest emission wavelength from an SDL-pumped Raman laser, achieving high power, CW output, and broad wavelength tuning around 1.73  $\mu\text{m}$ . The  $\text{KGdWO}_4$  (KGW) Raman laser, which was intracavity-pumped by a 1.18  $\mu\text{m}$  InGaAs-based SDL, demonstrated cascaded CW Stokes oscillation at 1.32  $\mu\text{m}$ , 1.50  $\mu\text{m}$ , and 1.73  $\mu\text{m}$  with watt-level output achievable at each wavelength. The 1.73  $\mu\text{m}$  Stokes emission was diffraction limited ( $M^2 < 1.01$ ) and narrow linewidth (<46 pm FWHM; measurement limited). By rotation of a birefringent filter placed within the fundamental resonator, we attained three tunable emission wavelength bands, one centred at each Stokes component, and achieved up to 65 nm tuning for the third-Stokes Raman laser from 1696 nm to 1761 nm. We have thus demonstrated a platform laser technology that takes well-developed InGaAs-based SDLs and provides spectral coverage and high performance in the near-infrared water transmission windows using commercially available components.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Photonics, University of Strathclyde  
Contributors: Casula, R., Penttinen, J., Guina, M., Kemp, A. J., Hastie, J. E.  
Number of pages: 8  
Pages: 1406-1413  
Publication date: 20 Nov 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Optica  
Volume: 5  
Issue number: 11  
ISSN (Print): 2334-2536  
Ratings:  
Scopus rating (2018): CiteScore 15.6 SJR 4.914 SNIP 3.162  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OPTICA.5.001406  
Source: Scopus  
Source ID: 85059018872  
Research output: Contribution to journal › Article › Scientific › peer-review

#### M2M Communication Assessment in Energy-Harvesting and Wake-Up Radio Assisted Scenarios Using Practical Components

Techniques for wireless energy harvesting (WEH) are emerging as a fascinating set of solutions to extend the lifetime of energy-constrained wireless networks, and are commonly regarded as a key functional technique for almost perpetual communications. For example, with WEH technology, wireless devices are able to harvest energy from different light sources or Radio Frequency (RF) signals broadcast by ambient or dedicated wireless transmitters to support their operation and communications capabilities. WEH technology will have increasingly wider range of use in upcoming applications such as wireless sensor networks, Machine-to-Machine (M2M) communications, and the Internet of Things. In this paper, the usability and fundamental limits of joint RF and solar cell or photovoltaic harvesting based M2M communication systems are studied and presented. The derived theoretical bounds are in essence based on the Shannon capacity theorem, combined with selected propagation loss models, assumed additional link nonidealities, diversity processing, as well as the given energy harvesting and storage capabilities. Fundamental performance limits and available capacity of the communicating link are derived and analyzed, together with extensive numerical results evaluated in different practical scenarios, including realistic implementation losses and state-of-the-art printed supercapacitor performance figures with voltage doubler-based voltage regulator. In particular, low power sensor type communication applications using passive and semi-passive wake-up radio (WuR) are addressed in the study. The presented analysis principles and results establish clear feasibility regions and performance bounds for wireless energy harvesting based low rate M2M communications in the future IoT networks.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Electronics and Communications Engineering, Nano Communication Centre, Department of Electrical and Computer Engineering, Ohio State University  
Contributors: Rinne, J., Keskinen, J., Berger, P. R., Lupo, D., Valkama, M.  
Publication date: 16 Nov 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Basel, Switzerland)  
Volume: 18  
Issue number: 11  
ISSN (Print): 1424-8220  
Ratings:  
Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642  
Original language: English  
ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering  
Keywords: diversity system, M2M communications, perpetual communications, propagation loss, Shannon limit, supercapacitor, wake-up radio, wireless energy harvesting  
Electronic versions:



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DOIs:

10.3390/s18113992

URLs:

<http://urn.fi/URN:NBN:fi:tty-201901071020>

Source: Scopus

Source ID: 85056711381

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Control of Rydberg-state population with realistic femtosecond laser pulses**

We investigate computationally a method for ultrafast preparation of alkali-metal atoms in their Rydberg states using a three-dimensional model potential in the single active electron approximation. By optimizing laser pulse shapes that can be generated with modern waveform synthesizers, we propose pulses for controlling the population transfer from the ground state to a preselected set of Rydberg states. Dynamical processes under the optimized pulses are shown to be much more complicated than in the traditional optical two-photon preparation of Rydberg states.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics

Contributors: Solanpää, J., Räsänen, E.

Publication date: 15 Nov 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A

Volume: 98

Issue number: 5

Article number: 053422

ISSN (Print): 2469-9926

Ratings:

Scopus rating (2018): CiteScore 2.84 SJR 1.268 SNIP 0.987

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

[control\\_of\\_Rydberg\\_state\\_2018](#)

DOIs:

10.1103/PhysRevA.98.053422

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910234057>

Source: Scopus

Source ID: 85057035731

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Super-resolution microscopy for biological specimens: Lensless phase retrieval in noisy conditions**

The paper is devoted to a computational super-resolution microscopy. A complex-valued wavefront of a transparent biological cellular specimen is restored from multiple intensity diffraction patterns registered with noise. For this problem, the recently developed lensless super-resolution phase retrieval algorithm [Optica, 4(7), 786 (2017)] is modified and tuned. This algorithm is based on a random phase coding of the wavefront and on a sparse complex-domain approximation of the specimen. It is demonstrated in experiments, that the reliable phase and amplitude imaging of the specimen is achieved for the low signal-to-noise ratio provided a low dynamic range of observations. The filterings in the observation domain and specimen variables are specific features of the applied algorithm. If these filterings are omitted the algorithm becomes a super-resolution version of the standard iterative phase retrieval algorithms. In comparison with this simplified algorithm with no filterings, our algorithm shows a valuable improvement in imaging with much smaller number of observations and shorter exposure time. In this way, presented algorithm demonstrates ability to work in a low radiation photon-limited mode.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI, ITMO University

Contributors: Shevkunov, I., Katkovnik, V., Petrov, N. V., Egiazarian, K.

Number of pages: 13

Pages: 5511-5523  
Publication date: 1 Nov 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Biomedical Optics Express

Volume: 9

Issue number: 11

Article number: #340805

ISSN (Print): 2156-7085

Ratings:

Scopus rating (2018): CiteScore 6.5 SJR 1.516 SNIP 1.604

Original language: English

ASJC Scopus subject areas: Biotechnology, Atomic and Molecular Physics, and Optics

Electronic versions:

boe-9-11-5511-1

DOIs:

10.1364/BOE.9.005511

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910224008>

Source: Scopus

Source ID: 85056609807

Research output: Contribution to journal › Article › Scientific › peer-review

#### Step-modulated decay cavity ring-down detection for double resonance spectroscopy

A method of measuring double resonant two-photon signal and background from a single cavity ring-down decay is introduced. This is achieved by modulating the double resonance loss via one of the light sources exciting the transition. The noise performance of the method is characterized theoretically and experimentally. The addition of a new parameter to the fitting function introduces a minor noise increase due to parameter correlation. However, the concurrent recording of the background can extend the stable measurement time. Alternatively, the method allows a faster measurement speed, while still recording the background, which is often advantageous in double resonance measurements. Finally, the method is insensitive to changes in the cavity decay rate at short timescales and can lead to improved performance if they have significant contribution to the final noise level compared to the detector noise.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, University of Helsinki, University of Virginia

Contributors: Karhu, J., Lehmann, K., Vainio, M., Metsälä, M., Halonen, L.

Number of pages: 13

Pages: 29086-29098

Publication date: 29 Oct 2018

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 26

Issue number: 22

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.26.029086

Source: Scopus

Source ID: 85055774623

Research output: Contribution to journal › Article › Scientific › peer-review

#### Focus model for metric depth estimation in standard plenoptic cameras

In recent years, a lot of efforts have been devoted to the problem of depth estimation from lightfield images captured by standard plenoptic cameras. However, most of the metric depth estimation methods in the state-of-the-art leverage pixel disparity only. In this paper, we tackle the problem of focus-based metric depth estimation in standard plenoptic cameras. For this purpose we propose a closed-form model that relates the refocusing parameter with the focus distance of a

plenoptic camera in order to allow for metric depth estimation. Based on the proposed model, we develop a calibration procedure that allows finding the parameters of the model. Using measurements of a time-of-flight sensor as ground-truth, experimental validation in a distance range of 0.2–1.6 m shows that focus-based depth estimation is feasible with a root-mean-squared error of less than 5 cm.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Universidad Industrial de Santander, Universidad Antonio Nariño

Contributors: Pertuz, S., Pulido-Herrera, E., Kämäräinen, J.

Number of pages: 10

Pages: 38-47

Publication date: 1 Oct 2018

Peer-reviewed: Yes

### Publication information

Journal: ISPRS Journal of Photogrammetry and Remote Sensing

Volume: 144

ISSN (Print): 0924-2716

Ratings:

Scopus rating (2018): CiteScore 10.6 SJR 2.979 SNIP 3.205

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering (miscellaneous), Computer Science Applications, Computers in Earth Sciences

Keywords: Calibration, Depth estimation, Focus, Lightfield, Plenoptic camera

DOIs:

10.1016/j.isprsjprs.2018.06.020

Source: Scopus

Source ID: 85049523458

Research output: Contribution to journal > Article > Scientific > peer-review

### Demonstration of optical nonlinearity in InGaAsP/InP passive waveguides

We report on the study of the third-order nonlinear optical interactions in  $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}/\text{InP}$  strip-loaded waveguides. The material composition and waveguide structures were optimized for enhanced nonlinear optical interactions. We performed self-phase modulation, four-wave mixing and nonlinear absorption measurements at the pump wavelength 1568 nm in our waveguides. The nonlinear phase shift of up to  $2.5\pi$  has been observed in self-phase modulation experiments. The measured value of the two-photon absorption coefficient  $\alpha_2$  was 19 cm/GW. The four-wave mixing conversion range, representing the wavelength difference between maximally separated signal and idler spectral components, was observed to be 45 nm. Our results indicate that InGaAsP has a high potential as a material platform for nonlinear photonic devices, provided that the operation wavelength range outside the two-photon absorption window is selected.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, University of Ottawa, Canada, Middle East Technical Univ.

Contributors: Saeidi, S., Rasekh, P., Awan, K. M., Tüngen, A., Huttunen, M. J., Dolgaleva, K.

Number of pages: 7

Pages: 524-530

Publication date: 1 Oct 2018

Peer-reviewed: Yes

### Publication information

Journal: Optical Materials

Volume: 84

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2018): CiteScore 3.9 SJR 0.59 SNIP 1.025

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Science(all), Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Integrated optics, Nonlinear optics, Optical devices

DOIs:

10.1016/j.optmat.2018.07.037

Source: Scopus

Source ID: 85050358317

Research output: Contribution to journal › Article › Scientific › peer-review

### **Accelerated optical solitons in reorientational media with transverse invariance and longitudinally modulated birefringence**

We demonstrate that reorientational spatial solitons can curve when propagating in a medium with engineered walk-off along the direction of propagation. In this regard, we employ nematic liquid crystals with molecular anchoring defined by electron-beam lithography and optic axis distribution modulated in the longitudinal direction only, keeping the transverse orientation constant. The experimental results are in remarkably good agreement with a simple modulation theory based on momentum conservation.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Politechnika Warszawska, University of Edinburgh, University "Roma Tre"

Contributors: Laudyn, U. A., Kwaśny, M., Karpierz, M. A., Smyth, N. F., Assanto, G.

Publication date: 7 Aug 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A

Volume: 98

Issue number: 2

Article number: 023810

ISSN (Print): 2469-9926

Ratings:

Scopus rating (2018): CiteScore 2.84 SJR 1.268 SNIP 0.987

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.98.023810

Source: Scopus

Source ID: 85051223073

Research output: Contribution to journal › Article › Scientific › peer-review

### **Multiwavelength surface contouring from phase-coded noisy diffraction patterns: Wavelength-division optical setup**

We propose an algorithm for absolute phase retrieval from multiwavelength noisy phase coded diffraction patterns. A lensless optical system is considered with a set of successive single wavelength experiments (wavelength-division setup). The phase masks are applied for modulation of the multiwavelength object wavefronts. The algorithm uses the forward/backward propagation for coherent light beams and sparsely encoding wavefronts, which leads to the complex-domain block-matching three-dimensional filtering. The key-element of the algorithm is an original aggregation of the multiwavelength object wavefronts for high-dynamic-range absolute phase reconstruction. Simulation tests demonstrate that the developed approach leads to the effective solutions explicitly using the sparsity for noise suppression and high-accuracy object absolute phase reconstruction from noisy data.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI, ITMO University

Contributors: Katkovnik, V., Shevkunov, I., Petrov, N. V., Egiazarian, K.

Publication date: 1 Aug 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Optical Engineering

Volume: 57

Issue number: 8

Article number: 085105

ISSN (Print): 0091-3286

Ratings:

Scopus rating (2018): CiteScore 2 SJR 0.403 SNIP 0.79

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering(all)

Keywords: absolute phase retrieval, discrete optical signal processing, multiwavelength phase retrieval, phase imaging, surface contouring

DOIs:

10.1117/1.OE.57.8.085105

Source: Scopus

Source ID: 85052936635

Research output: Contribution to journal › Article › Scientific › peer-review

### Temporal dynamics of light-written waveguides in unbiased liquid crystals

The control of light by light is one of the main aims in modern photonics. In this context, a fundamental cornerstone is the realization of light-written waveguides in real time, resulting in all-optical reconfigurability of communication networks. Light-written waveguides are often associated with spatial solitons, that is, non-diffracting waves due to a nonlinear self-focusing effect in the harmonic regime. From an applicative point of view, it is important to establish the temporal dynamics for the formation of such light-written guides. Here, we investigate theoretically the temporal dynamics in nematic liquid crystals, a material where spatial solitons can be induced using continuous wave lasers with a few milliwatts of power. We fully address the role of the spatial walk-off and the longitudinal nonlocality in the waveguide formation. We show that for powers large enough to induce light self-steering the beam undergoes several fluctuations before reaching the stationary regime, in turn leading to a much longer formation time for the light-written waveguide.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Friedrich-Schiller-University Jena, ENEA/CREATE/Università Degli Studi Napoli Federico II, Universidade do Porto, Fraunhofer Institute for Applied Optics and Precision Engineering IOF

Contributors: Alberucci, A., Barboza, R., Jisha, C. P., Nolte, S.

Number of pages: 10

Pages: 1878-1887

Publication date: 1 Aug 2018

Peer-reviewed: Yes

#### Publication information

Journal: Journal of the Optical Society of America B: Optical Physics

Volume: 35

Issue number: 8

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2018): CiteScore 3.9 SJR 0.875 SNIP 0.971

Original language: English

ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/JOSAB.35.001878

Source: Scopus

Source ID: 85057822710

Research output: Contribution to journal › Article › Scientific › peer-review

### 1.34 $\mu\text{m}$ VECSEL mode-locked with a GaSb-based SESAM

Mode locking of a 1.34  $\mu\text{m}$  vertical external cavity surface emitting laser is demonstrated using a GaSb-based semiconductor saturable absorber mirror (SESAM). The SESAM includes six AlGaSb quantum wells (QWs) with an absorption edge at  $\sim 1.37 \mu\text{m}$ . The proposed approach has two key benefits: the QWs can be grown lattice matched, and only a small number of Bragg reflector layers is required to provide high reflectivity. Pump-probe measurements also reveal that the AlGaSb/GaSb structure exhibits an intrinsically fast absorption recovery on a picosecond timescale. The mode-locked laser pulse train had a fundamental repetition rate of 1.03 GHz, a pulse duration of  $\sim 5$  ps, and a peak power of  $\sim 1.67$  W. The demonstration paves the way for exploiting GaSb-based SESAMs for mode locking in the 1.3–2  $\mu\text{m}$  wavelength range, which is not sufficiently addressed by GaAs and InP material systems.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Max Born Institute

Contributors: Härkönen, A., Suomalainen, S., Rantamäki, A., Nikkinen, J., Wang, Y., Griebner, U., Steinmeyer, G., Guina, M.

Number of pages: 4

Pages: 3353-3356

Publication date: 15 Jul 2018

Peer-reviewed: Yes

### Publication information

Journal: Optics Letters

Volume: 43

Issue number: 14

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2018): CiteScore 7.1 SJR 1.707 SNIP 1.602

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.43.003353

### Bibliographical note

EXT="Steinmeyer, Günter"

Source: Scopus

Source ID: 85049846710

Research output: Contribution to journal › Article › Scientific › peer-review

### Evaluation of screen printed silver trace performance and long-term reliability against environmental stress on a low surface energy substrate

Otherwise attractive substrate materials for printed electronics may have such surface characteristics that make patterning challenging. This article focuses on the printability and performance characterization of conductive patterns on a low surface energy substrate. Surface characteristics of a hydrophobic polyphenylene ether (PPE) substrate and the effects of surface modification using chemical and physical pre-treatments were studied. In addition, silver ink performance and its reliability on this substrate were evaluated. The surface was characterized by surface energy measurements and surface profile analysis. Screen-printed test patterns were characterized to evaluate print quality and electrical and mechanical performance. A further inspection of substrate-ink interactions was conducted using environmental reliability tests. It was observed that ink adhesion could be significantly promoted by choosing a suitable surface pre-treatment method. Low sheet resistances were obtained, and thus, suitable inks for further characterization were found. In addition, it was observed that environmental stress has a significant impact on ink-substrate interactions.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Nano Communication Centre

Contributors: Mikkonen, R., Mäntysalo, M.

Number of pages: 12

Pages: 54-65

Publication date: 1 Jul 2018

Peer-reviewed: Yes

### Publication information

Journal: Microelectronics Reliability

Volume: 86

ISSN (Print): 0026-2714

Ratings:

Scopus rating (2018): CiteScore 2.6 SJR 0.376 SNIP 1.017

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Safety, Risk, Reliability and Quality, Surfaces, Coatings and Films, Electrical and Electronic Engineering

Keywords: Adhesion, Environmental stress, PPE, Printed electronics, Reliability, Surface modification

Electronic versions:

MR-D-17-00926\_accepted. Embargo ended: 21/05/20

DOIs:

10.1016/j.microrel.2018.05.010

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201909273544>. Embargo ended: 20/05/20

Source: Scopus

Source ID: 85047240351

Research output: Contribution to journal › Article › Scientific › peer-review

### **Segmentation of vessel structures from photoacoustic images with reliability assessment**

Photoacoustic imaging enables the imaging of soft biological tissue with combined optical contrast and ultrasound resolution. One of the targets of interest is tissue vasculature. However, the photoacoustic images may not directly provide the information on, for example, vasculature structure. Therefore, the images are improved by reducing noise and artefacts, and processed for better visualisation of the target of interest. In this work, we present a new segmentation method of photoacoustic images that also straightforwardly produces assessments of its reliability. The segmentation depends on parameters which have a natural tendency to increase the reliability as the parameter values monotonically change. The reliability is assessed by counting classifications of image voxels with different parameter values. The resulting segmentation with reliability offers new ways and tools to analyse photoacoustic images and new possibilities for utilising them as anatomical priors in further computations. Our MATLAB implementation of the method is available as an open-source software package [P. Raumonon, Matlab, 2018].

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Mathematics, University of Eastern Finland, University College London

Contributors: Raumonon, P., Tarvainen, T.

Number of pages: 18

Pages: 2887-2904

Publication date: 1 Jul 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Biomedical Optics Express

Volume: 9

Issue number: 7

ISSN (Print): 2156-7085

Ratings:

Scopus rating (2018): CiteScore 6.5 SJR 1.516 SNIP 1.604

Original language: English

ASJC Scopus subject areas: Biotechnology, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/BOE.9.002887

Source: Scopus

Source ID: 85049377889

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Acquiring respiration rate from photoplethysmographic signal by recursive bayesian tracking of intrinsic modes in time-frequency spectra**

Respiration rate (RR) provides useful information for assessing the status of a patient. We propose RR estimation based on photoplethysmography (PPG) because the blood perfusion dynamics are known to carry information on breathing, as respiration-induced modulations in the PPG signal. We studied the use of amplitude variability of transmittance mode finger PPG signal in RR estimation by comparing four time-frequency (TF) representation methods of the signal cascaded with a particle filter. The TF methods compared were short-time Fourier transform (STFT) and three types of synchrosqueezing methods. The public VORTAL database was used in this study. The results indicate that the advanced frequency reallocation methods based on synchrosqueezing approach may present improvement over linear methods, such as STFT. The best results were achieved using wavelet synchrosqueezing transform, having a mean absolute error and median error of 2.33 and 1.15 breaths per minute, respectively. Synchrosqueezing methods were generally more accurate than STFT on most of the subjects when particle filtering was applied. While TF analysis combined with particle filtering is a promising alternative for real-time estimation of RR, artefacts and non-respiration-related frequency components remain problematic and impose requirements for further studies in the areas of signal processing algorithms an PPG instrumentation.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Sensor Technology and Biomeasurements (STB)

Contributors: Pirhonen, M., Peltokangas, M., Vehkaoja, A.

Publication date: 1 Jun 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors

Volume: 18

Issue number: 6  
Article number: 1693  
ISSN (Print): 1424-8220  
Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Particle filters, Photoplethysmography, Respiration, Synchrosqueezing, Time-frequency analysis

Electronic versions:

sensors-18-01693

DOIs:

10.3390/s18061693

URLs:

<http://urn.fi/URN:NBN:fi:ty-201806212010>

### Bibliographical note

int=TUT-BMT,"Pirhonen, Mikko"

Source: Scopus

Source ID: 85047608517

Research output: Contribution to journal › Article › Scientific › peer-review

### Evaluation of dry electrodes in canine heart rate monitoring

The functionality of three dry electrocardiogram electrode constructions was evaluated by measuring canine heart rate during four different behaviors: Standing, sitting, lying and walking. The testing was repeated ( $n = 9$ ) in each of the 36 scenarios with three dogs. Two of the electrodes were constructed with spring-loaded test pins while the third electrode was a molded polymer electrode with Ag/AgCl coating. During the measurement, a specifically designed harness was used to attach the electrodes to the dogs. The performance of the electrodes was evaluated and compared in terms of heartbeat detection coverage. The effect on the respective heart rate coverage was studied by computing the heart rate coverage from the measured electrocardiogram signal using a pattern-matching algorithm to extract the R-peaks and further the beat-to-beat heart rate. The results show that the overall coverage ratios regarding the electrodes varied between 45-95% in four different activity modes. The lowest coverage was for lying and walking and the highest was for standing and sitting.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Pervasive Computing, Research group: Sensor Technology and Biomeasurements (STB), University of Helsinki, Institute of Biomedical Engineering and Informatics, University of Tampere (UTA), Research Group for Emotions

Contributors: Virtanen, J., Somppi, S., Törnqvist, H., Jeyhani, V., Fiedler, P., Gizatdinova, Y., Majoranta, P., Väättäjä, H., Cardó, A. V., Lekkala, J., Tuukkanen, S., Surakka, V., Vainio, O., Vehkaoja, A.

Publication date: 1 Jun 2018

Peer-reviewed: Yes

### Publication information

Journal: Sensors

Volume: 18

Issue number: 6

Article number: 1757

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Dry electrode, Heart rate canine

Electronic versions:

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DOIs:

10.3390/s18061757

URLs:

<http://urn.fi/URN:NBN:fi:ty-201806212014>



Source: Scopus

Source ID: 85047961818

Research output: Contribution to journal > Article > Scientific > peer-review

### **Morphology evolution of PS-b-PDMS block copolymer and its hierarchical directed self-assembly on block copolymer templates**

Cylinder-forming polystyrene-block-polydimethylsiloxane (PS-b-PDMS, 27.2k-b-11.7k, SD39) block copolymer having a total molecular weight of  $39 \text{ kg mol}^{-1}$  was exploited to achieve in-plane morphologies of lines, dots and antidots. Brush-free self-assembly of the SD39 on silicon substrates was investigated using solvents that were PS or PDMS selective, neutral and non-solvents based on their Hansen solubility parameters. The different morphologies were achieved with annealing times ranging from 10 min to 1 h at room temperature. The SD39 patterns were used as an etch mask for transferring the pattern into the underlying substrate. Directed self-assembly and hierarchical directed self-assembly on block copolymer templates for confinement of dots was successfully demonstrated. The strategy for achieving multiple morphologies using one BCP by mere choice of the annealing solvents on unmodified substrates provides a simplified method for surface nanopatterning, templated growth of nanomaterials and nanofabrication.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Danmarks Tekniske Universitet, DTU Informatik, Trinity College Dublin, Laboratory of Photonics

Contributors: Rasappa, S., Schulte, L., Borah, D., Hulkkonen, H., Ndoni, S., Salminen, T., Senthamaraikandan, R., Morris, M. A., Niemi, T.

Number of pages: 7

Pages: 1-7

Publication date: 15 May 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Microelectronic Engineering

Volume: 192

ISSN (Print): 0167-9317

Ratings:

Scopus rating (2018): CiteScore 4.2 SJR 0.561 SNIP 0.958

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Surfaces, Coatings and Films, Electrical and Electronic Engineering

Keywords: Block copolymer, Hansen solubility, Hierarchical self-assembly, Selective solvent

DOIs:

10.1016/j.mee.2018.02.002

Source: Scopus

Source ID: 85041706803

Research output: Contribution to journal > Article > Scientific > peer-review

### **Thermo-optic soliton routing in nematic liquid crystals**

We demonstrate thermo-optic control on the propagation of optical spatial solitons in nematic liquid crystals. By varying the sample temperature, both linear and nonlinear optical properties of the reorientational material are modulated by acting on the refractive indices, the birefringence, and the elastic response. As a result, both the trajectory and transverse confinement of spatial solitons can be adjusted, demonstrating an effective means to tune and readdress self-induced optical waveguides.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Politechnika Warszawska, University "Roma Tre", NooEL–Nonlinear Optics and OptoElectronics Lab

Contributors: Laudyn, U. A., Piccardi, A., Kwasny, M., Karpierz, M. A., Assanto, G.

Number of pages: 4

Pages: 2296-2299

Publication date: 15 May 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 43

Issue number: 10  
ISSN (Print): 0146-9592  
Ratings:

Scopus rating (2018): CiteScore 7.1 SJR 1.707 SNIP 1.602  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:

10.1364/OL.43.002296  
Source: Scopus  
Source ID: 85047265805  
Research output: Contribution to journal > Article > Scientific > peer-review

### **Sub-10 optical-cycle passively mode-locked Tm:(Lu<sub>2</sub>/3Sc<sub>1</sub>/3)2O<sub>3</sub> ceramic laser at 2 μm**

A Tm-doped mixed sesquioxide ceramic laser is mode-locked near 2 μm using InGaAsSb quantum-well semiconductor saturable absorber and chirped mirrors for dispersion compensation. Maximum average output power of 175 mW is achieved for a pulse duration of 230 fs at a repetition rate of 78.9 MHz with a 3% output coupler. Applying a 0.2% output coupler pulses as short as 63 fs are generated at 2.057 μm.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Photonics, Max Born Institute, China Academy of Engineering Physics, ITMO University, Jiangsu Normal University, Universitat Rovira i Virgili  
Contributors: Wang, Y., Jing, W., Loiko, P., Zhao, Y., Huang, H., Mateos, X., Suomalainen, S., Härkönen, A., Guina, M., Griebner, U., Petrov, V.  
Number of pages: 6  
Pages: 10299-10304  
Publication date: 16 Apr 2018  
Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express  
Volume: 26  
Issue number: 8  
ISSN (Print): 1094-4087  
Ratings:  
Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OE.26.010299  
Source: Scopus  
Source ID: 85045566318  
Research output: Contribution to journal > Article > Scientific > peer-review

### **Ho:KY(WO<sub>4</sub>)<sub>2</sub> thin-disk laser passively Qswitched by a GaSb-based SESAM**

A Holmium thin-disk laser based on a 3 at.% Ho:KY(WO<sub>4</sub>)<sub>2</sub>/KY(WO<sub>4</sub>)<sub>2</sub> epitaxy and single-bounce pumping by a 1960 nm Tm-fiber laser is passively Q-switched with a GaSb-based quantum-well semiconductor saturable absorber mirror. It generates an average output power of 551 mW at 2056 nm with a slope efficiency of 44% (with respect to the absorbed pump power). The best pulse characteristics (energy and duration) are 4.1 μJ /201 ns at a repetition rate of 135 kHz and the conversion efficiency with respect to the continuous-wave regime is as high as 93%.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Photonics, Max Born Institute, Universitat Rovira i Virgili, LISA Laser Products OHG, ITMO University, Institute of Laser Physics of the Siberian Branch of the RAS  
Contributors: Mateos, X., Loiko, P., Lamrini, S., Scholle, K., Fuhrberg, P., Suomalainen, S., Härkönen, A., Guina, M., Vatik, S., Vedin, I., Aguiló, M., Díaz, F., Wang, Y., Griebner, U., Petrov, V.  
Number of pages: 6  
Pages: 9011-9016  
Publication date: 2 Apr 2018  
Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 26

Issue number: 7

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.26.009011

Source: Scopus

Source ID: 85044766941

Research output: Contribution to journal > Article > Scientific > peer-review

### AlGaAs-based vertical-external-cavity surface-emitting laser exceeding 4 W of direct emission power in the 740–790 nm spectral range

An optically pumped vertical-external-cavity surface-emitting laser (VECSEL) for direct emission in the 740–790 nm wavelength region is reported. The gain structure is based on 12 AlGaAs quantum wells. We demonstrate wavelength tuning between 747 nm and 788 nm and free-running operation with a maximum power of 4.24 W (pump power limited) for a heat sink temperature of 14°C. This laser system addresses a spectral gap not currently covered by VECSEL technology and represents the most powerful VECSEL reported within the 7XX-nm wavelength region.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC

Contributors: Kahle, H., Nechay, K., Penttinen, J., Tukiainen, A., Ranta, S., Guina, M.

Number of pages: 4

Pages: 1578-1581

Publication date: 1 Apr 2018

Peer-reviewed: Yes

### Publication information

Journal: Optics Letters

Volume: 43

Issue number: 7

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2018): CiteScore 7.1 SJR 1.707 SNIP 1.602

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.43.001578

Source: Scopus

Source ID: 85044838897

Research output: Contribution to journal > Article > Scientific > peer-review

### Ultra-large core birefringent Yb-doped tapered double clad fiber for high power amplifiers

We present a birefringent Yb-doped tapered double-clad fiber with a record core diameter of 96  $\mu\text{m}$ . An impressive gain of over 38 dB was demonstrated for linearly polarized CW and pulsed sources at a wavelength of 1040 nm. For the CW regime the output power was 70 W. For a mode-locked fiber laser a pulse energy of 28  $\mu\text{J}$  with 292 kW peak power was reached at an average output power of 28 W for a 1 MHz repetition rate. The tapered double-clad fiber has a high value of polarization extinction ratio at 30 dB and is capable of delivering the linearly polarized diffraction-limited beam ( $M^2 = 1.09$ ).

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Nanophotonics, Ampliconix Ltd, Institute of Radio Engineering and Electronics of the Russian Academy of Sciences, Moscow Institute of Physics and Technology, St. Petersburg State Polytechnical University

Contributors: Fedotov, A., Noronen, T., Gumenyuk, R., Ustimchik, V., Chamorovskii, Y., Golant, K., Odnoblyudov, M., Rissanen, J., Niemi, T., Filippov, V.

Number of pages: 12

Pages: 6581-6592  
Publication date: 19 Mar 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Optics Express  
Volume: 26  
Issue number: 6  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

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10.1364/OE.26.006581

URLs:

<http://urn.fi/URN:NBN:fi:tty-201804191513>

#### Bibliographical note

EXT="Noronen, Teppo"

INT=fot, "Rissanen, Joonas"

EXT="Filippov, Valery"

Source: Scopus

Source ID: 85044203104

Research output: Contribution to journal › Article › Scientific › peer-review

#### Guided-mode resonance gratings for enhanced mid-infrared absorption in quantum dot intermediate-band solar cells

Achieving strong absorption of low-energy photons is one of the key issues to demonstrate quantum dot solar cells working in the intermediate band regime at practical concentration factors and operating temperatures. Guided-mode resonance effects may enable large enhancement of quantum dot intraband optical transitions. We propose quantum dot thin-film cells designed to have significant field waveguiding in the quantum dot stack region and patterned at the rear-side with a sub-wavelength diffraction grating. Remarkable increase of the optical path length at mid-infrared wavelengths is shown owing to guided-mode resonances. Design guidelines are presented for energy and strength of the second-photon absorption for III-V quantum dots, such as InAs/GaAs and GaSb/GaAs, whose intraband and intersubband transitions roughly extends over the 2-8  $\mu\text{m}$  range. The proposed design can also be applied to quantum dot infrared detectors. Angle-selectivity is discussed in view of applications in concentrator photovoltaic systems and infrared imaging systems.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Politecnico di Torino

Contributors: Elsehrawy, F., Niemi, T., Cappelluti, F.

Pages: A352-A359

Publication date: 19 Mar 2018

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express  
Volume: 26  
Issue number: 6  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.26.00A352

Source: Scopus

Source ID: 85044122507

Research output: Contribution to journal › Article › Scientific › peer-review

## Comparison of metal/polymer back reflectors with half-sphere, blazed, and pyramid gratings for light trapping in III-V solar cells

We report on the fabrication of diffraction gratings for application as back contact reflectors. The gratings are designed for thin-film solar cells incorporating absorbers with bandgap slightly lower than GaAs, i.e. InAs quantum dot or GaInNAs solar cells. Light trapping in the solar cells enables the increase of the absorption leading to higher short circuit current densities and higher efficiencies. We study metal/polymer back reflectors with half-sphere, blazed, and pyramid gratings, which were fabricated either by photolithography or by nanoimprint lithography. The gratings are compared in terms of the total and the specular reflectance, which determine their diffraction capabilities, i.e. The feature responsible for increasing the absorption. The pyramid grating showed the highest diffuse reflection of light compared to the half-sphere structure and the blazed grating. The diffraction efficiency measurements were in agreement with the numerical simulations. The validated model enables designing such metal/polymer back reflectors for other type of solar cells by refining the optimal dimensions of the gratings for different wavelength ranges.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Faculty of Natural Sciences, Politecnico di Torino, Ita-Suomen yliopisto, Dispelix Oy

Contributors: Aho, T., Guina, M., Elsehrawy, F., Cappelluti, F., Raappana, M., Tukiainen, A., Khairul Alam, A. B., Vartiainen, I., Kuitinen, M., Niemi, T.

Pages: A331-A340

Publication date: 19 Mar 2018

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 26

Issue number: 6

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

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DOIs:

10.1364/OE.26.00A331

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910173913>

Source: Scopus

Source ID: 85044133519

Research output: Contribution to journal › Article › Scientific › peer-review

## Speckle reduction method for image-based coherent stereogram generation

We propose a speckle noise reduction method for generation of coherent holographic stereograms. The method employs densely sampled light field (DSLRF) of the scene together with depth information acquired for each ray in the captured DSLRF. Speckle reduction is achieved based on the ray separation technique where the scene is first described as a superposition of sparse sets of point sources corresponding to separated sets of rays and then the holographic reconstructions corresponding to these sparse sets of point sources are added incoherently (intensity-wise) to obtain the final reconstruction. The proposed method handles the light propagation between the sparse scene points and hologram elements accurately by utilizing ray resampling based on the notion of DSLRF. As a result, as demonstrated via numerical simulations, significant speckle suppression is achieved at no cost of sampling related reconstruction artifacts.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: 3D MEDIA

Contributors: Kinen, J. M., Sahin, E., Gotchev, A.

Number of pages: 14

Pages: 5381-5394

Publication date: 5 Mar 2018

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 26

Issue number: 5  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2018): CiteScore 6.8 SJR 1.473 SNIP 1.631  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Electronic versions:

Speckle reduction method for image-based 2018  
DOIs:

10.1364/OE.26.005381

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002252334>

Source: Scopus

Source ID: 85042784476

Research output: Contribution to journal > Article > Scientific > peer-review

### **Noise minimized high resolution digital holographic microscopy applied to surface topography**

The topography of surface relief gratings was studied by digital holographic microscopy. The applicability of the method for quantitative measurements of surface microstructure at nanoscale was demonstrated. The method for wavefront reconstruction of surface relief from a digital hologram recorded in off-axis configuration was also applied. The main feature is noise filtration due to the presence of noise in the recorded intensity distribution and the use of all orders of the hologram. Reconstruction results proved a better effectiveness of our approach for topography studying of relief grating patterned on a ChG  $As_2S_3$  - Se nanomultilayers in comparison with standard Fourier Transform and Atom Force Microscope methods.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI, Institute of Applied Physics Academy of Sciences of Moldova, University of Stuttgart, St. Petersburg State University, Department of Signal Processing

Contributors: Achimova, E., Abaskin, V., Claus, D., Pedrini, G., Shevkunov, I., Katkovnik, V.

Number of pages: 6

Pages: 267-272

Publication date: 1 Mar 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Computer Optics

Volume: 42

Issue number: 2

ISSN (Print): 0134-2452

Ratings:

Scopus rating (2018): CiteScore 3.3 SJR 0.535 SNIP 2.365

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Computer Science Applications, Electrical and Electronic Engineering

Keywords: Diffraction gratings, Digital holography, Digital image processing

DOIs:

10.18287/2412-6179-2018-42-2-267-272

Source: Scopus

Source ID: 85046122008

Research output: Contribution to journal > Article > Scientific > peer-review

### **An activity recognition framework deploying the random forest classifier and a single optical heart rate monitoring and triaxial accelerometer wrist-band**

Wrist-worn sensors have better compliance for activity monitoring compared to hip, waist, ankle or chest positions. However, wrist-worn activity monitoring is challenging due to the wide degree of freedom for the hand movements, as well as similarity of hand movements in different activities such as varying intensities of cycling. To strengthen the ability of wrist-worn sensors in detecting human activities more accurately, motion signals can be complemented by physiological signals such as optical heart rate (HR) based on photoplethysmography. In this paper, an activity monitoring framework using an optical HR sensor and a triaxial wrist-worn accelerometer is presented. We investigated a range of daily life activities including sitting, standing, household activities and stationary cycling with two intensities. A random forest (RF) classifier was exploited to detect these activities based on the wrist motions and optical HR. The highest overall accuracy of  $89.6 \pm 3.9\%$  was achieved with a forest of a size of 64 trees and 13-s signal segments with 90% overlap. Removing the

HR-derived features decreased the classification accuracy of high-intensity cycling by almost 7%, but did not affect the classification accuracies of other activities. A feature reduction utilizing the feature importance scores of RF was also carried out and resulted in a shrunken feature set of only 21 features. The overall accuracy of the classification utilizing the shrunken feature set was  $89.4 \pm 4.2\%$ , which is almost equivalent to the above-mentioned peak overall accuracy.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Personal Health Informatics-PHI, Department of Future Technologies

Contributors: Mehrang, S., Pietilä, J., Korhonen, I.

Publication date: 22 Feb 2018

Peer-reviewed: Yes

#### Publication information

Journal: Sensors

Volume: 18

Issue number: 2

Article number: 613

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Accelerometer, Activity recognition, Context awareness, Machine learning, Photoplethysmography, Random forest, Wrist-worn sensors

Electronic versions:

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DOIs:

10.3390/s18020613

URLs:

<http://urn.fi/URN:NBN:fi:tty-201803141373>

Source: Scopus

Source ID: 85042489750

Research output: Contribution to journal > Article > Scientific > peer-review

#### 87 fs mode-locked Tm,Ho:CaYAlO<sub>4</sub> laser at ~2043 nm

We report on, to the best of our knowledge, the first sub-100 fs mode-locked Ho<sup>3+</sup>-laser in the 2 μm spectral range employing a disordered co-doped Tm;Ho:CaYAlO<sub>4</sub> (Tm, Ho:CALYO) crystal as a gain medium. Pulses as short as 87 fs are produced with an average output power of 27 mW at 80.45 MHz repetition rate. An output power of 96 mW is reached for a pulse duration of 98 fs.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Max Born Institute, Jiangsu Normal University, Universitat Rovira i Virgili, China Academy of Engineering Physics, ITMO University, Tongji University

Contributors: Zhao, Y., Wang, Y., Zhang, X., Mateos, X., Pan, Z., Loiko, P., Zhou, W., Xu, X., Xu, J., Shen, D., Suomalainen, S., Härkönen, A., Guina, M., Griebner, U., Petrov, V.

Number of pages: 4

Pages: 915-918

Publication date: 1 Feb 2018

Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 43

Issue number: 4

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2018): CiteScore 7.1 SJR 1.707 SNIP 1.602

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.43.000915

Source: Scopus

Source ID: 85042032809

Research output: Contribution to journal > Article > Scientific > peer-review

### **Surface relief and refractive index gratings patterned in chalcogenide glasses and studied by off-axis digital holography**

Surface relief gratings and refractive index gratings are formed by direct holographic recording in amorphous chalcogenide nanomultilayer structures  $\text{As}_2\text{S}_3\text{-Se}$  and thin films  $\text{As}_2\text{S}_3$ . The evolution of the grating parameters, such as the modulation of refractive index and relief depth in dependence of the holographic exposure, is investigated. Off-axis digital holographic microscopy is applied for the measurement of the photoinduced phase gratings. For the high-accuracy reconstruction of the wavefront (amplitude and phase) transmitted by the fabricated gratings, we used a computational technique based on the sparse modeling of phase and amplitude. Both topography and refractive index maps of recorded gratings are revealed. Their separated contribution in diffraction efficiency is estimated.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI, Institute of Applied Physics of Academy of Sciences of Moldova, University of Stuttgart

Contributors: Cazac, V., Meshalkin, A., Achimova, E., Abashkin, V., Katkovnik, V., Shevkunov, I., Claus, D., Pedrini, G.

Number of pages: 7

Pages: 507-513

Publication date: 20 Jan 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Applied Optics

Volume: 57

Issue number: 3

ISSN (Print): 1559-128X

Ratings:

Scopus rating (2018): CiteScore 3.5 SJR 0.749 SNIP 1.263

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/AO.57.000507

Source: Scopus

Source ID: 85040793865

Research output: Contribution to journal > Article > Scientific > peer-review

### **Narrow-linewidth 780 nm DFB lasers fabricated using nanoimprint lithography**

The paper presents narrow-linewidth 780 nm edgeemitting semiconductor DFB lasers fabricated without regrowth using UV-nanoimprinted surface gratings. The thirdorder laterally-coupled ridge-waveguide surface gratings enable single mode operation, excellent spectral purity (40-55 dB side mode suppression ratio and 10 kHz linewidth) and good lightcurrent-voltage characteristics in continuous wave operation (~112 mA threshold current, ~1.55 V opening voltage and 28.9 mW output power from one facet at 300 mA current for 2.4 mm long devices), which are vital in various applications, such as rubidium spectroscopy and atomic clock pumping. The low fabrication costs, high throughput, structural flexibility and high device yield make the fabrication method fully compatible with large scale mass production, enabling the fabrication of low-cost miniaturized modules.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics

Contributors: Virtanen, H., Uusitalo, T., Karjalainen, M., Ranta, S., Viheriala, J., Dumitrescu, M.

Pages: 51-54

Publication date: 2018

Peer-reviewed: Yes

Early online date: 9 Nov 2017

#### **Publication information**

Journal: IEEE Photonics Technology Letters

Volume: 30

Issue number: 1



ISSN (Print): 1041-1135

Ratings:

Scopus rating (2018): CiteScore 5.4 SJR 0.991 SNIP 1.272

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: DFB laser, Gratings, Laser modes, Measurement by laser beam, narrow linewidth, Optical device fabrication, Optical interferometry, Surface emitting lasers, surface gratings, UV-nanoimprint lithography

DOIs:

10.1109/LPT.2017.2772337

Source: Scopus

Source ID: 85034223754

Research output: Contribution to journal › Article › Scientific › peer-review

### **Programming Photoresponse in Liquid Crystal Polymer Actuators with Laser Projector**

A versatile, laser-projector-based method is demonstrated for programming alignment patterns into monolithic films of liquid crystal polymer networks. Complex images can be photopatterned into the polymer films with sub-100  $\mu\text{m}$  resolution, using relatively short exposure times. The method is further used to devise both photochemically and photothermally driven actuators that can undergo distinct light-induced shape changes, dictated by the programmed alignment patterns. Deformation modes such as buckling and coiling, as well as miniature robotic devices such as a gripper and a light-responsive octopod, are demonstrated. The reported technique enables easy and cost-effective programmable actuation with relatively high throughput, thus significantly facilitating the design and realization of functional soft robotic actuators.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, University of Warsaw

Contributors: Wani, O. M., Zeng, H., Wasylczyk, P., Priimagi, A.

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2017

#### **Publication information**

Journal: Advanced Optical Materials

Volume: 6

Issue number: 1

Article number: 1700949

ISSN (Print): 2195-1071

Ratings:

Scopus rating (2018): CiteScore 10.2 SJR 2.711 SNIP 1.6

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: Azobenzene, Laser projectors, Liquid crystal, Patterning, Photoactuation, Photoalignment

Electronic versions:

Wani\_AOM\_Final\_revised\_GOA. Embargo ended: 4/12/18

DOIs:

10.1002/adom.201700949

URLs:

<http://urn.fi/URN:NBN:fi:tty-201901111061>

Source: Scopus

Source ID: 85037631675

Research output: Contribution to journal › Article › Scientific › peer-review

### **Standoff alpha radiation detection for hot cell imaging and crime scene investigation**

This paper presents the remote detection of alpha contamination in a nuclear facility. Alpha-active material in a shielded nuclear radiation containment chamber has been localized by optical means. Furthermore, sources of radiation danger have been identified in a staged crime scene setting. For this purpose, an electron-multiplying charge-coupled device camera was used to capture photons generated by alpha-induced air scintillation (radioluminescence). The detected radioluminescence was superimposed with a regular photograph to reveal the origin of the light and thereby the alpha radioactive material. The experimental results show that standoff detection of alpha contamination is a viable tool in radiation threat detection. Furthermore, the radioluminescence spectrum in the air is spectrally analyzed. Possibilities of camera-based alpha threat detection under various background lighting conditions are discussed.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Helsinki Institute of Physics, STUK - Radiation and Nuclear Safety Authority, European Commission Joint Research Centre, Institute for Transuranium Elements Karlsruhe

Contributors: Kerst, T., Sand, J., Ihantola, S., Peräjärvi, K., Nicholl, A., Hrnccek, E., Toivonen, H., Toivonen, J.

Pages: 429–436

Publication date: 2018

Peer-reviewed: Yes

Early online date: 13 Feb 2018

### Publication information

Journal: Optical Review

Volume: 25

Issue number: 3

ISSN (Print): 1340-6000

Ratings:

Scopus rating (2018): CiteScore 1.7 SJR 0.312 SNIP 0.56

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: Alpha radiation, Radioluminescence, Remote detection, Solar blind

Electronic versions:

standoff\_alpha\_radiation\_detection\_for\_hot\_cell\_imaging

DOIs:

10.1007/s10043-018-0413-8

URLs:

<http://urn.fi/URN:NBN:fi:ty-201908232004>

Source: Scopus

Source ID: 85041913306

Research output: Contribution to journal > Article > Scientific > peer-review

### Sub-100 ps monolithic diamond Raman laser emitting at 573 nm

We report a compact and efficient picosecond diamond Raman laser at 573 nm wavelength. The laser consists of a 0.5 mm thick single-crystal synthetic diamond coated to form a plane-plane laser resonator, and pumped at 532 nm by a frequency-doubled Q-switched microchip laser system. The pump delivers 85 ps pulses at 100 kHz repetition rate at a maximum average power of 500 mW. We demonstrate 1st Stokes emission from the diamond Raman laser with maximum power of 175 mW, corresponding to a conversion efficiency of 47%; and a pulse duration of 71 ps. Substantial pulse shortening is obtained by proper adjustment of the pump spot diameter on the diamond sample. A minimum pulse duration of 39 ps is reported for a conversion efficiency of 36%; and 150 mW output power. The simplicity of the architecture makes the system highly appealing as a yellow picosecond laser source.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC, University of Strathclyde

Contributors: Nikkinen, J., Savitski, V., Reilly, S., Dziechciarzyk, L., Härkönen, A., Kemp, A., Guina, M.

Pages: 981-984

Publication date: 2018

Peer-reviewed: Yes

Early online date: 13 Feb 2018

### Publication information

Journal: IEEE Photonics Technology Letters

Volume: 30

Issue number: 11

ISSN (Print): 1041-1135

Ratings:

Scopus rating (2018): CiteScore 5.4 SJR 0.991 SNIP 1.272

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Diamond, Diamond Raman lasers, Laser excitation, Lenses, Microchip lasers, Power generation, Pulsed lasers, Pump lasers, Q-switched lasers, Raman lasers, Stimulated emission, Visible lasers

DOIs:

10.1109/LPT.2018.2806183

Source: Scopus

Source ID: 85042062344

Research output: Contribution to journal › Article › Scientific › peer-review

### **Real-time full-field characterization of transient dissipative soliton dynamics in a mode-locked laser**

Dissipative solitons are remarkably localized states of a physical system that arise from the dynamical balance between nonlinearity, dispersion and environmental energy exchange. They are the most universal form of soliton that can exist, and are seen in far-from-equilibrium systems in many fields, including chemistry, biology and physics. There has been particular interest in studying their properties in mode-locked lasers, but experiments have been limited by the inability to track the dynamical soliton evolution in real time. Here, we use simultaneous dispersive Fourier transform and time-lens measurements to completely characterize the spectral and temporal evolution of ultrashort dissipative solitons as their dynamics pass through a transient unstable regime with complex break-up and collisions before stabilization. Further insight is obtained from reconstruction of the soliton amplitude and phase and calculation of the corresponding complex-valued eigenvalue spectrum. These findings show how real-time measurements provide new insights into ultrafast transient dynamics in optics.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, UMR 6174

Contributors: Ryczkowski, P., Närhi, M., Billet, C., Merolla, J. M., Genty, G., Dudley, J. M.

Number of pages: 7

Pages: 221–227

Publication date: 2018

Peer-reviewed: Yes

Early online date: 5 Mar 2018

#### **Publication information**

Journal: Nature Photonics

Volume: 12

ISSN (Print): 1749-4885

Ratings:

Scopus rating (2018): CiteScore 59.9 SJR 13.456 SNIP 8.761

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

DOIs:

10.1038/s41566-018-0106-7

Source: Scopus

Source ID: 85042848951

Research output: Contribution to journal › Article › Scientific › peer-review

### **Lensless broadband diffractive imaging with improved depth of focus: wavefront modulation by multilevel phase masks**

This paper introduces a novel lensless full colour diffractive computational imaging system with a planar Multilevel Phase Mask (MPM) as a diffractive optical element (DOE). The novelty concerns: a methodology of MPM design for improved depth of focus (DoF); design of PSFs for RGB imaging and an inverse imaging algorithm with sparse colour image modelling simultaneous for all RGB channels. MPMs are step-wise invariant. The cubic wavefront coding (WFC) is incorporated in MPMs with optimization of number of levels and width of invariant steps. This design of MPM makes the system robust with respect to defocus (improves DoF) and diminish chromatic aberrations typical for DOEs. Broadband multichannel test-images are exploited for design and testing of the lensless system. We consider two alternative optical setups: Wavelength Multiplexing (WM) and Wavelength Division (WD). In WM, the light beam is broadband multichannel with light sources radiating all wavelengths simultaneously and a CMOS sensor is equipped with a Bayer colour filter array (CFA) for registration of spectral measurements. In this setup, a single MPM is designed for the broadband multichannel light beams. In WD, separate exposures of RGB channels are registered by a broadband grey-scale CCD sensor. Different MPMs are designed for each of the RGB channels. Simulation experiments demonstrate the essentially extended DoF of the designed lensless systems and the advanced accuracy and quality of imaging with respect to the corresponding WM and WD systems with refractive lenses. Due to robustness of the designed lensless system to chromatic aberrations, this advantage has a place even with respect to the lens-system.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI

Contributors: Katkovnik, V., Ponomarenko, M., Egiazarian, K.

Publication date: 2018

Peer-reviewed: Yes

### Publication information

Journal: Journal of Modern Optics

ISSN (Print): 0950-0340

Ratings:

Scopus rating (2018): CiteScore 2.7 SJR 0.436 SNIP 0.694

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: chromatic aberrations, computational imaging, extended depth of focus, inverse imaging, Multilevel diffractive optical elements, multilevel phase mask design, wavefront coding

DOIs:

10.1080/09500340.2018.1526344

Source: Scopus

Source ID: 85054570905

Research output: Contribution to journal › Article › Scientific › peer-review

### 1.4 $\mu\text{m}$ continuous-wave diamond Raman laser

The longest wavelength ( $\sim 1.4 \mu\text{m}$ ) emitted by a diamond Raman laser pumped by a semiconductor disk laser (SDL) is reported. The output power of the intracavity-pumped Raman laser reached a maximum of 2.3 W with an optical conversion efficiency of 3.4% with respect to the absorbed diode pump power. Narrow Stokes emission (FWHM  $< 0.1 \text{ nm}$ ) was attained using etalons to limit the fundamental spectrum to a single etalon peak. Tuning of the Raman laser over  $> 40 \text{ nm}$  was achieved via rotation of an intracavity birefringent filter that tuned the SDL oscillation wavelength.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC, University of Strathclyde

Contributors: Casula, R., Penttinen, J., Kemp, A. J., Guina, M., Hastie, J. E.

Number of pages: 7

Pages: 31377-31383

Publication date: 11 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 25

Issue number: 25

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: VECSEL

Electronic versions:

oe-25-25-31377

DOIs:

10.1364/OE.25.031377

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712222490>

Research output: Contribution to journal › Article › Scientific › peer-review

### Bright off-axis directional emission with plasmonic corrugations

In this work, a new plasmonic bulls-eye structure is introduced to efficiently harvest the emitted light from diamond nitrogen vacancy (NV) centers. We show that the presence of a simple metal sub-layer underneath of a conventional bulls-eye antenna, separated by a dielectric layer, results in the spontaneous emission enhancement and increment in out-coupled light intensity. High Purcell factor is accessible in such a structure, which consequently boosts efficiency of the radiated light intensity from the structure. The structure shows considerable enhancement in far-field intensity, about three times higher than that of a one-side corrugated (conventional) optimized structure. In addition, we study for the first time asymmetric structures to steer emitted beams in two-axis. Our results show that spatial off-axial steering over a cone is approachable by introducing optimal asymmetries to grooves and ridges of the structure. The steered light retains a level of intensity even higher than conventional symmetric structures. A high value of directivity of 16 for off-axis steering is reported.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, CRPP, Bilkent University, Nanotechnology Research Center

Contributors: Sattari, H., Rashed, A. R., Ozbay, E., Caglayan, H.

Number of pages: 16

Pages: 30827-30842

Publication date: 11 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 25

Issue number: 25

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-25-30827

DOIs:

10.1364/OE.25.030827

URLs:

<http://urn.fi/URN:NBN:fi:ty-201801181109>

Source: Scopus

Source ID: 85038213896

Research output: Contribution to journal > Article > Scientific > peer-review

### High-Power 1180-nm GaInNAs DBR Laser Diodes

We report high-power 1180-nm GaInNAs distributed Bragg reflector laser diodes with and without a tapered amplifying section. The untapered and tapered components reached room temperature output powers of 655 mW and 4.04 W, respectively. The diodes exhibited narrow linewidth emission with side-mode suppression ratios in the range of 50 dB for a broad range of operating current, extending up to 2 A for the untapered component and 10 A for the tapered component. The high output power is rendered possible by the use of a high quality GaInNAs-based quantum well gain region, which allows for lower strain and better carrier confinement compared with traditional GaInAs quantum wells. The development opens new opportunities for the power scaling of frequency-doubled lasers with emission at yellow–orange wavelengths.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC, Research group: Surface Science, Okmetic Oyj, Norlase ApS, Denmark

Technical University DTU, Optoelectronics Research Centre, Tampere University of Technology

Contributors: Aho, A. T., Viheriälä, J., Korpjärvi, V., Koskinen, M., Virtanen, H., Christensen, M., Uusitalo, T., Lahtonen, K., Valden, M., Guina, M.

Number of pages: 4

Pages: 2023-2026

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: IEEE Photonics Technology Letters

Volume: 29

Issue number: 23

ISSN (Print): 1041-1135

Ratings:

Scopus rating (2017): CiteScore 5.2 SJR 0.961 SNIP 1.267

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: High power, distributed Bragg reflector laser, frequency doubling, Coating(s)

Electronic versions:

08060506

DOIs:

10.1109/LPT.2017.2760038

URLs:

<http://urn.fi/URN:NBN:fi:ty-201711072119>

### Bibliographical note

INT=FOT, "Koskinen, Mervi"

Research output: Contribution to journal > Article > Scientific > peer-review

### Bending reorientational solitons with modulated alignment

While curved waveguides are fundamental elements in photonics, those induced all optically in nonlinear uniform dielectrics tend to be straight. In uniaxial soft matter with a reorientational response, such as nematic liquid crystals (NLCs), light beams in the extraordinary polarization undergo self-focusing via an increase in refractive index and eventually form spatial solitons, i.e., self-induced waveguides. Hereby we investigate the bending of such waveguides by analyzing the trajectory of solitons in NLCs—nematicons—in the presence of a linearly varying transverse orientation of the optic axis. To this extent, we use and compare two approaches: i) a slowly varying (adiabatic) approximation based on momentum conservation of the nematicon in a Hamiltonian sense; and ii) the Frank–Oseen elastic theory coupled with a fully vectorial and nonlinear beam propagation method. The models provide comparable results in such a non-homogeneously oriented uniaxial medium and predict bent soliton paths with either monotonic or non-monotonic curvatures, enabling the design of curved channel waveguides induced by light beams.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Politechnika Warszawska, University of Edinburgh, Department of Electrical Engineering, University of Rome Roma Tre, University "Roma Tre", Laboratory of Photonics

Contributors: Sala, F. A., Smyth, N. F., Laudyn, U. A., Karpierz, M. A., Minzoni, A. A., Assanto, G.

Number of pages: 8

Pages: 2459-2466

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Journal of the Optical Society of America B: Optical Physics

Volume: 34

Issue number: 12

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2017): CiteScore 3.8 SJR 0.859 SNIP 0.834

Original language: English

ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/JOSAB.34.002459

Source: Scopus

Source ID: 85037529512

Research output: Contribution to journal > Article > Scientific > peer-review

### Sub-50 ps pulses at 620 nm obtained from frequency doubled 1240 nm diamond Raman laser

We report a monolithic 1240 nm diamond Raman laser producing pulses with duration of 42–62 ps at 100 kHz repetition rate, and maximum average power of 246 mW. The Raman laser is formed by a 0.5-mm thick planar diamond, coated on both sides and pumped by ~100 ps pulses from a Q-switched 1064 nm laser. The maximum conversion efficiency from 1064 nm to 1240 nm was about 25%. The 1240 nm signal was frequency-doubled in single-pass configuration through a 10-mm long LBO crystal, enabling generation of pulses with a duration of 29–46 ps at 620 nm. The maximum average power at 620 nm was 128 mW, and the maximum conversion efficiency from 1240 nm to 620 nm was 50%. The Raman laser provides an efficient and flexible way to extend short pulse operation to wavelengths in spectral domains difficult to reach, such as 620 nm and in addition provides a simple pulse shortening mechanisms.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics

Contributors: Nikkinen, J., Härkönen, A., Guina, M.

Number of pages: 6

Pages: 30365-30370

Publication date: 27 Nov 2017

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 25

Issue number: 24

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-24-30365

DOIs:

10.1364/OE.25.030365

URLs:

<http://urn.fi/URN:NBN:fi:ty-201712212461>

Source: Scopus

Source ID: 85036471667

Research output: Contribution to journal › Article › Scientific › peer-review

### Investigating solvent effects on aggregation behaviour, linear and nonlinear optical properties of silver nanoclusters

We herein report the solvent effects on the aggregation, linear and nonlinear optical properties of silver nanoclusters synthesised using three solvents namely; ethanol, acetone and isopropanol. The Ag clusters were characterized using UV-Visible (UV-vis) and photoluminescence (PL) spectroscopy, Fourier transform-infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), high resolution transmission electron microscopy (HRTEM), small angle X-ray scattering (SAXS), dynamic light scattering (DLS), and open aperture Z-Scan measurements. Density functional theory (DFT) calculations at the B3PW91 level of theory, were done to compute the electric dipole, quadrupole, octapole and hexadecapole moment of mercaptosuccinic acid and mercaptosuccinic acid-Ag<sub>9</sub> cluster in three solvents. Linear optical properties show characteristic absorption profile with quantum confinement at different wavelengths for all the three clusters. The Open aperture Z-scan measurement in Ag clusters establishes the optical limiting properties which arise mostly from excited state absorption (ESA) and relatively weak saturable absorption (SA). The nonlinear optical behaviour varies within the three clusters with maximum optical limiting value obtained for the clusters synthesised using acetone. The theoretically computed hyperpolarizabilities together with z-scan measurements establish the solvent effect on the clusters and their potential applications in optical limiting devices.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, St Teresas's College, Mahatma Gandhi University, Kolkata Centre, Birla Institute of Technology & Science, Swinburne University of Technology, University of Johannesburg

Contributors: Bhavitha, K. B., Nair, A. K., Perumbilavil, S., Joseph, S., Kala, M. S., Saha, A., Narayanan, R. A., Hameed, N., Thomas, S., Oluwafemi, O. S., Kalarikkal, N.

Number of pages: 11

Pages: 695-705

Publication date: 1 Nov 2017

Peer-reviewed: Yes

### Publication information

Journal: Optical Materials

Volume: 73

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2017): CiteScore 3.7 SJR 0.592 SNIP 1.054

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Science(all), Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Aggregation behaviour, DFT, Linear optical properties, Non linear optical properties, Silver nanoclusters, Solvent effects

DOIs:

10.1016/j.optmat.2017.09.024

Source: Scopus

Source ID: 85030173026

Research output: Contribution to journal › Article › Scientific › peer-review

### Paraxial light beams in structured anisotropic media

We discuss the paraxial approximation for optical waves propagating in a uniaxial anisotropic medium inhomogeneously twisted on the plane normal to the wave vector, with the latter being parallel to one of the two principal axes normal to the optic axis. Such geometry implies a continuous power transfer between the ordinary and extraordinary components, regardless of the input beam polarization. We pinpoint that this peculiar feature, generalizable to any inhomogeneous linear birefringent material, strongly affects the application of the paraxial approximation due to the simultaneous presence of two different phase velocities. We eventually show that a local coordinate transformation permits a correct application of the paraxial approximation.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Nonlinear Optics, Univ Porto, Universidade do Porto, Fac Med, Dept Med Imaging

Contributors: Jisha, C. P., Alberucci, A.

Number of pages: 6

Pages: 2019-2024

Publication date: 1 Nov 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of the Optical Society of America A: Optics and Image Science, and Vision

Volume: 34

Issue number: 11

ISSN (Print): 1084-7529

Ratings:

Scopus rating (2017): CiteScore 3.5 SJR 0.687 SNIP 1.098

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Computer Vision and Pattern Recognition

DOIs:

10.1364/JOSAA.34.002019

Source: Scopus

Source ID: 85033368214

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### Generation of Sub-100 ps Pulses at 532, 355, and 266 nm Using a SESAM Q-Switched Microchip Laser

We report a single-frequency semiconductor saturable absorber mirror Q-switched microchip laser system generating sub-100 ps pulses at 532, 355, and 266 nm. The system consists of a 1064 nm Nd:YVO<sub>4</sub> master oscillator, Nd:YVO<sub>4</sub> power amplifier, and one or two nonlinear crystals for single-pass frequency-conversion to visible and UV. The average output power is about 720 mW at 532 nm, 150 mW at 355 nm and 83 mW at 266 nm for a pulse repetition rate of 100 kHz. At 532 nm the peak power is nearly 80 kW with pulse energy of about 7.2 μJ and spectral width of about 0.026 nm. The optical-to-optical conversion efficiency from 808 to 532 nm is about 8.3%. In comparison with mode-locked picosecond systems, the proposed laser has intrinsically low repetition rate, which is desirable in certain applications. The laser has also inherently narrow spectral width, and high peak power and pulse energy. This unique combination of output parameters could make the system useful in several applications including fluorescence lifetime imaging microscopy, high-accuracy submarine LIDAR, STED microscopy, time-gated Raman spectroscopy two-photon polymerization, diamond Raman laser pumping, photo-acoustic imaging, and micro-machining/marking.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics

Contributors: Nikkinen, J., Härkönen, A., Leino, I., Guina, M.

Number of pages: 4

Pages: 1816-1819

Publication date: 1 Nov 2017

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Photonics Technology Letters

Volume: 29

Issue number: 21

ISSN (Print): 1041-1135

Ratings:



Scopus rating (2017): CiteScore 5.2 SJR 0.961 SNIP 1.267

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Microchip lasers, pulsed lasers, Q-switched lasers, UV lasers, visible lasers

DOIs:

10.1109/LPT.2017.2752421

Source: Scopus

Source ID: 85030256814

Research output: Contribution to journal › Article › Scientific › peer-review

### Diode-pumped Tm: KY(WO<sub>4</sub>)<sub>2</sub> laser passively modelocked with a GaSb-SESAM

We present the first diode-pumped modelocked thulium (Tm<sup>3+</sup>) laser based on a double-tungstate crystalline gain material. The solid-state laser consists of a Tm:KY(WO<sub>4</sub>)<sub>2</sub> crystal as gain medium and a GaInSb/GaSb quantum well saturable absorber for self-starting passive mode locking. The laser is pumped by a multi-mode fiber-coupled laser diode at a wavelength of 793 nm. An average output power of 202 mW is achieved at a center wavelength of 2032 nm. Pulses with duration of 3 ps are generated at a repetition rate of 139.6 MHz. We also report on the first noise evaluation of a modelocked solid-state laser operating in the 2- $\mu$ m wavelength range. We measured a timing jitter of sub-100 fs and a relative intensity noise of only 0.04% (frequency range from 500 Hz to 1 MHz).

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Université de Neuchâtel, Belarusian National Technical University, RefleKron Ltd

Contributors: Gaponenko, M., Wittwer, V. J., Härkönen, A., Suomalainen, S., Kuleshov, N., Guina, M., Südmeyer, T.

Number of pages: 7

Pages: 25760-25766

Publication date: 16 Oct 2017

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 25

Issue number: 21

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-21-25760

DOIs:

10.1364/OE.25.025760

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712152384>

Source: Scopus

Source ID: 85031940564

Research output: Contribution to journal › Article › Scientific › peer-review

### Sparse superresolution phase retrieval from phase-coded noisy intensity patterns

We consider a computational superresolution inverse diffraction problem for phase retrieval from phase-coded intensity observations. The optical setup includes a thin lens and a spatial light modulator for phase coding. The designed algorithm is targeted on an optimal solution for Poissonian noisy observations. One of the essential instruments of this design is a complex-domain sparsity applied for complex-valued object (phase and amplitude) to be reconstructed. Simulation experiments demonstrate that good quality imaging can be achieved for high-level of the superresolution with a factor of 32, which means that the pixel of the reconstructed object is 32 times smaller than the sensor's pixel. This superresolution corresponds to the object pixel as small as a quarter of the wavelength.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI

Contributors: Katkovnik, V., Egiazarian, K.

Publication date: 1 Sep 2017

Peer-reviewed: Yes

### Publication information

Journal: Optical Engineering

Volume: 56

Issue number: 9

Article number: 094103

ISSN (Print): 0091-3286

Ratings:

Scopus rating (2017): CiteScore 2.2 SJR 0.424 SNIP 0.81

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering(all)

Keywords: complex-domain sparsity, discrete optical signal processing, phase imaging, phase retrieval, superresolution

Electronic versions:

094103\_1

DOIs:

10.1117/1.OE.56.9.094103

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910224007>

Source: Scopus

Source ID: 85029753126

Research output: Contribution to journal › Article › Scientific › peer-review

### Computational super-resolution phase retrieval from multiple phase-coded diffraction patterns: Simulation study and experiments

In this paper, we consider computational super-resolution inverse diffraction phase retrieval. The optical setup is lensless, with a spatial light modulator for aperture phase coding. The paper is focused on experimental tests of the super-resolution sparse phase amplitude retrieval algorithm. We start from simulations and proceed to physical experiments. Both simulation tests and experiments demonstrate good-quality imaging for super-resolution with a factor of 4 and a serious advantage over diffraction-limited resolution as defined by Abbe's criterion.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI, Department of Photonics and Optical Information Technology, ITMO University

Contributors: Katkovnik, V., Shevkunov, I., Petrov, N. V., Egiazarian, K.

Number of pages: 9

Pages: 786-794

Publication date: 20 Jul 2017

Peer-reviewed: Yes

### Publication information

Journal: Optica

Volume: 4

Issue number: 7

ISSN (Print): 2334-2536

Ratings:

Scopus rating (2017): CiteScore 11.9 SJR 4.602 SNIP 2.811

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: Discrete optical signal processing, Image processing, Noise in imaging systems, Phase retrieval, Superresolution

DOIs:

10.1364/OPTICA.4.000786

Source: Scopus

Source ID: 85025162894

Research output: Contribution to journal › Article › Scientific › peer-review

### Chiral near-field manipulation in Au-GaAs hybrid hexagonal nanowires

We demonstrate the control of enhanced chiral field distribution at the surface of hybrid metallo-dielectric nanostructures composed of self-assembled vertical hexagonal GaAs-based nanowires having three of the six sidewalls covered with Au. We show that weakly-guided modes of vertical GaAs nanowires can generate regions of high optical chirality that are

further enhanced by the break of the symmetry introduced by the gold layer. Changing the angle of incidence of a linearly polarized plane wave it is possible to tailor and optimize the maps of the optical chirality in proximity of the gold plated walls. The low cost feasibility of the sample combined to the simple control by using linearly polarized light and the easy positioning of chiral molecules by functionalization of the gold plates make our proposed scheme very promising for enhanced enantioselective spectroscopy applications.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC, Sapienza University

Contributors: Petronijevic, E., Centini, M., Belardini, A., Leahu, G., Hakkarainen, T., Sibilia, C.

Number of pages: 10

Pages: 14148-14157

Publication date: 26 Jun 2017

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 25

Issue number: 13

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-13-14148

DOIs:

10.1364/OE.25.014148

URLs:

<http://urn.fi/URN:NBN:fi:itty-201712152390>

Source: Scopus

Source ID: 85021225855

Research output: Contribution to journal > Article > Scientific > peer-review

#### Dynamic speckle analysis with smoothed intensity-based activity maps

Pointwise intensity-based algorithms are the most popular algorithms in dynamic laser speckle measurement of physical or biological activity. The output of this measurement is a two-dimensional map which qualitatively separates regions of higher or lower activity. In the paper, we have proposed filtering of activity maps to enhance visualization and to enable quantitative determination of activity time scales. As a first step, we have proved that the severe spatial fluctuations within the map resemble a signal-dependent noise. As a second step, we have illustrated implementation of the proposed idea by applying filters to non-normalized and normalized activity estimates derived from synthetic and experimental data. Statistical behavior of the estimates has been analyzed to choose the filter parameters, and substantial narrowing of the probability density functions of the estimates has been achieved after the filtering. The filtered maps exhibit an improved contrast and allowed for quantitative description of activity.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: 3D MEDIA, Bulgarian Academy of Sciences, Korea Electronics Technology Institute

Contributors: Stoykova, E., Berberova, N., Kim, Y., Nazarova, D., Ivanov, B., Gotchev, A., Hong, J., Kang, H.

Number of pages: 11

Pages: 55-65

Publication date: 1 Jun 2017

Peer-reviewed: Yes

#### Publication information

Journal: Optics and Lasers in Engineering

Volume: 93

ISSN (Print): 0143-8166

Ratings:

Scopus rating (2017): CiteScore 6.2 SJR 1.018 SNIP 1.919

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Digital image processing, Dynamic speckle, Speckle, Speckle metrology

Electronic versions:

Dynamic speckle analysis with smoothed intensity-based activity maps

DOIs:

10.1016/j.optlaseng.2017.01.012

URLs:

<http://urn.fi/URN:NBN:fi:tty-201704251342>

Source: Scopus

Source ID: 85010222438

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Enhanced self-mixing interferometry based on volume Bragg gratings and laser diodes emitting at 405-nm wavelengths**

Self-mixing interferometry (SMI) represents a robust, self-aligned technique for metrology applications. Recently, it has been shown that the detection of the frequency-modulated (FM) signal enhances the conventional SMI signal based on the amplitude modulation. Here, an all-optical, simple and effective alternative approach to detect the FM self-mixing signal is presented. We demonstrate the enhanced self-mixing approach using a laser diode emitting at 405 nm and a volume Bragg grating (VBG) to map frequency to intensity modulations for further optical detection. Our approach overcomes the spectral range limitation of the edge filtering approach based on molecular absorption filters, since the VBGs can be fabricated at any spectral range.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Applied Optics, Department of Electrical Engineering

Contributors: Contreras, V., Toivonen, J., Martinez, H.

Number of pages: 3

Pages: 2221-2223

Publication date: 1 Jun 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 42

Issue number: 11

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2017): CiteScore 7.3 SJR 1.79 SNIP 1.572

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.42.002221

Source: Scopus

Source ID: 85020460315

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Reply to "comment on 'Spatial optical solitons in highly nonlocal media'"**

In their Comment, Petrović et al. claim that some of the results previously published by us on the use of the "accessible soliton" model of Snyder et al. are incorrect, and they claim that the correct results were published elsewhere. In order to give our perspective on the problem, we discuss and clarify some of the existing literature and our own work on the subject, underlining the importance of the accessible soliton approximation and its recent improvements towards enabling a general understanding of light self-confinement in highly nonlocal media, both quantitatively and qualitatively.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Univ Porto, Universidade do Porto, Fac Med, Dept Med Imaging, University of Edinburgh, University "Roma Tre", CNR-ISC, Institute for Complex Systems

Contributors: Alberucci, A., Jisha, C. P., Smyth, N. F., Assanto, G.

Publication date: 25 May 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A

Volume: 95

Issue number: 5  
Article number: 057802  
ISSN (Print): 2469-9926  
Ratings:

Scopus rating (2017): CiteScore 8.1 SJR 1.288 SNIP 1.014  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:

10.1103/PhysRevA.95.057802

Source: Scopus  
Source ID: 85026922362

Research output: Contribution to journal > Article > Scientific > peer-review

### **Nonlinear imaging of nanostructures using beams with binary phase modulation**

We demonstrate nonlinear microscopy of oriented nanowires using excitation beams with binary phase modulation. A simple and intuitive optical scheme comprising a spatial light modulator gives us the possibility to control the phase across an incident Hermite-Gaussian beam of order (1,0) ( $HG_{10}$  mode). This technique allows us to gradually vary the spatial distribution of the longitudinal electric fields in the focal volume, as demonstrated by second-harmonic generation from vertically-aligned GaAs nanowires. These results open new opportunities for the full control of polarization in the focal volume to enhance light interaction with nanostructured materials.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research area: Optics, Research group: Nonlinear Optics, Research group: Nonlinear Optics, Aalto University

Contributors: Turquet, L., Kakko, J. P., Jiang, H., Isotalo, T. J., Huhtio, T., Niemi, T., Kauppinen, E., Lipsanen, H., Kauranen, M., Bautista, G.

Number of pages: 8

Pages: 10441-10448

Publication date: 1 May 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 25

Issue number: 9

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-9-10441

DOIs:

10.1364/OE.25.010441

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712152389>

Source: Scopus

Source ID: 85018298162

Research output: Contribution to journal > Article > Scientific > peer-review

### **Anisotropic tapered polarization-maintaining large mode area optical fibers**

We demonstrate a novel type of tapered large mode area polarization-maintaining fiber. These birefringent fibers have an elliptical inner cladding and a core diameter that increases adiabatically from 8  $\mu\text{m}$  to 70  $\mu\text{m}$ . The polarization maintaining ability of the fiber samples was investigated by measuring the spatial distribution of polarization beat length by using optical frequency-domain reflectometry. The measurements show a clear correlation between the birefringence and the fiber core size, resulting in a modest 10-15% variation in polarization beat length along the fiber. There is no significant coupling of polarization modes or transverse modes in the tested fibers and, therefore, the linear polarization state of propagating light is preserved.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Russian Quantum Center, Institute of Radio Engineering and Electronics of the Russian Academy of Sciences, Moscow Institute of Physics and Technology

Contributors: Ustimchik, V. E., Rissanen, J., Popov, S. M., Chamorovskii, Y. K., Nikitov, S. A.

Number of pages: 11

Pages: 10693-10703

Publication date: 1 May 2017

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 25

Issue number: 9

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-9-10693

DOIs:

10.1364/OE.25.010693

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712152391>

### Bibliographical note

INT=fot,"Rissanen, J."

Source: Scopus

Source ID: 85018264751

Research output: Contribution to journal > Article > Scientific > peer-review

### Universal scaling relations for the energies of many-electron Hooke atoms

A three-dimensional harmonic oscillator consisting of  $N \geq 2$  Coulomb-interacting charged particles, often called a (many-electron) Hooke atom, is a popular model in computational physics for, e.g., semiconductor quantum dots and ultracold ions. Starting from Thomas-Fermi theory, we show that the ground-state energy of such a system satisfies a nontrivial relation:  $E_{gs} = \omega N^4 / 3 f_{gs}(\beta N^{1/2})$ , where  $\omega$  is the oscillator strength,  $\beta$  is the ratio between Coulomb and oscillator characteristic energies, and  $f_{gs}$  is a universal function. We perform extensive numerical calculations to verify the applicability of the relation. In addition, we show that the chemical potentials and addition energies also satisfy approximate scaling relations. In all cases, analytic expressions for the universal functions are provided. The results have predictive power in estimating the key ground-state properties of the system in the large- $N$  limit, and can be used in the development of approximative methods in electronic structure theory.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Quantum Control and Dynamics, Research area: Computational Physics, ICIMAF

Contributors: Odriazola, A., Solanpää, J., Kylänpää, I., González, A., Räsänen, E.

Publication date: 19 Apr 2017

Peer-reviewed: Yes

### Publication information

Journal: Physical Review A

Volume: 95

Issue number: 4

Article number: 042511

ISSN (Print): 2469-9926

Ratings:

Scopus rating (2017): CiteScore 8.1 SJR 1.288 SNIP 1.014

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.95.042511

### Bibliographical note

INT=fys,"Ordiazola, A."

Source: Scopus

Source ID: 85017581330

Research output: Contribution to journal › Article › Scientific › peer-review

### Halogen bonding stabilizes a cis-azobenzene derivative in the solid state: A crystallographic study

Crystals of trans- and cis-isomers of a fluorinated azobenzene derivative have been prepared and characterized by single-crystal X-ray diffraction. The presence of F atoms on the aromatic core of the azobenzene increases the lifetime of the metastable cis-isomer, allowing single crystals of the cis-azobenzene to be grown. Structural analysis on the cis-azobenzene, complemented with density functional theory calculations, highlights the active role of the halogen-bond contact (N...I synthon) in promoting the stabilization of the cis-isomer. The presence of a long aliphatic chain on the azobenzene unit induces a phase segregation that stabilizes the molecular arrangement for both the trans- and cis-isomers. Due to the rarity of cis-azobenzene crystal structures in the literature, our paper makes a step towards understanding the role of non-covalent interactions in driving the packing of metastable azobenzene isomers. This is expected to be important in the future rational design of solid-state, photoresponsive materials based on halogen bonding. We show by single-crystal X-ray diffraction studies and computational analysis that halogen bonding can stabilize a metastable cis-azobenzene derivative in the solid state.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Research group: Chemistry & Advanced Materials, Politecnico di Milano, Aalto University

Contributors: Saccone, M., Siiskonen, A., Fernandez-Palacio, F., Priimägi, A., Terraneo, G., Resnati, G., Metrangolo, P.

Number of pages: 7

Pages: 227-233

Publication date: 1 Apr 2017

Peer-reviewed: Yes

### Publication information

Journal: ACTA CRYSTALLOGRAPHICA SECTION B : STRUCTURAL SCIENCE, CRYSTAL ENGINEERING AND MATERIALS

Volume: 73

Issue number: 2

ISSN (Print): 2052-5192

Ratings:

Scopus rating (2017): CiteScore 6.1 SJR 1.654 SNIP 1.602

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Metals and Alloys, Materials Chemistry

Keywords: azobenzene, halogen bonding, isomerization

Electronic versions:

Halogen bonding stabilizes a cis-azobenzene derivative 2017

DOIs:

10.1107/S2052520617003444

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202005085078>

Source: Scopus

Source ID: 85017113549

Research output: Contribution to journal › Article › Scientific › peer-review

### Simulation studies of DFB laser longitudinal structures for narrow linewidth emission

The paper presents simulation studies targeting high-power narrow-linewidth emission from semiconductor distributed feedback (DFB) lasers. The studies contain analytic and numerical calculations of emission linewidth, side mode suppression ratio and output power for DFB lasers without phase shifts and with  $1 \times \lambda/4$  and  $2 \times \lambda/8$  phase shifts, taking into account the grating and facets reflectivities, the randomness of the spontaneous emission and the longitudinal photon and carrier density distributions in the laser cavity. Single device structural parameter optimization is generally associated with a trade-off between achieving a narrow linewidth and a high output power. Correlated optimization of multiple structural parameters enables the evaluation of achievable ranges of narrow linewidth and high power combinations. Devices with long cavities and low grating coupling coefficients,  $\kappa$  (keeping  $\kappa L$  values below the levels that promote re-broadening), with AR-coated facets and with a distributed phase-shift have the flattest longitudinal photon and carrier density distributions. This flatness enables stable single-longitudinal-mode operation with high side-mode-suppression ratio up to high injection current densities, which facilitates narrow linewidths and high output powers. The results reported in the paper indicate that Master-Oscillator Power-Amplifier laser structures are needed for achieving W-level high-powers

with sub-MHz linewidths because most single-cavity DFB laser structural variations that reduce the linewidth also limit the achievable output power in single-mode operation.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Semiconductor Technology and Applications

Contributors: Virtanen, H., Uusitalo, T., Dumitrescu, M.

Number of pages: 13

Publication date: 23 Mar 2017

Peer-reviewed: Yes

#### Publication information

Journal: Optical and Quantum Electronics

Volume: 49

Issue number: 4

Article number: 160

ISSN (Print): 0306-8919

Ratings:

Scopus rating (2017): CiteScore 1.8 SJR 0.353 SNIP 0.631

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Distributed feedback laser, High power, Narrow linewidth

Electronic versions:

2017-simulation-studies-springer. Embargo ended: 23/03/18

DOIs:

10.1007/s11082-017-0993-8

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712152382>. Embargo ended: 23/03/18

Source: Scopus

Source ID: 85016097411

Research output: Contribution to journal > Article > Scientific > peer-review

#### 33 W continuous output power semiconductor disk laser emitting at 1275 nm

We demonstrate a semiconductor disk laser emitting at 1275nm, employing a wafer fused AlInGaAs/InP-AlAs/GaAs gain mirror. A built-in Au-reflector was used to reflect the pump light not absorbed in a single pass through the gain chip active region. The laser exhibited an output power of 33 W for a pump spot with a diameter of 0.86 mm, an output coupler of 2.5%, and a heat-sink temperature of -5°C. When the temperature of the heat-sink was increased to 15°C, the maximum output power reached a value of ~24 W. The study reveals that the wafer fused gain mirrors have a high optical quality and good uniformity enabling scaling of the maximum emitted power with the diameter of the pump spot, i.e. at least up to the 1 mm diameter.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Semiconductor Technology and Applications, II-VI Laser Enterprise GmbH, RTI-Research S.A., CRPP

Contributors: Leinonen, T., Iakovlev, V., Sirbu, A., Kapon, E., Guina, M.

Number of pages: 6

Pages: 7008-7013

Publication date: 20 Mar 2017

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 25

Issue number: 6

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:



oe-25-6-7008

DOIs:

10.1364/OE.25.007008

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712152386>

Source: Scopus

Source ID: 85015888267

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Diode-pumped mode-locked Tm:LuAG laser at 2 $\mu\text{m}$ based on GaSb-SESAM**

Mode-locking of a directly diode-pumped Tm:LuAG laser is demonstrated using GaSb-based semiconductor saturable absorber mirrors (SESAMs). Stable and self-starting mode-locked operation was realized, generating pulses as short as 13.6 ps at 2024 nm with a maximum output power of 98 mW. Two GaInAs-based SESAMs were used for comparison with the operation based upon the use of the GaSb SESAM; in this case, longer pulses with durations of 27 ps and 34 ps were obtained under the same experimental conditions. Our work sets a new record in pulse duration for mode-locked Tm:LuAG lasers and confirms that lattice-matched GaSb-based SESAMs are beneficial for mode-locked solid-state lasers in the 2  $\mu\text{m}$  range.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Semiconductor Technology and Applications, Qingdao Univ, Qingdao University, Shandong University, Shandong Univ, Key Lab Photon Mat & Technol, School of Information Science and Engineering, State Key Laboratory of Crystal Material, Shandong Jianzhu University, German Aerospace Center, Shanghai Institute of Ceramics Chinese Academy of Sciences

Contributors: Luan, C., Yang, K., Zhao, J., Zhao, S., Li, T., Zhang, H., He, J., Song, L., Dekorsy, T., Guina, M., Zheng, L.

Number of pages: 4

Pages: 839-842

Publication date: 15 Feb 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 42

Issue number: 4

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2017): CiteScore 7.3 SJR 1.79 SNIP 1.572

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.42.000839

Source: Scopus

Source ID: 85013403108

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Spin-orbit interactions in optically active materials**

We investigate the inherent influence of light polarization on the intensity distribution in anisotropic media undergoing a local inhomogeneous rotation of the principal axes. Whereas, in general, such a configuration implies a complicated interaction between the geometric and the dynamic phase, we show that, in a medium showing an inhomogeneous circular birefringence, the geometric phase vanishes. Due to the spin-orbit interaction, the two circular polarizations perceive reversed spatial distribution of the dynamic phase. Based on this effect, polarization-selective lenses, waveguides, and beam deflectors are proposed.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Nonlinear Optics, Univ Porto, Universidade do Porto, Fac Med, Dept Med Imaging

Contributors: Jisha, C. P., Alberucci, A.

Number of pages: 4

Pages: 419-422

Publication date: 1 Feb 2017

Peer-reviewed: Yes

### Publication information

Journal: Optics Letters

Volume: 42

Issue number: 3

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2017): CiteScore 7.3 SJR 1.79 SNIP 1.572

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.42.000419

Source: Scopus

Source ID: 85011650203

Research output: Contribution to journal > Article > Scientific > peer-review

### Very high dose electron irradiation effects on photoluminescence from GaInNAs/GaAs quantum wells grown by molecular beam epitaxy

The effects of 7 MeV electron irradiation at very high doses of  $2 \times 10^{17}$  and  $1.5 \times 10^{18}$  electrons/cm<sup>2</sup> and subsequent rapid thermal annealing on photoluminescence from a strain-compensated GaInAsN/GaAsN/GaAs quantum well structure are investigated. A large additional blueshift of photoluminescence has been observed from the lower-dose irradiated sample as compared to the non-irradiated one when annealed after the irradiation. This additional blueshift will become considerably reduced by an ageing effect, which occurs already at room temperature. The mechanism causing the additional blueshift of photoluminescence and its reduction is qualitatively assigned to metastable complex defects promoted by electron irradiation in the nitrogen containing layers. No such additional blueshift of photoluminescence under the thermal treatment has been observed in the higher-dose irradiated sample.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, National Institute for Research and Development in Microtechnologies Romania, Faculty of Exact Sciences and Engineering, Hyperion University

Contributors: Pavelescu, E. M., Bălăţeanu, N., Spănulescu, S. I., Arola, E.

Number of pages: 5

Pages: 361-365

Publication date: 1 Feb 2017

Peer-reviewed: Yes

### Publication information

Journal: Optical Materials

Volume: 64

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2017): CiteScore 3.7 SJR 0.592 SNIP 1.054

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Science(all), Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Dilute nitrides, Electron irradiation, Photoluminescence

DOIs:

10.1016/j.optmat.2016.12.007

### Bibliographical note

EXT="Pavelescu, E. M."

Source: Scopus

Source ID: 85008334984

Research output: Contribution to journal > Article > Scientific > peer-review

### Polarization resolved photoluminescence in GaAs<sub>1-x</sub>Bi<sub>x</sub>/GaAs quantum wells

We have investigated polarization resolved photoluminescence (PL) of GaAs<sub>1-x</sub>Bi<sub>x</sub>/GaAs quantum wells (QWs) with different Bi concentrations in the dilute range ( $x < 10^{-2}$ ). The PL intensity of GaAs<sub>1-x</sub>Bi<sub>x</sub>/GaAs QWs increase with the increase of Bi concentration. Excitonic  $g_{ex}$ -factors of 4 and 10 were obtained at 15 T for as-grown GaAs<sub>1-x</sub>Bi<sub>x</sub>/GaAs QWs with 1.2% and 1.9% Bi concentration, respectively. These values evidence an important increase of electron and hole  $g$ -factors with the introduction of Bi in GaAs.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Universidade Federal de São Carlos, University of Nottingham, Universidade Federal de São Carlos

Contributors: Balanta, M. A. G., Orsi Gordo, V., Carvalho, A. R. H., Puustinen, J., Alghamdi, H. M., Henini, M., Galeti, H. V. A., Guina, M., Galvão Gobato, Y.

Number of pages: 4

Pages: 49-52

Publication date: Feb 2017

Peer-reviewed: Yes

Early online date: 13 Oct 2016

### Publication information

Journal: Journal of Luminescence

Volume: 182

ISSN (Print): 0022-2313

Ratings:

Scopus rating (2017): CiteScore 5 SJR 0.694 SNIP 1.074

Original language: English

ASJC Scopus subject areas: Biophysics, Chemistry(all), Atomic and Molecular Physics, and Optics, Biochemistry, Condensed Matter Physics

DOIs:

10.1016/j.jlumin.2016.10.008

Source: Scopus

Source ID: 84992707527

Research output: Contribution to journal > Article > Scientific > peer-review

### Architectures and codecs for real-time light field streaming

Light field 3D displays represent a major step forward in visual realism, providing glasses-free spatial vision of real or virtual scenes. Applications that capture and process live imagery have to process data captured by potentially tens to hundreds of cameras and control tens to hundreds of projection engines making up the human perceivable 3D light field using a distributed processing system. The associated massive data processing is difficult to scale beyond a specific number and resolution of images, limited by the capabilities of the individual computing nodes. The authors therefore analyze the bottlenecks and data flow of the light field conversion process and identify possibilities to introduce better scalability. Based on this analysis they propose two different architectures for distributed light field processing. To avoid using uncompressed video data all along the processing chain, the authors also analyze how the operation of the proposed architectures can be supported by existing image/video codecs.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: 3D MEDIA, Holografika, Nokia

Contributors: Kovács, P. T., Zare, A., Balogh, T., Bregovic, R., Gotchev, A.

Publication date: 1 Jan 2017

Peer-reviewed: Yes

### Publication information

Journal: Journal of Imaging Science and Technology

Volume: 61

Issue number: 1

Article number: 010403

ISSN (Print): 1062-3701

Ratings:

Scopus rating (2017): CiteScore 0.9 SJR 0.237 SNIP 0.718

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Chemistry(all), Atomic and Molecular Physics, and Optics, Computer Science Applications

Electronic versions:

Architectures and codecs for real-time 2017

DOIs:

10.2352/J.ImagingSci.Technol.2017.61.1.010403

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002282426>

Source: Scopus

Source ID: 85016298177

Research output: Contribution to journal > Article > Scientific > peer-review

### All-optical guided-wave random laser in nematic liquid crystals

Spatial solitons can affect and enhance random lasing in optically-pumped dye-doped nematic liquid crystals. Upon launching two collinear beams in the sample, the first to pump the fluorescent guest molecules and the second to induce a reorientational soliton, strikingly the second beam not only guides the emitted photons in the soliton waveguide, but also enhances the lasing efficiency and modulates its spectral width. By altering the scattering paths of the emitted photons, the soliton also contributes to the selection of the lasing modes, as further confirmed by the observed kinks in the input/output characteristics. These experimental results demonstrate that random lasing can be efficiently controlled by a light beam which does not interact with the gain molecules, opening a route towards light-controlled random lasers.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, University "Roma Tre", University of Southampton, United Kingdom, Case Western Reserve University, Nonlinear Optics and OptoElectronics Lab

Contributors: Perumbilavil, S., Piccardi, A., Buchnev, O., Kauranen, M., Strangi, G., Assanto, G.

Number of pages: 8

Pages: 4672-4679

Publication date: 2017

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 25

Issue number: 5

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2017): CiteScore 6.7 SJR 1.519 SNIP 1.562

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

oe-25-5-4672

DOIs:

10.1364/OE.25.004672

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712152387>

Source: Scopus

Source ID: 85014546572

Research output: Contribution to journal > Article > Scientific > peer-review

### Optimal control of photoelectron emission by realistic waveforms

Recent experimental techniques in multicolor waveform synthesis allow the temporal shaping of strong femtosecond laser pulses with applications in the control of quantum mechanical processes in atoms, molecules, and nanostructures.

Prediction of the shapes of the optimal waveforms can be done computationally using quantum optimal control theory. In this work we demonstrate the control of above-threshold photoemission of one-dimensional hydrogen model with pulses feasible for experimental waveform synthesis. By mixing different spectral channels and thus lowering the intensity requirements for individual channels, the resulting optimal pulses can extend the cutoff energies by at least up to 50% and bring up the electron yield by several orders of magnitude. Insights into the electron dynamics for optimized photoelectron emission are obtained with a semiclassical two-step model.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Computational Physics, Institute of Physics of the Academy of Sciences of the Czech Republic

Contributors: Solanpää, J., Ciappina, M. F., Räsänen, E.

Number of pages: 9

Pages: 1784-1792

Publication date: 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Modern Optics

Volume: 64

Issue number: 17

ISSN (Print): 0950-0340

Ratings:

Scopus rating (2017): CiteScore 2.3 SJR 0.41 SNIP 0.62

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: Above-threshold ionization, optimal control, waveforms

Electronic versions:

[optimal\\_control](#). Embargo ended: 26/04/18

DOIs:

[10.1080/09500340.2017.1317857](https://doi.org/10.1080/09500340.2017.1317857)

URLs:

<https://arxiv.org/abs/1607.03079>

<http://urn.fi/URN:NBN:fi:tty-201802121210>. Embargo ended: 26/04/18

Source: Scopus

Source ID: 85018191164

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Optimization of convectively cooled heat sinks

Many factors of heat sink, such as its size and mass, component locations, number of fins, and fan power affect heat transfer. Owing to the opposite effects of these factors on heat sink maximum temperature, we have now a multi-objective optimization problem. A typical optimization case consists of hundreds of heat sink temperature field evaluations, which would be impractical to do with CFD. Instead, we propose to combine analytical results of convection and numerical solution of conduction to address these so-called conjugated heat transfer problems. We solve heat conduction in a solid numerically using the finite volume method and tackle convection with the analytical equation of forced convection in a parallel plate channel. This model is suitable for forced and natural convection heat sinks, and we have verified its validity by comparing its results to measured data and CFD calculations. We use the model to improve two industrial examples, using a multi-objective version of the particle swarm optimization (PSO) algorithm. The first example is a forced convection heat sink composed of nine heat generating components at the base plate, and the other is a natural convection case with two components. In both cases, mass is minimized; the other criterion is maximum temperature for the forced convection case and heat sink outer volume for the natural convection case. Our method is many orders of magnitude faster than CFD. Additionally, we provide some LES results of pin fins with natural convection for further use in similar optimizations.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Mechanical Engineering and Industrial Systems

Contributors: Lampio, K., Karvinen, R.

Pages: 473-479

Publication date: 2017

Peer-reviewed: Yes

### Publication information

Journal: Microelectronics Reliability

Volume: 79

ISSN (Print): 0026-2714

Ratings:

Scopus rating (2017): CiteScore 2.6 SJR 0.388 SNIP 0.907

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Safety, Risk, Reliability and Quality, Surfaces, Coatings and Films, Electrical and Electronic Engineering

Keywords: Fin array, Forced convection, Heat sink, Multi-objective optimization, Natural convection, Pin fins

DOIs:

[10.1016/j.microrel.2017.06.011](https://doi.org/10.1016/j.microrel.2017.06.011)

Source: Scopus

Source ID: 85020690970

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **High-resolution coded-aperture design for compressive X-ray tomography using low resolution detectors**

One of the main challenges in Computed Tomography (CT) is obtaining accurate reconstructions of the imaged object while keeping a low radiation dose in the acquisition process. In order to solve this problem, several researchers have proposed the use of compressed sensing for reducing the amount of measurements required to perform CT. This paper tackles the problem of designing high-resolution coded apertures for compressed sensing computed tomography. In contrast to previous approaches, we aim at designing apertures to be used with low-resolution detectors in order to achieve super-resolution. The proposed method iteratively improves random coded apertures using a gradient descent algorithm subject to constraints in the coherence and homogeneity of the compressive sensing matrix induced by the coded aperture. Experiments with different test sets show consistent results for different transmittances, number of shots and super-resolution factors.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Signal Processing  
Contributors: Mojica, E., Pertuz, S., Arguello, H.  
Pages: 103-109  
Publication date: 2017  
Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Communications  
Volume: 404  
ISSN (Print): 0030-4018  
Ratings:  
Scopus rating (2017): CiteScore 3.5 SJR 0.614 SNIP 0.933  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Physical and Theoretical Chemistry, Electrical and Electronic Engineering  
Keywords: Coded apertures, Compressive sensing, Computed tomography, Super-resolution  
DOIs:  
10.1016/j.optcom.2017.06.053  
Source: Scopus  
Source ID: 85021667000  
Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Design of a 25 MWe Solar Thermal Power Plant in Iran with Using Parabolic Trough Collectors and a Two-Tank Molten Salt Storage System**

Nowadays, parabolic trough solar thermal plants are prevalent around the world. In different areas concerning the amount of solar radiation, their standard size is approximately between 20 and 100 MWe. Certainly, the right size of the solar field is the first selection with regard to nominal electrical power. A vast area will be economically unreasonable whereas a small area will mainly cause the power plant to operate at the part-load condition. This paper presents an economic modeling of a solar parabolic trough plant, operating at 25 MWe in Yazd, Iran. The varying types of collector dimensions have been investigated; then, by selecting autumnal equinox (22 September) at 12:00 PM as the design point, thermal performance of the solar power plant has been featured annually, in all conditions. The total operating time of the power plant is about 1726 hours (1248 hours in full-load condition). In the end, the effect of thermal storage tanks has been analyzed to save extra solar heat and use it at nights in hot months. By implementing a storage system, the total operating time will be increased to 3169 hours (2785 in full-load condition). Moreover, 7974 GJ useful thermal energy can be obtained from the solar field and storage system.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Automation and Hydraulic Engineering, University of Guilan  
Contributors: Kordmahaleh, A. A., Naghashzadegan, M., Javaherdeh, K., Khoshgoftar, M.  
Publication date: 2017  
Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Photoenergy  
Volume: 2017  
Article number: 4210184  
ISSN (Print): 1110-662X  
Ratings:  
Scopus rating (2017): CiteScore 2.8 SJR 0.341 SNIP 0.605

Original language: English

ASJC Scopus subject areas: Chemistry(all), Atomic and Molecular Physics, and Optics, Renewable Energy, Sustainability and the Environment, Materials Science(all)

Electronic versions:

4210184

DOIs:

10.1155/2017/4210184

URLs:

<http://urn.fi/URN:NBN:fi:tty-201801081036>

#### **Bibliographical note**

INT=aut,"Kordmahaleh, Aidin Alinezhad"

Source: Scopus

Source ID: 85038904387

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Fabrication of Ion-Shaped Anisotropic Nanoparticles and their Orientational Imaging by Second-Harmonic Generation Microscopy**

Ion beam shaping is a novel and powerful tool to engineer nanocomposites with effective three-dimensional (3D) architectures. In particular, this technique offers the possibility to precisely control the size, shape and 3D orientation of metallic nanoparticles at the nanometer scale while keeping the particle volume constant. Here, we use swift heavy ions of xenon for irradiation in order to successfully fabricate nanocomposites consisting of anisotropic gold nanoparticles that are oriented in 3D and embedded in silica matrix. Furthermore, we investigate individual nanorods using a nonlinear optical microscope based on second-harmonic generation (SHG). A tightly focused linearly or radially-polarized laser beam is used to excite nanorods with different orientations. We demonstrate high sensitivity of the SHG response for these polarizations to the orientation of the nanorods. The SHG measurements are in excellent agreement with the results of numerical modeling based on the boundary element method.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Nonlinear Optics, Optoelectronics Research Centre, Research group: Nanophotonics, Ecole Polytechnique, Laboratoire de Photonique et Nanostructures; CNRS, Marcoussis, France., 5Laboratoire de Physique des Solides CNRS/UMR8502, Bâtiment 510, University Paris-Sud, Orsay, 91405, France, 3Laboratoire des Solides Irradiés, Ecole Polytechnique, CEA/DRF/IRAMIS, CNRS, Université Paris-Saclay, Route de Saclay, 91128, Palaiseau, France., Université de Paris-Sud

Contributors: Slablab, A., Isotalo, T. J., Mäkitalo, J., Turquet, L., COULON, P., Niemi, T., Ulysse, C., Kociak, M., Mailly, D., Rizza, G., Kauranen, M.

Number of pages: 10

Publication date: 24 Nov 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Scientific Reports

Volume: 6

Issue number: 37469

Article number: 37469

ISSN (Print): 2045-2322

Ratings:

Scopus rating (2016): CiteScore 4.2 SJR 1.692 SNIP 1.364

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: optics, plasmonics, Nonlinear microscopy, IRRADIATION

Electronic versions:

slablab et al. 2016

DOIs:

10.1038/srep37469

URLs:

<http://urn.fi/URN:NBN:fi:tty-201612154861>

Research output: Contribution to journal > Article > Scientific > peer-review

### Frequency-doubled passively Q-switched microchip laser producing 225 ps pulses at 671 nm

We report a 671 nm laser source emitting 225 ps pulses with an average power of 55 mW and a repetition rate of 444 kHz. The system consists of a 1342 nm SESAM Q-switched Nd:YVO<sub>4</sub> microchip master oscillator and a dual-stage Nd:YVO<sub>4</sub> power amplifier. The 1342 nm signal was frequency-doubled to 671 nm using a periodically poled lithium niobate crystal. This laser source provides a practical alternative for applications requiring high energy picosecond pulses, such as time-gated Raman spectroscopy.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications

Contributors: Nikkinen, J., Korpijärvi, V., Leino, I., Härkönen, A., Guina, M.

Number of pages: 4

Pages: 5385-5388

Publication date: 15 Nov 2016

Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 41

Issue number: 22

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2016): CiteScore 6.8 SJR 1.769 SNIP 1.511

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.41.005385

Source: Scopus

Source ID: 84995663953

Research output: Contribution to journal > Article > Scientific > peer-review

### VECSEL systems for the generation and manipulation of trapped magnesium ions

Experiments in atomic, molecular, and optical (AMO) physics rely on lasers at many different wavelengths and with varying requirements on the spectral linewidth, power, and intensity stability. Vertical external-cavity surface-emitting lasers (VECSELs), when combined with nonlinear frequency conversion, can potentially replace many of the laser systems currently in use. Here, we present and characterize VECSEL systems that can perform all laser-based tasks for quantum information processing experiments with trapped magnesium ions. For the photoionization of neutral magnesium, 570.6 nm light is generated with an intracavity frequency-doubled VECSEL containing a lithium triborate crystal. External frequency doubling produces 285.3 nm light for a resonant interaction with the  $1S_0 \leftrightarrow 1P_1$  transition of neutral Mg. Using an externally frequency-quadrupled VECSEL, we implement Doppler cooling of Mg<sup>25+</sup> on the 279.6 nm  $2S_{1/2} \leftrightarrow 2P_{3/2}$  cycling transition, repumping on the 280.4 nm  $2S_{1/2} \leftrightarrow 2P_{1/2}$  transition, coherent state manipulation, and resolved sideband cooling close to the motional ground state. Our systems serve as prototypes for applications in AMO requiring single-frequency, power-scalable laser sources at multiple wavelengths.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, National Institute of Standards and Technology, Time and Frequency Division, Boulder, Colorado

Contributors: Burd, S., Allcock, D., Leinonen, T., Penttinen, J., Slichter, D., Srinivas, R., Wilson, A., Jördens, R., Guina, M., Leibfried, D., Wineland, D.

Number of pages: 6

Pages: 1294-1299

Publication date: 8 Nov 2016

Peer-reviewed: Yes

#### Publication information

Journal: Optica

Volume: 3

Issue number: 12

Article number: 268119

ISSN (Print): 2334-2536

Ratings:

Scopus rating (2016): CiteScore 6.9 SJR 4.761 SNIP 3.34



Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: Semiconductor lasers, Lasers, frequency doubled, Laser cooling, Quantum information and processing, Spectroscopy, high-resolution, Spectroscopy, trapped ion

DOIs:

10.1364/OPTICA.3.001294

Research output: Contribution to journal › Article › Scientific › peer-review

### **Adaptive multiresolution method for MAP reconstruction in electron tomography**

3D image reconstruction with electron tomography holds problems due to the severely limited range of projection angles and low signal to noise ratio of the acquired projection images. The maximum a posteriori (MAP) reconstruction methods have been successful in compensating for the missing information and suppressing noise with their intrinsic regularization techniques. There are two major problems in MAP reconstruction methods: (1) selection of the regularization parameter that controls the balance between the data fidelity and the prior information, and (2) long computation time. One aim of this study is to provide an adaptive solution to the regularization parameter selection problem without having additional knowledge about the imaging environment and the sample. The other aim is to realize the reconstruction using sequences of resolution levels to shorten the computation time. The reconstructions were analyzed in terms of accuracy and computational efficiency using a simulated biological phantom and publically available experimental datasets of electron tomography. The numerical and visual evaluations of the experiments show that the adaptive multiresolution method can provide more accurate results than the weighted back projection (WBP), simultaneous iterative reconstruction technique (SIRT), and sequential MAP expectation maximization (sMAPEM) method. The method is superior to sMAPEM also in terms of computation time and usability since it can reconstruct 3D images significantly faster without requiring any parameter to be set by the user.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, BioMediTech

Contributors: Acar, E., Peltonen, S., Ruotsalainen, U.

Number of pages: 11

Pages: 24-34

Publication date: 1 Nov 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Ultramicroscopy

Volume: 170

ISSN (Print): 0304-3991

Ratings:

Scopus rating (2016): CiteScore 5.5 SJR 1.896 SNIP 1.184

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Instrumentation

Keywords: Adaptive reconstruction, Electron tomography (ET), Maximum a posteriori (MAP) reconstruction, Missing wedge, Multiresolution reconstruction, Regularization parameter

DOIs:

10.1016/j.ultramic.2016.08.002

Source: Scopus

Source ID: 84981309739

Research output: Contribution to journal › Article › Scientific › peer-review

### **UPS and DFT investigation of the electronic structure of gas-phase trimesic acid**

Benzene-1,3,5-tricarboxylic acid (trimesic acid, TMA) molecules in gas-phase have been investigated by using valence band photoemission. The photoelectron spectrum in the binding energy region from 9 to 22 eV is interpreted based on the density functional theory calculations. The electronic configuration that makes contribution to each transition is demonstrated. Furthermore, electronic structure of TMA is compared with benzene and benzoic acid (BA) in order to demonstrate changes in molecular orbital energies induced by addition of carboxyl groups to benzene ring.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Surface Science, University of Tartu, MAX IV Laboratory, Lund University

Contributors: Reisberg, L., Pärna, R., Kikas, A., Kuusik, I., Kisand, V., Hirsimäki, M., Valden, M., Nömmiste, E.

Number of pages: 6  
Pages: 11-16  
Publication date: Nov 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Electron Spectroscopy and Related Phenomena  
Volume: 213  
ISSN (Print): 0368-2048  
Ratings:

Scopus rating (2016): CiteScore 3.2 SJR 0.852 SNIP 0.731

Original language: English

ASJC Scopus subject areas: Organic Chemistry, Atomic and Molecular Physics, and Optics

Keywords: trimesic acid, molecules, electronic structure, synchrotron radiation, MAX IV Laboratory, UPS, DFT, organic acids, gas-phase, spectroscopy, photoemission

Electronic versions:

Author's post-print accepted manuscript. Embargo ended: 18/10/18

DOIs:

10.1016/j.elspec.2016.10.004

URLs:

<http://urn.fi/URN:NBN:fi:tty-201612094854>. Embargo ended: 18/10/18

Research output: Contribution to journal > Article > Scientific > peer-review

#### RF measurements to pinpoint defects in inkjet-printed, thermally and mechanically stressed coplanar waveguides

In this work 10-GHz-band RF measurement and microscopy characterizations were performed on thermally and mechanically long-term-stressed coplanar waveguides (CPW) to observe electrical and mechanical degradation in 1-mm-thick PPO/PPE polymer substrates with inkjet-printed Ag conductors. The structure contained two different CPW geometries in a total of 18 samples with 250/270  $\mu\text{m}$  line widths/gaps and 670/180  $\mu\text{m}$  line widths/gaps. A reliability test was carried out with three sets. In set #1 three 250  $\mu\text{m}$  and three 670  $\mu\text{m}$  lines were stored in room temperature conditions and used as a reference. In set #2 six samples were thermally cycled (TC) for 10,000 cycles, and in set #3 six samples were thermally cycled and bent with 6 mm and 8 mm bending diameters. Thermal stressing was done by cycling the samples in a thermal cycling test chamber operating at 0/100  $^{\circ}\text{C}$  with 15-minutes rise, fall, and dwell times, resulting in a one-hour cycle. The samples were analyzed during cycling breaks using a vector network analyzer (VNA). In addition to optical microscopy, field emission scanning electron microscopy (FESEM) and atomic force microscopy (AFM) imaging were used to mechanically characterize the structures. The results showed that the line width of 670  $\mu\text{m}$  had better signal performance and better long-term reliability than the line width of 250  $\mu\text{m}$ . In this study, the average limit for proper RF operation was 2500 thermal cycles with both line geometries. The wide CPW lines provided more stable characteristics than the narrow CPW lines for the whole 10,000-cycle duration of the test, combined with repeated bending with a maximum bending radius of 6 mm. A phenomenon of nanoparticle silver protruding from cracks in the print of the bent samples was observed, as well as fracturing of the silver print in the CPW lines.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Microelectronics Research, University of Oulu, Tampere University of Applied Sciences

Contributors: Myllymäki, S., Putaala, J., Hannu, J., Kunnari, E., Mäntysalo, M.

Number of pages: 9

Pages: 142-150

Publication date: 1 Oct 2016

Peer-reviewed: Yes

#### Publication information

Journal: Microelectronics Reliability

Volume: 65

ISSN (Print): 0026-2714

Ratings:

Scopus rating (2016): CiteScore 2.6 SJR 0.447 SNIP 0.991

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Safety, Risk, Reliability and Quality, Surfaces, Coatings and Films, Electrical and Electronic Engineering

DOIs:

10.1016/j.microrel.2016.08.021

### Bibliographical note

EXT="Kunnari, Esa"

EXT="Myllymäki, Sami"

Source: Scopus

Source ID: 84992618636

Research output: Contribution to journal > Article > Scientific > peer-review

### General polarizability and hyperpolarizability estimators for the path-integral Monte Carlo method applied to small atoms, ions, and molecules at finite temperatures

The nonlinear optical properties of matter have a broad relevance and many methods have been invented to compute them from first principles. However, the effects of electronic correlation, finite temperature, and breakdown of the Born-Oppenheimer approximation have turned out to be challenging and tedious to model. Here we propose a straightforward approach and derive general field-free polarizability and hyperpolarizability estimators for the path-integral Monte Carlo method. The estimators are applied to small atoms, ions, and molecules with one or two electrons. With the adiabatic, i.e., Born-Oppenheimer, approximation we obtain accurate tensorial ground state polarizabilities, while the nonadiabatic simulation adds in considerable rovibrational effects and thermal coupling. In both cases, the 0 K, or ground-state, limit is in excellent agreement with the literature. Furthermore, we report here the internal dipole moment of PsH molecule, the temperature dependence of the polarizabilities of H<sup>-</sup>, and the average dipole polarizabilities and the ground-state hyperpolarizabilities of HeH<sup>+</sup> and H<sub>3</sub><sup>+</sup>.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Semiconductor Technology and Applications, Research area:

Computational Physics, Research group: Electronic Structure Theory

Contributors: Tiihonen, J., Kylänpää, I., Rantala, T. T.

Number of pages: 8

Publication date: 26 Sep 2016

Peer-reviewed: Yes

### Publication information

Journal: Physical Review A

Volume: 94

Issue number: 3

Article number: 032515

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2016): CiteScore 6.7 SJR 1.482 SNIP 1.02

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.94.032515

Additional files:

Reprint

Source: Scopus

Source ID: 84989247221

Research output: Contribution to journal > Article > Scientific > peer-review

### Semiclassical two-step model for strong-field ionization

We present a semiclassical two-step model for strong-field ionization that accounts for path interferences of tunnel-ionized electrons in the ionic potential beyond perturbation theory. Within the framework of a classical trajectory Monte Carlo representation of the phase-space dynamics, the model employs the semiclassical approximation to the phase of the full quantum propagator in the exit channel. By comparison with the exact numerical solution of the time-dependent Schrödinger equation for strong-field ionization of hydrogen, we show that for suitable choices of the momentum distribution after the first tunneling step, the model yields good quantitative agreement with the full quantum simulation. The two-dimensional photoelectron momentum distributions, the energy spectra, and the angular distributions are found to be in good agreement with the corresponding quantum results. Specifically, the model quantitatively reproduces the fanlike interference patterns in the low-energy part of the two-dimensional momentum distributions, as well as the modulations in the photoelectron angular distributions.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Quantum Control and Dynamics, Research area: Computational Physics, Leibniz-Universität Hannover, Aarhus Universitet, TU Vienna, Hungarian Academy of Sciences, IAFE (UBA-

Conicet), ELI-HU Nonprofit Ltd.

Contributors: Shvetsov-Shilovski, N. I., Lein, M., Madsen, L. B., Räsänen, E., Lemell, C., Burgdörfer, J., Arbó, D. G., Tokési, K.

Publication date: 19 Jul 2016

Peer-reviewed: Yes

#### Publication information

Journal: Physical Review A

Volume: 94

Issue number: 1

Article number: 013415

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2016): CiteScore 6.7 SJR 1.482 SNIP 1.02

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.94.013415

URLs:

<https://arxiv.org/abs/1604.05123v1>

Source: Scopus

Source ID: 84978906019

Research output: Contribution to journal > Article > Scientific > peer-review

#### Nonlocal soliton scattering in random potentials

We experimentally investigate the transport behaviour of nonlocal spatial optical solitons when launched in and interacting with propagation-invariant random potentials. The solitons are generated in nematic liquid crystals; the randomness is created by suitably engineered illumination of planar voltage-biased cells equipped with a photosensitive wall. We find that the fluctuations follow a super-diffusive trend, with the mean square displacement lowering for decreasing spatial correlation of the noise.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, University "Roma Tre", CNRS, Nonlinear Optics and OptoElectronics Lab, Optics Laboratory, Department of Physics, Tampere University of Technology

Contributors: Piccardi, A., Residori, S., Assanto, G.

Number of pages: 5

Publication date: 1 Jul 2016

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Optics

Volume: 18

Issue number: 7

Article number: 07LT01

ISSN (Print): 2040-8978

Ratings:

Scopus rating (2016): CiteScore 3.4 SJR 0.715 SNIP 0.829

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: liquid crystals, nematicons, random potential, scattering, spatial solitons

DOIs:

10.1088/2040-8978/18/7/07LT01

Source: Scopus

Source ID: 84978954030

Research output: Contribution to journal > Article > Scientific > peer-review

#### Electronically tunable thulium-holmium modelocked fiber laser for the 1700-1800 nm wavelength band

We demonstrate a widely tunable, mode-locked fiber laser capable of producing sub-picosecond pulses between 1705 and 1805 nm. The 100 nm tuning range is achieved by using intracavity acousto-optic tunable filter. The laser delivers highly stable pulses via self-starting hybrid mode-locking triggered by frequency-shifting and nonlinear polarization evolution.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers  
Contributors: Noronen, T., Okhotnikov, O., Gumenyuk, R.  
Number of pages: 6  
Pages: 14703-14708  
Publication date: 27 Jun 2016  
Peer-reviewed: Yes

### Publication information

Journal: Optics Express  
Volume: 24  
Issue number: 13  
ISSN (Print): 1094-4087  
Ratings:  
Scopus rating (2016): CiteScore 6.7 SJR 1.532 SNIP 1.528  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OE.24.014703  
Source: Scopus  
Source ID: 84977638649  
Research output: Contribution to journal › Article › Scientific › peer-review

### Robust statistical approaches for RSS-based floor detection in indoor localization

Floor detection for indoor 3D localization of mobile devices is currently an important challenge in the wireless world. Many approaches currently exist, but usually the robustness of such approaches is not addressed or investigated. The goal of this paper is to show how to robustify the floor estimation when probabilistic approaches with a low number of parameters are employed. Indeed, such an approach would allow a building-independent estimation and a lower computing power at the mobile side. Four robustified algorithms are to be presented: a robust weighted centroid localization method, a robust linear trilateration method, a robust nonlinear trilateration method, and a robust deconvolution method. The proposed approaches use the received signal strengths (RSS) measured by the Mobile Station (MS) from various heardWiFi access points (APs) and provide an estimate of the vertical position of the MS, which can be used for floor detection. We will show that robustification can indeed increase the performance of the RSS-based floor detection algorithms.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Electronics and Communications Engineering, Research group: Wireless Communications and Positioning  
Contributors: Razavi, A., Valkama, M., Lohan, E. S.  
Publication date: 1 Jun 2016  
Peer-reviewed: Yes

### Publication information

Journal: Sensors  
Volume: 16  
Issue number: 6  
Article number: 793  
ISSN (Print): 1424-8220  
Ratings:  
Scopus rating (2016): CiteScore 4.1 SJR 0.623 SNIP 1.629  
Original language: English  
ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Analytical Chemistry, Biochemistry  
Keywords: Floor detection, Indoor localization, Robust regression, RSS-based localization, Trilateration, Weighted centroid localization  
Electronic versions:  
sensors-16-00793  
DOIs:  
10.3390/s16060793  
URLs:  
<http://urn.fi/URN:NBN:fi:tty-201606204285>

Source: Scopus

Source ID: 84971596811

Research output: Contribution to journal › Article › Scientific › peer-review

### Roadmap on optical rogue waves and extreme events

The pioneering paper 'Optical rogue waves' by Solli et al (2007 Nature 450 1054) started the new subfield in optics. This work launched a great deal of activity on this novel subject. As a result, the initial concept has expanded and has been enriched by new ideas. Various approaches have been suggested since then. A fresh look at the older results and new discoveries has been undertaken, stimulated by the concept of 'optical rogue waves'. Presently, there may not be a unique view on how this new scientific term should be used and developed. There is nothing surprising when the opinion of the experts diverge in any new field of research. After all, rogue waves may appear for a multiplicity of reasons and not necessarily only in optical fibers and not only in the process of supercontinuum generation. We know by now that rogue waves may be generated by lasers, appear in wide aperture cavities, in plasmas and in a variety of other optical systems. Theorists, in turn, have suggested many other situations when rogue waves may be observed. The strict definition of a rogue wave is still an open question. For example, it has been suggested that it is defined as 'an optical pulse whose amplitude or intensity is much higher than that of the surrounding pulses'. This definition (as suggested by a peer reviewer) is clear at the intuitive level and can be easily extended to the case of spatial beams although additional clarifications are still needed. An extended definition has been presented earlier by N Akhmediev and E Pelinovsky (2010 Eur. Phys. J. Spec. Top. 185 1-4). Discussions along these lines are always useful and all new approaches stimulate research and encourage discoveries of new phenomena. Despite the potentially existing disagreements, the scientific terms 'optical rogue waves' and 'extreme events' do exist. Therefore coordination of our efforts in either unifying the concept or in introducing alternative definitions must be continued. From this point of view, a number of the scientists who work in this area of research have come together to present their research in a single review article that will greatly benefit all interested parties of this research direction. Whether the authors of this 'roadmap' have similar views or different from the original concept, the potential reader of the review will enrich their knowledge by encountering most of the existing views on the subject. Previously, a special issue on optical rogue waves (2013 J. Opt. 15 060201) was successful in achieving this goal but over two years have passed and more material has been published in this quickly emerging subject. Thus, it is time for a roadmap that may stimulate and encourage further research.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Australian National University, Université de Bourgogne Franche-Comté, Università degli Studi di Brescia, Texas A and M University at Qatar, Shunde Polytechnic, Xi'an Jiaotong University, CSIC - Instituto de Óptica Daza de Valdeals (IO), CRPP, Universidad Adolfo Ibáñez, Université libre de Bruxelles (ULB), Vrije Universiteit Brussel, Université Lille 1, Université de Franche-Comté, Leibniz-Universität Hannover, Weierstrass-Institut für Angewandte Analysis und Stochastik, Max Born Institute, Universitat Politècnica de Catalunya, The University of Auckland, Dodd-Walls Centre for Photonic and Quantum Technologies, CNRS, CNR-INO

Contributors: Akhmediev, N., Kibler, B., Baronio, F., BeliĆ, M., Zhong, W. P., Zhang, Y., Chang, W., Soto-Crespo, J. M., Vouzas, P., Grelu, P., Lecaplain, C., Hammani, K., Rica, S., Picozzi, A., Tlidi, M., Panajotov, K., Mussot, A., Bendahmane, A., Szriftgiser, P., Genty, G., Dudley, J., Kudlinski, A., Demircan, A., Morgner, U., Amiranashvili, S., Bree, C., Steinmeyer, G., Masoller, C., Broderick, N. G. R., Runge, A. F. J., Erkintalo, M., Residori, S., Bortolozzo, U., Arecchi, F. T., Wabnitz, S., Tiofack, C. G., Coulibaly, S., Taki, M.

Publication date: 1 Jun 2016

Peer-reviewed: Yes

### Publication information

Journal: Journal of Optics

Volume: 18

Issue number: 6

Article number: 063001

ISSN (Print): 2040-8978

Ratings:

Scopus rating (2016): CiteScore 3.4 SJR 0.715 SNIP 0.829

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: extreme events, nonlinear optics, rogue waves

DOIs:

10.1088/2040-8978/18/6/063001

### Bibliographical note

EXT="Steinmeyer, Günter"

EXT="Erkintalo, Miro"

Source: Scopus

Source ID: 84975818584

### **Vortex stabilization by means of spatial solitons in nonlocal media**

We investigate how optical vortices, which tend to be azimuthally unstable in local nonlinear materials, can be stabilized by a copropagating coaxial spatial solitary wave in nonlocal, nonlinear media. We focus on the formation of nonlinear vortex-soliton vector beams in reorientational soft matter, namely nematic liquid crystals, and report on experimental results, as well as numerical simulations.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics

Contributors: Izdebskaya, Y., Krolikowski, W., Smyth, N. F., Assanto, G.

Publication date: 1 May 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Optics

Volume: 18

Issue number: 5

Article number: 054006

ISSN (Print): 2040-8978

Ratings:

Scopus rating (2016): CiteScore 3.4 SJR 0.715 SNIP 0.829

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: liquid crystals, optical vortex, self-action effects, spatial solitons

DOIs:

10.1088/2040-8978/18/5/054006

Source: Scopus

Source ID: 84969245814

Research output: Contribution to journal › Article › Scientific › peer-review

### **Temporal coherence characterization of supercontinuum pulse trains using Michelson's interferometer**

Temporal coherence properties of supercontinuum pulse trains generated in nonlinear fibers are analyzed within the framework of the second-order coherence theory of nonstationary light. Time-resolved Michelson's interference patterns are simulated, from which the full two-time mutual coherence function can (at least in principle) be determined experimentally. Standard time-integrated Michelson's interferograms are also simulated and shown to provide a rough estimate for the coherence time of the quasi-stationary contribution. A simple but illustrative analytical model representing supercontinuum pulse trains is presented, and numerically simulated realizations of such pulse trains are considered.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Nonlinear Fiber Optics, Research area: Optics

Contributors: Dutta, R., Turunen, J., Genty, G., Friberg, A. T.

Pages: B72-B77

Publication date: 20 Apr 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Applied Optics

Volume: 55

Issue number: 12

ISSN (Print): 1559-128X

Ratings:

Scopus rating (2016): CiteScore 3.1 SJR 0.695 SNIP 1.17

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/AO.55.000B72

Source: Scopus

Source ID: 84964414579

Research output: Contribution to journal › Article › Scientific › peer-review

### **Detection of single microparticles in airflows by edge-filter enhanced self-mixing interferometry**

A laser Doppler velocimetry (LDV) sensor using the edge-filter enhanced self-mixing interferometry (ESMI) is presented based on speed measurements of single microparticles. The ESMI detection utilizes an acetylene edge-filter that maps the frequency modulation of a semiconductor laser into an intensity modulation as the laser wavelength is tuned to the steep edge of the absorption profile. In this work, the ESMI signal was analyzed for aerosol particles of different sizes from 1  $\mu\text{m}$  to 10  $\mu\text{m}$  at a distance of 2.5 m. At this operation range, the signal from single particles of all sizes was successfully acquired enabling particle velocity measurements through the Doppler shifted frequency along the beam axis. For the particular case of 10  $\mu\text{m}$  particles, single aerosol particles were still detected at an unprecedented range of 10 m. A theoretical treatment describing the relation between Mie scattering theory and the self-mixing phenomenon on single-particle detection is presented supporting the experimental results. The results show that the edge-filter enhanced self-mixing technique opens new possibilities for self-mixing detection where longer ranges, lower backscattering laser powers and higher velocities are involved. For example, it can be used as a robust and inexpensive anemometer for LDV applications for airflows with low-number density of microparticles.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics, Vaisala Oyj

Contributors: Contreras, V., Lönnqvist, J., Toivonen, J.

Number of pages: 9

Pages: 8886-8894

Publication date: 18 Apr 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 24

Issue number: 8

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2016): CiteScore 6.7 SJR 1.532 SNIP 1.528

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.24.008886

Source: Scopus

Source ID: 84964575559

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Microwave assisted laser-induced breakdown spectroscopy at ambient conditions**

Signal enhancements in laser-induced breakdown spectroscopy (LIBS) using external microwave power are demonstrated in ambient air. Pulsed microwave at 2.45 GHz and of 1 millisecond duration was delivered via a simple near field applicator (NFA), with which an external electric field is generated and coupled into laser induced plasma. The external microwave power can significantly increase the signal lifetime from a few microseconds to hundreds of microseconds, resulting in a great enhancement on LIBS signals with the use of a long integration time. The dependence of signal enhancement on laser energy and microwave power is experimentally assessed. With the assistance of microwave source, a significant enhancement of  $\sim 100$  was achieved at relatively low laser energy that is only slightly above the ablation threshold. A limit of detection (LOD) of 8.1 ppm was estimated for copper detection in  $\text{Cu}/\text{Al}_2\text{O}_3$  solid samples. This LOD corresponds to a 93-fold improvement compared with conventional single-pulse LIBS. Additionally, in the microwave assisted LIBS, the self-reversal effect was greatly reduced, which is beneficial in measuring elements of high concentration. Temporal measurements have been performed and the results revealed the evolution of the emission process in microwave-enhanced LIBS. The optimal position of the NFA related to the ablation point has also been investigated.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics, Optics Laboratory, Department of Physics, Tampere University of Technology, University of Adelaide

Contributors: Viljanen, J., Sun, Z., Alwahabi, Z. T.

Number of pages: 8

Pages: 29-36

Publication date: 1 Apr 2016



Peer-reviewed: Yes

### Publication information

Journal: Spectrochimica Acta Part B: Atomic Spectroscopy

Volume: 118

ISSN (Print): 0584-8547

Ratings:

Scopus rating (2016): CiteScore 5.3 SJR 1.095 SNIP 1.351

Original language: English

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics, Analytical Chemistry, Spectroscopy

Keywords: Copper Detection, Laser-induced breakdown spectroscopy, Microwave signal enhancement

DOIs:

10.1016/j.sab.2016.02.002

Source: Scopus

Source ID: 84962861465

Research output: Contribution to journal › Article › Scientific › peer-review

### Validity of power functionals for a homogeneous electron gas in reduced-density-matrix-functional theory

Physically valid and numerically efficient approximations for the exchange and correlation energy are critical for reduced-density-matrix-functional theory to become a widely used method in electronic structure calculations. Here we examine the physical limits of power functionals of the form  $f(n,n')=(nn')^\alpha$  for the scaling function in the exchange-correlation energy. To this end we obtain numerically the minimizing momentum distributions for the three- and two-dimensional homogeneous electron gas, respectively. In particular, we examine the limiting values for the power  $\alpha$  to yield physically sound solutions that satisfy the Lieb-Oxford lower bound for the exchange-correlation energy and exclude pinned states with the condition  $n(k)$

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, University of Missouri-Columbia, JENOPTIK Optical Systems GmbH, Nanoscience Center, University of Jyväskylä

Contributors: Putaja, A., Eich, F. G., Baldsiefen, T., Räsänen, E.

Publication date: 10 Mar 2016

Peer-reviewed: Yes

### Publication information

Journal: Physical Review A

Volume: 93

Issue number: 3

Article number: 032503

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2016): CiteScore 6.7 SJR 1.482 SNIP 1.02

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.93.032503

### Bibliographical note

INT=fys,"Putaja, A."

Source: Scopus

Source ID: 84961714989

Research output: Contribution to journal › Article › Scientific › peer-review

### Super-resolution in a defocused plenoptic camera: a wave-optics-based approach

Plenoptic cameras enable the capture of a light field with a single device. However, with traditional light field rendering procedures, they can provide only low-resolution two-dimensional images. Super-resolution is considered to overcome this drawback. In this study, we present a superresolution method for the defocused plenoptic camera (Plenoptic 1.0), where the imaging system is modeled using wave optics principles and utilizing low-resolution depth information of the scene. We are particularly interested in super-resolution of in-focus and near in-focus scene regions, which constitute the most challenging cases. The simulation results show that the employed wave-optics model makes super-resolution possible for such regions as long as sufficiently accurate depth information is available.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Signal Processing, Research group: 3D MEDIA  
Contributors: Sahin, E., Katkovnik, V., Gotchev, A.  
Number of pages: 4  
Pages: 998-1001  
Publication date: 1 Mar 2016  
Peer-reviewed: Yes

### Publication information

Journal: Optics Letters  
Volume: 41  
Issue number: 5  
ISSN (Print): 0146-9592  
Ratings:  
Scopus rating (2016): CiteScore 6.8 SJR 1.769 SNIP 1.511  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OL.41.000998  
Source: Scopus  
Source ID: 84961616493  
Research output: Contribution to journal › Article › Scientific › peer-review

### Machine-to-machine communications over FiWi enhanced LTE networks: A power-saving framework and end-to-end performance

To cope with the unprecedented acceleration of machine-to-machine (M2M) services over cellular networks, this paper envisions a highly converged network architecture based on the integration of high-capacity and reliable Ethernet fiber-wireless (FiWi) access networks with flexible and cost-effective 4G long term evolution (LTE) technology to support M2M connectivity in an end-to-end fashion, i.e., from air interface to transport (backhaul) network. In such emerging architecture, energy efficiency must be addressed in a comprehensive way, in which both wireless front-end and optical backhaul segments are considered at the same time to maximize the battery life of battery-constrained M2M devices as well as reduce operational expenditures for network operators, while maintaining acceptable network performance. Toward this end, an end-to-end power-saving framework is introduced in this paper that devises a timeout driven discontinuous reception (DRX) mechanism for LTE-enabled M2M devices and a polling-based power-saving mechanism for optical network units (ONUs) to improve the overall energy efficiency. End-to-end performance in terms of energy saving and packet delay is analytically modeled based on a semi-Markov process for the front-end and an M/G/1 queue for the backhaul. The obtained results indicate that the device battery life is significantly prolonged by extending the DRX cycle, whereas the backhaul energy consumption is minimized by incorporating the ONU power-saving modes into the dynamic bandwidth allocation process of the optical backhaul.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Electronics and Communications Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Surface and Corrosion Science, Institut National de la Recherche Scientifique, Ericsson Research  
Contributors: Van, D. P., Rimal, B. P., Andreev, S., Tirronen, T., Maier, M.  
Number of pages: 10  
Pages: 1062-1071  
Publication date: 15 Feb 2016  
Peer-reviewed: Yes

### Publication information

Journal: Journal of Lightwave Technology  
Volume: 34  
Issue number: 4  
ISSN (Print): 0733-8724  
Ratings:  
Scopus rating (2016): CiteScore 6.8 SJR 1.23 SNIP 1.818  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Keywords: Discontinuous reception (DRX), energy efficiency, Fiber-Wireless (FiWi), M2M communications, ONU sleep  
DOIs:  
10.1109/JLT.2015.2510358

Source: Scopus

Source ID: 84961918904

Research output: Contribution to journal › Article › Scientific › peer-review

### High-power temperature-stable GaInNAs distributed Bragg reflector laser emitting at 1180 nm

We report a single-mode 1180 nm distributed Bragg reflector (DBR) laser diode with a high output power of 340 mW. For the fabrication, we employed novel nanoimprint lithography that ensures cost-effective, large-area, conformal patterning and does not require regrowth. The output characteristics exhibited outstanding temperature insensitivity with a power drop of only 30% for an increase of the mount temperature from 20°C to 80°C. The high temperature stability was achieved by using GaInNAs/GaAs quantum wells (QWs), which exhibit improved carrier confinement compared to standard InGaAs/GaAs QWs. The corresponding characteristic temperatures were  $T_0 = 110$  K and  $T_1 = 160$  K. Moreover, we used a large detuning between the peak wavelength of the material gain at room temperature and the lasing wavelength determined by the DBR. In addition to good temperature characteristics, GaInNAs/GaAs QWs exhibit relatively low lattice strain with direct impact on improving the lifetime of laser diodes at this challenging wavelength range. The single-mode laser emission could be tuned by changing the mount temperature (0.1 nm/°C) or the drive current (0.5 pm/mA). The laser showed no degradation in a room-temperature lifetime test at 900 mA drive current. These compact and efficient 1180 nm laser diodes are instrumental for the development of compact frequency-doubled yellow - orange lasers, which have important applications in medicine and spectroscopy.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Nanophotonics

Contributors: Korpijärvi, V., Viheriälä, J., Koskinen, M., Aho, A. T., Guina, M.

Number of pages: 4

Pages: 657-660

Publication date: 15 Feb 2016

Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 41

Issue number: 4

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2016): CiteScore 6.8 SJR 1.769 SNIP 1.511

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.41.000657

#### Bibliographical note

INT=orc,"Koskinen, Mervi"

INT=orc,"Aho, Antti T."

Source: Scopus

Source ID: 84962091445

Research output: Contribution to journal › Article › Scientific › peer-review

### Optimization of light field display-camera configuration based on display properties in spectral domain

The visualization capability of a light field display is uniquely determined by its angular and spatial resolution referred to as display passband. In this paper we use a multidimensional sampling model for describing the display-camera channel. Based on the model, for a given display passband, we propose a methodology for determining the optimal distribution of ray generators in a projection-based light field display. We also discuss the required camera setup that can provide data with the necessary amount of details for such display that maximizes the visual quality and minimizes the amount of data.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: 3D MEDIA, Holografika

Contributors: Bregovic, R., Kovács, P., Gotchev, A.

Number of pages: 22

Pages: 3067-3088

Publication date: 8 Feb 2016

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 24

Issue number: 3

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2016): CiteScore 6.7 SJR 1.532 SNIP 1.528

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.24.003067

Source: Scopus

Source ID: 84962300926

Research output: Contribution to journal > Article > Scientific > peer-review

#### Effects of insertion of strain-engineering Ga(In)NAs layers on optical properties of InAs/GaAs quantum dots for high-efficiency solar cells

We report study on stacked InAs/GaNAs quantum dots heterostructures with dilute nitride GaInNAs strain mediating layers embedded in GaAs p-i-n solar cell structure. The insertion of GaInNAs strain mediating layers in the vicinity of the strain compensated InAs/GaNAs quantum dots heterostructures enhances their surface density, improves and significantly red shifts their light emission. Embedding a stack of the strain-mediated InAs/GaInNAs/GaNAs quantum dots in the i region of a GaAs p-i-n solar cell leads also to a red shift of the absorption edge of the solar cells and improves the solar cell photogenerated currents at longer wavelengths beyond 1200 nm.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, National Institute for Research and Development in Microtechnologies Romania, Faculty of Exact Sciences and Engineering, Hyperion University

Contributors: Pavelescu, E., Polojärvi, V., Schramm, A., Tukiainen, A., Aho, A., Zhang, W., Puustinen, J., Salmi, J., Guina, M.

Number of pages: 4

Pages: 177-180

Publication date: 1 Feb 2016

Peer-reviewed: Yes

#### Publication information

Journal: Optical Materials

Volume: 52

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2016): CiteScore 3.8 SJR 0.636 SNIP 1.061

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Computer Science(all)

Keywords: Dilute nitrides, Molecular beam epitaxy, Optical properties

DOIs:

10.1016/j.optmat.2015.12.035

#### Bibliographical note

EXT="Pavelescu, Emil-Mihai"

Source: Scopus

Source ID: 84959293536

Research output: Contribution to journal > Article > Scientific > peer-review

#### Ghost imaging in the time domain

Ghost imaging is a novel technique that produces the image of an object by correlating the intensity of two light beams, neither of which independently carries information about the shape of the object. Ghost imaging has opened up new perspectives to obtain highly resolved images, even in the presence of noise and turbulence. Here, by exploiting the duality between light propagation in space and time, we demonstrate the temporal analogue of ghost imaging. We use a conventional fast detector that does not see the temporal 'object' to be characterized and a slow integrating 'bucket' detector that does see the object but without resolving its temporal structure. Our experiments achieve temporal resolution

at the picosecond level and are insensitive to the temporal distortion that may occur after the object. The approach is scalable, can be integrated on-chip, and offers great promise for dynamic imaging of ultrafast waveforms.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Nonlinear Fiber Optics

Contributors: Ryczkowski, P., Barbier, M., Friberg, A. T., Dudley, J. M., Genty, G.

Number of pages: 4

Pages: 167-170

Publication date: 1 Feb 2016

Peer-reviewed: Yes

#### Publication information

Journal: Nature Photonics

Issue number: 10

ISSN (Print): 1749-4885

Ratings:

Scopus rating (2016): CiteScore 61 SJR 15.689 SNIP 9.052

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

DOIs:

10.1038/nphoton.2015.274

Source: Scopus

Source ID: 84957042861

Research output: Contribution to journal › Article › Scientific › peer-review

#### Effect of the glass melting condition on the processing of phosphate-based glass-ceramics with persistent luminescence properties

In this paper, we discuss the impact of the temperature and the duration of the melting on the persistent luminescence properties of phosphate glasses within the  $P_2O_5$ - $Na_2O$ - $CaO$  and  $P_2O_5$ - $Na_2O$ - $SrO$  systems prepared using a standard melting process in normal atmosphere by adding  $Sr_4Al_{14}O_{25}:Eu^{2+}, Dy^{3+}$  microparticles in the glass batch before melting. Glasses with persistent luminescence properties can be successfully prepared if the melting conditions are carefully controlled.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue

Engineering Group, Abo Akad Univ, Abo Akademi University, Dept Phys, Academy of Sciences, Turun Yliopisto/Turun Biomateriaalikeskus, University of Turku, University of São Paulo

Contributors: Massera, J., Gaussiran, M., Gluchowski, P., Lastusaari, M., Petit, L., Hölsä, J., Hupa, L.

Number of pages: 6

Pages: 56-61

Publication date: 1 Feb 2016

Peer-reviewed: Yes

#### Publication information

Journal: Optical Materials

Volume: 52

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2016): CiteScore 3.8 SJR 0.636 SNIP 1.061

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Computer Science(all)

Keywords: Energy dispersive analysis of X-rays (EDS or EDAX), Glasses, Heat treatment, Luminescence

DOIs:

10.1016/j.optmat.2015.12.006

Source: Scopus

Source ID: 84959313726

Research output: Contribution to journal › Article › Scientific › peer-review

### **Analysis of single mass-regulated particles in precisely controlled trap using laser-induced breakdown spectroscopy**

We report the influence of water content, droplet displacement and laser fluence on the laser-induced breakdown spectroscopy (LIBS) signal of precisely controlled single droplets. For the first time in single particle LIBS scheme, the degree of evaporation of an additive-free droplet was followed and the position of the residual particle was adjusted at micrometer resolution using electrodynamic trapping. The results show signal intensification throughout the 6 s period of the complete evaporation of the droplet into a dry residual particle. The analyte line emission remained stable when the particle was moved within the focal spot area and almost tenfold compared with situation where the particle lies 15  $\mu\text{m}$  outside the laser beam path. Combination of low, about 6 mJ, excitation laser pulse energy and short, about 1  $\mu\text{s}$  detection delay time was found to be the optimal in the detection of most metals. The presented findings will pave the way for more sensitive and reproducible single particle elemental analysis exploited in the real-time monitoring of water, atmospheric aerosols or industrial emissions.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics

Contributors: Järvinen, S. T., Toivonen, J.

Number of pages: 10

Pages: 1314-1323

Publication date: 25 Jan 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 24

Issue number: 2

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2016): CiteScore 6.7 SJR 1.532 SNIP 1.528

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.24.001314

Source: Scopus

Source ID: 84962263849

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **High performance corrosion resistant coatings by novel coaxial cold- and hot-wire laser cladding methods**

In the last few years, coaxial laser heads have been developed with centric wire feeding equipment, which enables the laser processing of complex-shaped objects in various applications. These newly developed laser heads are being used particularly in laser brazing experiments in the automotive industry. This study presents experimental results of using a coaxial laser head for cold- and hot-wire cladding application. The coaxial wire cladding method has significant improvements compared with the off-axis wire cladding method such as independence of the travel direction, alignment of the wire to the laser beam, and a reduced number of controlling parameters. These features are important to achieve high quality coatings. Cladding tests were conducted on mild steel with a coaxial laser wire welding head using Ni-based Inconel 625 and Thermanit 2509 super duplex stainless steel solid wires in order to determine the properties of the cladding process and the coatings deposited. The corrosion resistance of the obtained coatings was examined by long-term acetic acid salt spray (AASS) and electrochemical critical pitting temperature tests. The test results showed that by using the coaxial wire cladding method, defect-free high quality and corrosion resistant Inconel 625 and super duplex stainless steel coatings with low dilution were achieved. The average pitting temperature for Thermanit 2509 duplex coating was 75  $^{\circ}\text{C}$  in 1M NaCl solution, which was comparable to wrought 2507 duplex stainless steel. Low diluted Inconel 625 coating survived the AASS test for 2000 h without signs of corrosion.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Surface Engineering, Tampere University of Technology, Technology Centre Ketek Ltd.

Contributors: Pajukoski, H., Näkki, J., Thieme, S., Tuominen, J., Nowotny, S., Vuoristo, P.

Publication date: 2016

Peer-reviewed: Yes

Early online date: 8 Dec 2015

#### **Publication information**

Journal: Journal of Laser Applications

Volume: 28  
Issue number: 1  
Article number: 012011  
ISSN (Print): 1042-346X  
Ratings:

Scopus rating (2016): CiteScore 2 SJR 0.673 SNIP 1.233

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Biomedical Engineering, Instrumentation

Keywords: coaxial wire feed, hot-wire laser cladding, Inconel 625, super duplex stainless steel

DOIs:

10.2351/1.4936988

#### **Bibliographical note**

AUX=mol,"Pajukoski, H."

Source: Scopus

Source ID: 84950156186

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Rapid and facile synthesis of graphene oxide quantum dots with good linear and nonlinear optical properties**

We herein report a rapid and effective method for the synthesis of graphene oxide quantum dots (GOQDs) with excellent linear and nonlinear optical properties. The GOQDs were prepared by chemical cutting of graphite oxide and characterized using Fourier transform infrared spectroscopy, X-ray diffraction, UV-Vis absorption spectroscopy, Raman spectroscopy and transmission electron microscopy. The Commission International de l'Éclairage 1931 chromaticity coordinates for GOQDs ( $x = 0.21$ ,  $y = 0.23$ ) demonstrated that highly pure blue-light emission was achieved upon 330 nm excitation wavelength. Optical nonlinearity measurements conducted at 532 nm using 5 ns laser pulses indicated saturable absorption behavior, which tends to the onset of reverse saturable absorption as the input light fluence was increased.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Nonlinear Optics, Research area: Optics, Mahatma Gandhi University, University of Johannesburg, Ultra-Fast and Nonlinear Optical Lab, Raman Research Institute, St Teresas's College

Contributors: Sakho, E. H. M., Oluwafemi, O. S., Perumbilavil, S., Philip, R., Kala, M. S., Thomas, S., Kalarikkal, N.

Pages: 10926–10933

Publication date: 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Materials Science: Materials in Electronics

Volume: 27

Issue number: 10

ISSN (Print): 0957-4522

Ratings:

Scopus rating (2016): CiteScore 2.6 SJR 0.469 SNIP 0.802

Original language: English

ASJC Scopus subject areas: Condensed Matter Physics, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering

DOIs:

10.1007/s10854-016-5204-z

Source: Scopus

Source ID: 84975307980

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Determination of beam incidence conditions based on the analysis of laser interference patterns**

Beam incidence conditions in the formation of two-, three- and four-beam laser interference patterns are presented and studied in this paper. In a laser interference lithography (LIL) process, it is of importance to determine and control beam incidence conditions based on the analysis of laser interference patterns for system calibration as any slight change of incident angles or intensities of beams will introduce significant variations of periods and contrasts of interference patterns. In this work, interference patterns were captured by a He-Ne laser interference system under different incidence conditions, the pattern period measurement was achieved by cross-correlation with, and the pattern contrast was calculated by image processing. Subsequently, the incident angles and intensities of beams were determined based on the analysis of spatial distributions of interfering beams. As a consequence, the relationship between the beam incidence

conditions and interference patterns is revealed. The proposed method is useful for the calibration of LIL processes and for reverse engineering applications.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Changchun University of Science and Technology, University of Bedfordshire, Xi'an Jiaotong-Liverpool University, DCSSE

Contributors: Wang, D., Wang, Z., Yue, Y., Yu, J., Tan, C., Li, D., Qiu, R., Maple, C.

Number of pages: 6

Pages: 2902-2907

Publication date: 1 Nov 2015

Peer-reviewed: Yes

Early online date: 17 Jul 2015

#### Publication information

Journal: Optik

Volume: 126

Issue number: 21

ISSN (Print): 0030-4026

Ratings:

Scopus rating (2015): CiteScore 1.4 SJR 0.332 SNIP 0.682

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Beam incidence condition, Interference lithography, Laser interference, Modulation period

DOIs:

10.1016/j.ijleo.2015.07.039

URLs:

<http://www.scopus.com/inward/record.url?scp=84942373998&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84942373998

Research output: Contribution to journal > Article > Scientific > peer-review

#### Nonlinear negative refraction in reorientational soft matter

We analyze the propagation of self-trapped optical beams close to the Fréedericksz threshold in nematic liquid crystals. Accounting for power-dependent changes in walk-off due to the all-optical response, we demonstrate that light beams can switch from positive to negative refraction according to the excitation.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Nonlinear Optics, Frontier Photonics, Universidade do Porto, Centro de Física Do Porto, Faculdade de Ciências e Tecnologia da Universidade Nova, NooEL–Nonlinear Optics and OptoElectronics Laboratory, University Roma Tre, I-00146 Rome, Italy

Contributors: Alberucci, A., Jisha, C. P., Assanto, G.

Publication date: 18 Sep 2015

Peer-reviewed: Yes

#### Publication information

Journal: Physical Review A

Volume: 92

Issue number: 3

Article number: 033835

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2015): CiteScore 5.3 SJR 1.747 SNIP 1.06

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.92.033835

URLs:

<http://www.scopus.com/inward/record.url?scp=84942134476&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus



Source ID: 84942134476

Research output: Contribution to journal › Article › Scientific › peer-review

### Performance of intensity-based non-normalized pointwise algorithms in dynamic speckle analysis

Intensity-based pointwise non-normalized algorithms for 2D evaluation of activity in optical metrology with dynamic speckle analysis are studied and compared. They are applied to a temporal sequence of correlated speckle patterns formed at laser illumination of the object surface. Performance of each algorithm is assessed through the histogram of estimates it produces. A new algorithm is proposed that provides the same quality of the 2D activity map for less computational effort. The algorithms are applied both to synthetic and experimental data.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Signal Processing Research Community (SPRC), Korea Electronics Technology Institute, Bulgarian Academy of Sciences

Contributors: Stoykova, E., Nazarova, D., Berberova, N., Gotchev, A.

Number of pages: 15

Pages: 25128-25142

Publication date: 17 Sep 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 23

Issue number: 19

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2015): CiteScore 7.1 SJR 1.91 SNIP 1.645

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.23.025128

Source: Scopus

Source ID: 84943620686

Research output: Contribution to journal › Article › Scientific › peer-review

### Incoherent broadband cavity enhanced absorption spectroscopy using supercontinuum and superluminescent diode sources

We investigate incoherent broadband cavity enhanced absorption spectroscopy using a tailored supercontinuum source. By tailoring the supercontinuum spectrum to match the high reflectivity bandwidth of the mirrors, we achieve an unprecedented spectral brightness of more than 7 dBm/nm at wavelengths where the effective absorption path length in the cavity exceeds 40 km. We demonstrate the potential of the source in spectrally broadband measurement of weak overtone transitions of carbon dioxide and methane in the near-infrared 1590 nm-1700 nm range and evaluate its performance against that of a typical superluminescent diode source. Minimum detectable absorption coefficients ( $3\sigma$ ) of  $2.2 \times 10^{-9} \text{ cm}^{-1}$  and  $6.2 \times 10^{-9} \text{ cm}^{-1}$  are obtained with the supercontinuum and the superluminescent diode sources, respectively. We further develop a spectral fitting method based on differential optical absorption spectroscopy to fully and properly account for the combined effect of absorption line saturation and limited spectral resolution of the detection. The method allows to cope with high dynamic range of absorption features typical of real-world multicomponent measurements.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Nonlinear Fiber Optics, Research group: Applied Optics, Frontier Photonics, Metrology Research Institute, Aalto University

Contributors: Aalto, A., Genty, G., Laurila, T., Toivonen, J.

Number of pages: 10

Pages: 25225-25234

Publication date: 17 Sep 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 23

Issue number: 19  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2015): CiteScore 7.1 SJR 1.91 SNIP 1.645  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:

10.1364/OE.23.025225

URLs:

<http://www.scopus.com/inward/record.url?scp=84943613310&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Laurila, T."

Source: Scopus

Source ID: 84943613310

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Measuring synthesis yield in graphene oxide synthesis by modified hummers method**

Synthesis of graphene oxide by the modified Hummers method and measuring the synthesis yield were investigated. Based on the results, a comprehensive method to measure graphene oxide synthesis yield was proposed, which will allow comparison of future literature results. In addition, changes are proposed to the exfoliation procedure to improve the yield of the modified Hummers synthesis. With the proposed method, systematic error of the concentration measurement was calculated to be  $\pm 0.08 \times 10^{-3}$  g mL<sup>-1</sup>. In addition, changes proposed to the graphene oxide exfoliation process can improve the synthesis yield by up to 70%.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Ceramic materials, Tampere University of Technology, Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Research group: Materials Characterization, Engineering materials science and solutions (EMASS), University of Helsinki

Contributors: Frankberg, E. J., George, L., Efimov, A., Honkanen, M., Pessi, J., Levänen, E.

Number of pages: 5

Pages: 755-759

Publication date: 2 Sep 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Fullerenes Nanotubes and Carbon Nanostructures

Volume: 23

Issue number: 9

ISSN (Print): 1536-383X

Ratings:

Scopus rating (2015): CiteScore 1.9 SJR 0.278 SNIP 0.605

Original language: English

ASJC Scopus subject areas: Organic Chemistry, Physical and Theoretical Chemistry, Materials Science(all), Atomic and Molecular Physics, and Optics

Keywords: Concentration, Graphene oxide, Hummers method, Synthesis, Yield

Electronic versions:

Frankberg\_revised\_text\_print

DOIs:

10.1080/1536383X.2014.993754

URLs:

<http://urn.fi/URN:NBN:fi:tty-201603173654>

#### **Bibliographical note**

Versio ja lupa ok 26.1.2016 KK

Source: Scopus

Source ID: 84929598253

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Highly Nonlinear Dispersion Increasing Fiber for Femtosecond Pulse Generation**

The optical pulse evolution in a highly nonlinear normal dispersion-increasing fiber has been considered, both experimentally and theoretically. It was found that large spectral broadening in tapered waveguides could occur without

temporal instabilities and impose the linear frequency modulation, i.e., chirp, required for high-quality pulse compression. The pedestal-free pulses have been demonstrated after dechirping in a standard single-mode fiber.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Prokhorov General Physics Institute, Russian Academy of Sciences, Laboratory of Quantum Electronics and Optoelectronics, Ulyanovsk State University, Optoelectronics Research Centre, Tampere University of Technology

Contributors: Korobko, D. A., Okhotnikov, O. G., Stoliarov, D. A., Sysoliatin, A. A., Zolotovskii, I. O.

Number of pages: 6

Pages: 3643-3648

Publication date: 1 Sep 2015

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Lightwave Technology

Volume: 33

Issue number: 17

Article number: 7134708

ISSN (Print): 0733-8724

Ratings:

Scopus rating (2015): CiteScore 7.2 SJR 1.598 SNIP 1.878

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: Fiber nonlinear optics, Optical fiber applications, Optical pulses

DOIs:

10.1109/JLT.2015.2448941

URLs:

<http://www.scopus.com/inward/record.url?scp=84939425577&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939425577

Research output: Contribution to journal > Article > Scientific > peer-review

#### Effects of thinning and heating for TiO<sub>2</sub>/AlInP junctions

TiO<sub>2</sub>/AlInP junctions are used to construct the antireflection coatings for solar cells and to passivate III-V nanostructure surfaces. The thickness of AlInP epilayer affects light absorption and appropriate Al composition determining further the energy barrier for carriers. We report on reducing the AlInP thickness by dry etching down to 10 nm without introducing harmful defect states at TiO<sub>2</sub>/AlInP interface and AlInP/GaInP interface below, according to photoluminescence. Synchrotron-radiation photoelectron spectroscopy reveals that increased oxidation of phosphorus is not harmful to TiO<sub>2</sub>/AlInP and that post heating of the material enhances AlInP oxidation and group III element segregation resulting in decreased material homogeneity.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Frontier Photonics, Department of Physics and Astronomy, University of Turku, University of Turku

Contributors: Mäkelä, J., Tuominen, M., Yasir, M., Polojärvi, V., Aho, A., Tukiainen, A., Kuzmin, M., Punkkinen, M. P. J., Laukkanen, P., Kokko, K., Guina, M.

Number of pages: 4

Pages: 6-9

Publication date: 24 Aug 2015

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Electron Spectroscopy and Related Phenomena

Volume: 205

ISSN (Print): 0368-2048

Ratings:

Scopus rating (2015): CiteScore 2.7 SJR 0.817 SNIP 0.813

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Physical and Theoretical Chemistry, Spectroscopy, Condensed Matter Physics, Atomic and Molecular Physics, and Optics, Radiation

Keywords: AlInP, Passivation, Solar cell, TiO<sub>2</sub>

DOIs:

10.1016/j.elspec.2015.08.004

URLs:

<http://www.scopus.com/inward/record.url?scp=84939833093&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Laukkanen, P."

EXT="Tuominen, M."

EXT="Kuzmin, M."

Source: Scopus

Source ID: 84939833093

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Bringing High-Performance GaInNAsSb/GaAs SOAs to True Data Applications**

We experimentally demonstrate the high-speed data processing capabilities of a GaInNAsSb semiconductor optical amplifier operating at 1.55  $\mu\text{m}$ . The investigated structure exhibits good thermal characteristics and fast gain dynamics with 10%-90% recovery time of 55 ps. Successful wavelength conversion of 10-Gb/s signals is reported. A maximum power penalty of <2.4 dB for return to zero formatting and of 1.9 dB for nonreturn to zero is demonstrated.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Nanophotonics, Frontier Photonics, Photonics Research Communications Laboratory, National Technological University of Athens

Contributors: Giannoulis, G., Korpijärvi, V., Iliadis, N., Mäkelä, J., Viheriälä, J., Apostolopoulos, D., Guina, M., Avramopoulos, H.

Number of pages: 4

Pages: 1691-1694

Publication date: 15 Aug 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Photonics Technology Letters

Volume: 27

Issue number: 16

Article number: 7113825

ISSN (Print): 1041-1135

Ratings:

Scopus rating (2015): CiteScore 5.2 SJR 1.19 SNIP 1.254

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: dilute nitrides, Photonic integration, semiconductor optical amplifier (SOA), wavelength conversion

DOIs:

10.1109/LPT.2015.2436697

URLs:

<http://www.scopus.com/inward/record.url?scp=84937146617&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84937146617

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Influence of relative humidity and physical load during storage on dustiness of inorganic nanomaterials: implications for testing and risk assessment**

Dustiness testing using a down-scaled EN15051 rotating drum was used to investigate the effects of storage conditions such as relative humidity and physical loading on the dustiness of five inorganic metal oxide nanostructured powder materials. The tests consisted of measurements of gravimetric respirable dustiness index and particle size distributions. Water uptake of the powders during 7 days of incubation was investigated as an explanatory factor of the changes. Consequences of these varying storage conditions in exposure modelling were tested using the control banding and risk management tool NanoSafer. Drastic material-specific effects on powder respirable dustiness index were observed with the change in  $\text{TiO}_2$  from 30 % RH (639 mg/kg) to 50 % RH (1.5 mg/kg). All five tested materials indicate a decreasing dustiness index with relative humidity increasing from 30 to 70 % RH. Test of powder water uptake showed an apparent link with the decreasing dustiness index. Effects of powder compaction appeared more material specific with both increasing and decreasing dustiness indices observed as an effect of compaction. Tests of control banding exposure models using the measured dustiness indices in three different exposure scenarios showed that in two of the tested

materials, one 20 % change in RH changed the exposure banding from the lowest level to the highest. The study shows the importance of powder storage conditions prior to tests for classification of material dustiness indices. It also highlights the importance of correct storage information and relative humidity and expansion of the dustiness test conditions specifically, when using dustiness indices as a primary parameter for source strength in exposure assessment.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Materials Characterization, Engineering materials science and solutions (EMASS), Department of Micro and Nanotechnology, Denmark Technical University DTU, Finnish Institute of Occupational Health, CIC biomaGUNE, National Research Centre for the Working Environment

Contributors: Levin, M., Rojas, E., Vanhala, E., Vippola, M., Liguori, B., Kling, K. I., Koponen, I. K., Mølhav, K., Tuomi, T., Gregurec, D., Moya, S., Jensen, K. A.

Publication date: 14 Aug 2015

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Nanoparticle Research

Volume: 17

Issue number: 8

Article number: 337

ISSN (Print): 1388-0764

Ratings:

Scopus rating (2015): CiteScore 3.8 SJR 0.568 SNIP 0.725

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Modelling and Simulation, Chemistry(all), Materials Science(all), Bioengineering

Keywords: Dustiness, Exposure assessment, Nanotechnology, Occupational health, Powder storage, Rotating drum

DOIs:

10.1007/s11051-015-3139-6

URLs:

<http://www.scopus.com/inward/record.url?scp=84939162642&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939162642

Research output: Contribution to journal › Article › Scientific › peer-review

#### Optimal emission enhancement in orthogonal double-pulse laser-induced breakdown spectroscopy

Abstract Orthogonal double-pulse (DP) laser-induced breakdown spectroscopy (LIBS) was performed using reheating and pre-ablative configurations. The ablation pulse power density was varied by two orders of magnitude and the DP experiments were carried out for a wide range of interpulse delays. For both DP-LIBS schemes, the signal enhancement was evaluated with respect to the corresponding single-pulse (SP) LIBS as a function of the interpulse delay. The reheating scheme shows a sharp maximum signal enhancement of up to 200-fold for low ablative power densities ( $0.4 \text{ GW cm}^{-2}$ ); however, for power densities larger than  $10 \text{ GW cm}^{-2}$  this configuration did not improve the SP outcome. On the other hand, a more uniform signal enhancement of about 4-6 was obtained for the pre-ablative scheme nearly independently of the used ablative power density. In terms of the signal-to-noise ratio (SNR) the pre-ablative scheme shows a monotonic increment with the ablative power density. Whereas the reheating configuration reaches a maximum at  $2.2 \text{ GW cm}^{-2}$ , its enhancement effect collapses markedly for fluencies above  $10 \text{ GW cm}^{-2}$ .

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics, Centro de Ciencias Aplicadas y Desarrollo Tecnológico, Universidad Nacional Autónoma de México (CCADET-UNAM), Cátedra CONACyT, Centro de Nanociencias y Nanotecnología, Universidad Nacional Autónoma de México, Universidad Autónoma Metropolitana-Unidad Azcapotzalco

Contributors: Sanginés, R., Contreras, V., Sobral, H., Robledo-Martinez, A.

Number of pages: 7

Pages: 139-145

Publication date: 6 Jul 2015

Peer-reviewed: Yes

#### Publication information

Journal: Spectrochimica Acta Part B: Atomic Spectroscopy

Volume: 110

Article number: 4935  
ISSN (Print): 0584-8547  
Ratings:

Scopus rating (2015): CiteScore 4.9 SJR 0.999 SNIP 1.414

Original language: English

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics, Analytical Chemistry, Spectroscopy

Keywords: Double-pulse, Emission enhancement, LIBS

DOIs:

10.1016/j.sab.2015.06.012

URLs:

<http://www.scopus.com/inward/record.url?scp=84934759672&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84934759672

Research output: Contribution to journal › Article › Scientific › peer-review

### Adiabatic and nonadiabatic static polarizabilities of H and H<sub>2</sub>

The path-integral Monte Carlo method is employed to evaluate static (hyper)polarizabilities of small hydrogen systems at finite temperature. Exact quantum statistics are obtained for hydrogen atom and hydrogen molecule immersed in homogeneous electric field. The method proves to be reliable and yields perfect agreement with known values of static polarizabilities in both adiabatic and nonadiabatic simulations. That is, we demonstrate how electronic, rotational, and vibrational contributions can be evaluated either separately or simultaneously. Indeed, at finite temperature and nonzero-field strengths we observe considerable rovibrational effects in the polarization of the hydrogen molecule. Given sufficient computational resources, the path-integral Monte Carlo method turns out to be a straightforward tool for describing and computing static polarizabilities for traditionally challenging regimes.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Semiconductor Technology and Applications, Research group: Electronic Structure Theory, Computational Science X (CompX)

Contributors: Tiihonen, J., Kylänpää, I., Rantala, T. T.

Publication date: 12 Jun 2015

Peer-reviewed: Yes

### Publication information

Journal: Physical Review A

Volume: 91

Issue number: 6

Article number: 062503

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2015): CiteScore 5.3 SJR 1.747 SNIP 1.06

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: hyperpolarizability, hydrogen, hydrogen molecule, path integral Monte Carlo, finite temperature

DOIs:

10.1103/PhysRevA.91.062503

Additional files:

Reprint of the published article

URLs:

<http://www.scopus.com/inward/record.url?scp=84937404643&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: RIS

Source ID: urn:069084BC266EF8BB0195BFB5DD7DDD69

Research output: Contribution to journal › Article › Scientific › peer-review

### Tolman-Oppenheimer-Volkoff equations in nonlocal $f(R)$ gravity

Nonlocal  $f(R)$  gravity was proposed as a powerful alternative to general relativity (GR). This theory has potentially adverse implications for infrared (IR) regime as well as ultraviolet (UV) early epochs. However, there are a lot of powerful features, making it really user-friendly. A scalar-tensor frame comprising two auxiliary scalar fields is used to reduce complex action. However, this is not the case for the modification complex which plays a distinct role in modified theories for gravity. In this work, we study the dynamics of a static, spherically symmetric object. The interior region of space-time had rapidly filled the perfect fluid. However, it is possible to derive a physically based model which relates interior metric to nonlocal  $f(R)$ . The Tolman-Oppenheimer-Volkoff (TOV) equations would be a set of first-order differential equations from which we can

deduce all mathematical (physical) truths and derive all dynamical objects. This set of dynamical equations govern pressure  $p$ , density  $\rho$ , mass  $m$  and auxiliary fields  $\{\varphi, \xi\}$ . The full conditional solutions are evaluated and inverted numerically to obtain exact forms of the compact stars Her X-1, SAX J 1808.4-3658 and 4U 1820-30 for nonlocal Starobinsky model of  $f(\rightarrow^{\sup>-1</sup> R) = \rightarrow^{\sup>-1</sup> R + \alpha(\rightarrow^{\sup>-1</sup> R)^{\sup>2</sup>}$ . The program solves the differential equations numerically using adaptive Gaussian quadrature. An ascription of correctness is supposed to be an empirical equation of state  $P/P_{\text{c}} = a(1 - e^{-b \rho/\rho_{\text{c}}})$  for star which is informative in so far as it excludes an alternative nonlocal approach to compact star formation. This model is most suited for astrophysical observation.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Eurasian International Center for Theoretical Physics, Department of General and Theoretical Physics, Eurasian National University, COMSATS Institute of Information Technology, State Key Laboratory of Modern Optical Instrumentation, Centre for Optical and Electromagnetic Research, Zhejiang University

Contributors: Momeni, D., Gholizade, H., Raza, M., Myrzakulov, R.

Number of pages: 20

Publication date: 10 Jun 2015

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Modern Physics A

Volume: 30

Issue number: 16

Article number: 1550093

ISSN (Print): 0217-751X

Ratings:

Scopus rating (2015): CiteScore 2.9 SJR 1.031 SNIP 0.786

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Astronomy and Astrophysics, Nuclear and High Energy Physics

Keywords: conduction, convection, equations of state, Higher-dimensional gravity and other theories of gravity, neutron stars, thermodynamic processes

DOIs:

10.1142/S0217751X15500931

URLs:

<http://www.scopus.com/inward/record.url?scp=84930934998&partnerID=8YFLogxK> (Link to publication in Scopus)

Research output: Contribution to journal › Article › Scientific › peer-review

### Comparison of three light doses in the photodynamic treatment of actinic keratosis using mathematical modeling

Photodynamic therapy (PDT) is an emerging treatment modality for various diseases, especially for cancer therapy. Although high efficacy is demonstrated for PDT using standardized protocols in nonhyperkeratotic actinic keratoses, alternative light doses expected to increase efficiency, to reduce adverse effects or to expand the use of PDT, are still being evaluated and refined. We propose a comparison of the three most common light doses in the treatment of actinic keratosis with 5-aminolevulinic acid PDT through mathematical modeling. The proposed model is based on an iterative procedure that involves determination of the local fluence rate, updating of the local optical properties, and estimation of the local damage induced by the therapy. This model was applied on a simplified skin sample model including an actinic keratosis lesion, with three different light doses (red light dose,  $37 \text{ J/cm}^2$ ,  $75 \text{ mW/cm}^2$ , 500 s; blue light dose,  $10 \text{ J/cm}^2$ ,  $10 \text{ mW/cm}^2$ , 1000 s; and daylight dose, 9000 s). Results analysis shows that the three studied light doses, although all efficient, lead to variable local damage. Defining reference damage enables the nonoptimal parameters for the current light doses to be refined and the treatment to be more suitable.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Univ Paris 06, Centre National de la Recherche Scientifique (CNRS), Pierre & Marie Curie University - Paris 6, Institut de Recherche pour le Developpement (IRD), Inria, Institut National de la Sante et de la Recherche Medicale (Inserm), Univ Sorbonne, CNRS, ICM, UMR S 1127, UMR 7225, U1127, INSERM, Inria Paris Rocquencourt, Inst Cerveau & Mo, Univ Lille Nord de France, Lille University Hospital - CHRU

Contributors: Vignion-Dewalle, A. S., Betrouni, N., Tylcz, J. B., Vermandel, M., Mortier, L., Mordon, S.

Publication date: 1 May 2015

Peer-reviewed: Yes

### Publication information

Journal: JOURNAL OF BIOMEDICAL OPTICS

Volume: 20  
Issue number: 5  
Article number: 058001  
ISSN (Print): 1083-3668  
Ratings:

Scopus rating (2015): CiteScore 5.3 SJR 1.173 SNIP 1.276

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Biomaterials, Biomedical Engineering

Keywords: light doses comparison, mathematical modeling, photodynamic therapy, protoporphyrin IX

DOIs:

10.1117/1.JBO.20.5.058001

URLs:

<http://www.scopus.com/inward/record.url?scp=84930001957&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84930001957

Research output: Contribution to journal › Article › Scientific › peer-review

### **Workplace performance of a loose-fitting powered air purifying respirator during nanoparticle synthesis**

Nanoparticle (particles with diameter  $\leq 100$  nm) exposure is recognized as a potentially harmful size fraction for pulmonary particle exposure. During nanoparticle synthesis, the number concentrations in the process room may exceed  $10 \times 10^6 \text{ cm}^{-3}$ . During such conditions, it is essential that the occupants in the room wear highly reliable high-performance respirators to prevent inhalation exposure. Here we have studied the in-use program protection factor (PPF) of loose-fitting powered air purifying respirators, while workers were coating components with  $\text{TiO}_2$  or  $\text{Cu}_x\text{O}_y$  nanoparticles under a hood using a liquid flame spray process. The PPF was measured using condensation particle counters, an electrical low pressure impactor, and diffusion chargers. The room particle concentrations varied from  $4 \times 10^6$  to  $40 \times 10^6 \text{ cm}^{-3}$ , and the count median aerodynamic diameter ranged from 32 to 180 nm. Concentrations inside the respirator varied from 0.7 to  $7.2 \text{ cm}^{-3}$ . However, on average, tidal breathing was assumed to increase the respirator concentration by  $2.3 \text{ cm}^{-3}$ . The derived PPF exceeded  $1.1 \times 10^6$ , which is more than  $40 \times 10^3$  times the respirator assigned protection factor. We were unable to measure clear differences in the PPF of respirators with old and new filters, among two male and one female user, or assess most penetrating particle size. This study shows that the loose-fitting powered air purifying respirator provides very efficient protection against nanoparticle inhalation exposure if used properly.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Aerosol Synthesis, National Research Centre for the Working Environment, Finnish Institute of Occupational Health, Helsinki University, TNO

Contributors: Koivisto, A. J., Aromaa, M., Koponen, I. K., Fransman, W., Jensen, K. A., Mäkelä, J. M., Hämeri, K. J.

Publication date: 9 Apr 2015

Peer-reviewed: Yes

### **Publication information**

Journal: Journal of Nanoparticle Research

Volume: 17

Issue number: 4

ISSN (Print): 1388-0764

Ratings:

Scopus rating (2015): CiteScore 3.8 SJR 0.568 SNIP 0.725

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Modelling and Simulation, Chemistry(all), Materials Science(all), Bioengineering

Keywords: Aerosol, Air purifying respirator, Filtration, Occupational safety, Protection factor, Respirator performance

DOIs:

10.1007/s11051-015-2990-9

URLs:

<http://www.scopus.com/inward/record.url?scp=84927730047&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

EXT="Koivisto, Antti J."

Source: Scopus

Source ID: 84927730047



### **Broadband infrared continuum generation in dispersion shifted tapered fiber**

Experimental and theoretical studies of supercontinuum generation in the telecom spectral window are reported for fibers with shifted decreasing anomalous dispersion. Numerical analysis highlights the high average power of the emitted dispersive waves and the good spectral flatness achieved within the control spectral band for the supercontinuum generated in optical fiber tapers. Reduction of the third-order dispersion in optical fiber tapers is shown to cause spectral broadening, which is extended by hundreds of nanometers in comparison with the supercontinuum generated in uniform fibers, even when subpicosecond pulses of moderate powers are used.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Tampere University of Technology, Ulyanovsk State University, Prokhorov General Physics Institute, Russian Academy of Sciences

Contributors: Korobko, D. A., Okhotnikov, O. G., Stoliarov, D. A., Sysolyatin, A. A., Zolotovskii, I. O.

Number of pages: 9

Pages: 692-700

Publication date: 1 Apr 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of the Optical Society of America B

Volume: 32

Issue number: 4

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2015): CiteScore 4 SJR 0.963 SNIP 0.893

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Statistical and Nonlinear Physics

DOIs:

10.1364/JOSAB.32.000692

#### **Bibliographical note**

AUX=orc,"Stoliarov, D. A."

Source: Scopus

Source ID: 84926483478

Research output: Contribution to journal > Article > Scientific > peer-review

### **An integrated "sense-and-communicate" broad-/narrow-band optically controlled reconfigurable antenna for cognitive radio systems**

An optically controlled reconfigurable antenna with operability in both wide and narrow bands is investigated for cognitive radio systems. The proposed antenna consists of a U-shaped patch for the spectrum sensing over a wide band and two open annuli for communication in narrow sub-bands within the frequency range of 3.1-10.6 GHz. The integration of narrow and wide bands devices makes the whole antenna structure compact with a dimension of  $40 \times 38.5 \text{ mm}^2$ . With an inherent property of being electromagnetically transparency, four appropriately placed laser-controlled photoconductive silicon switches are adopted to achieve reconfigurable frequency characteristics in the four bands of 5.8-6.8, 6.7-7.3, 7.0-8.4, and 7.9-9.2 GHz with the reflection coefficient below -10 dB. The wide-narrowband antenna is fed by two coplanar waveguides with the isolation of  $S_{21}$

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), South China University of Technology, Georgia Institute of Technology

Contributors: Liu, X., Fan, Y., Tentzeris, M. M.

Number of pages: 8

Pages: 1016-1023

Publication date: 1 Apr 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Microwave and Optical Technology Letters

Volume: 57

Issue number: 4

ISSN (Print): 0895-2477

Ratings:

Scopus rating (2015): CiteScore 1.5 SJR 0.318 SNIP 0.507

Original language: English

ASJC Scopus subject areas: Condensed Matter Physics, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering

Keywords: cognitive radio, Frequency reconfigurable antenna, optical control, photoconductive switches

DOIs:

10.1002/mop.29004

URLs:

<http://www.scopus.com/inward/record.url?scp=84923411745&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84923411745

Research output: Contribution to journal > Article > Scientific > peer-review

### Mode-locked Tm,Ho:KLu(WO<sub>4</sub>)<sub>2</sub> laser at 2060 nm using InGaSb-based SESAMs

Passive mode-locking of a Tm,Ho:KLu(WO<sub>4</sub>)<sub>2</sub> laser operating at 2060 nm using different designs of InGaAsSb quantum-well based semiconductor saturable absorber mirrors (SESAMs) is demonstrated. The self-starting mode-locked laser delivers pulse durations between 4 and 8 ps at a repetition rate of 93 MHz with maximum average output power of 155 mW. Mode-locking performance of a Tm,Ho:KLu(WO<sub>4</sub>)<sub>2</sub> laser is compared for usage of a SESAM to a single-walled carbon nanotube saturable absorber.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Frontier Photonics, Campus Sescelades, Max Born Institute, Sofia University St. Kliment Ohridski, Física i Cristal.lografia de Materials i Nanomaterials, Universitat Rovira i Virgili

Contributors: Aleksandrov, V., Gluth, A., Petrov, V., Buchvarov, I., Steinmeyer, G., Paajaste, J., Suomalainen, S., Härkönen, A., Guina, M., Mateos, X., Díaz, F., Griebner, U.

Number of pages: 6

Pages: 4614-4619

Publication date: 23 Feb 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 23

Issue number: 4

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2015): CiteScore 7.1 SJR 1.91 SNIP 1.645

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.23.004614

Source: Scopus

Source ID: 84924194860

Research output: Contribution to journal > Article > Scientific > peer-review

### High speed, high strength microwelding of Si/glass using ps-laser pulses

A novel microwelding procedure to join Si-to-glass using ps-laser pulses with high repetition rates is presented. The procedure provides weld joint with mechanical strength as high as 85 MPa and 45 MPa in sample pairs of Si/aluminosilicate (Si/SW-Y) and Si/borosilicate (Si/Borofloat 33), respectively, which are higher than anodic bonding, at high spatial resolution (< 20 μm) and very high throughput without pre- and post-heating. Laser-matter interaction analysis indicates that excellent weld joint of Si/glass is obtained by avoiding violent evaporation of Si substrate using ps-laser pulses. Laser welded Si/glass samples can be singulated along the weld lines by standard blade dicer without defects, demonstrating welding by ps-laser pulses is applicable to wafer-level packaging.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Osaka University, Erlangen Graduate School of Advanced Optical Technologies (SAOT), Okayama University, Corelase, Ltd.

Contributors: Miyamoto, I., Okamoto, Y., Hansen, A., Vihinen, J., Amberla, T., Kangastupa, J.  
Number of pages: 13  
Pages: 3427-3439  
Publication date: 9 Feb 2015  
Peer-reviewed: Yes

#### Publication information

Journal: Optics Express  
Volume: 23  
Issue number: 3  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2015): CiteScore 7.1 SJR 1.91 SNIP 1.645

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.23.003427

URLs:

<http://www.scopus.com/inward/record.url?scp=84922814586&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84922814586

Research output: Contribution to journal › Article › Scientific › peer-review

#### Microfluidic tunable inkjet-printed metamaterial absorber on paper

In this paper, we propose a novel microfluidic tunable metamaterial (MM) absorber printed on a paper substrate in silver nanoparticle ink. The metamaterial is designed using a periodic array consisting of square patches. The conductive patterns are inkjet-printed on paper using silver nanoparticle inks. The microfluidic channels are laseretched on polymethyl methacrylate (PMMA). The conductive patterns on paper and the microfluidic channels on PMMA are bonded by an SU-8 layer that is also inkjet-printed on the conductive patterns. The proposed MM absorber provides frequency-tuning capability for different fluids in the microfluidic channels. We performed full-wave simulations and measurements that confirmed that the resonant frequency decreased from 4.42 GHz to 3.97 GHz after the injection of distilled water into the microfluidic channels. For both empty and water-filled channels, the absorptivity is higher than 90% at horizontal and vertical polarizations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Chung-Ang University, Georgia Institute of Technology

Contributors: Ling, K., Yoo, M., Su, W., Kim, K., Cook, B., Tentzeris, M. M., Lim, S.

Number of pages: 11

Pages: 110-120

Publication date: 12 Jan 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express  
Volume: 23  
Issue number: 1  
ISSN (Print): 1094-4087  
Ratings:

Scopus rating (2015): CiteScore 7.1 SJR 1.91 SNIP 1.645

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.23.000110

URLs:

<http://www.scopus.com/inward/record.url?scp=84937199666&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84937199666

Research output: Contribution to journal › Article › Scientific › peer-review

### **Compact intracavity singly-resonant optical parametric oscillator pumped by GaSb-based vertical external cavity surface-emitting laser: Concept and the main operational characteristics**

The concept of an intracavity singly-resonant optical parametric oscillator pumped by a GaSb-based vertical external cavity surface-emitting laser has been proposed. The steady-state characteristics of the parametric oscillator with the joint cavity shared by the pump and signal optical fields have been numerically analyzed. Using a few millimeter long orientation-patterned quasi-phase-matched GaAs nonlinear crystal in such a cavity allows fairly compact (~15-mm long) device working in the mid-infrared range (wavelength of 16.5  $\mu$  m) to be built.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Russian Academy of Sciences, Kotelnikov Institute of Radio Engineering and Electronics, Saratov Branch, P.N. Lebedev Physical Institute, Russian Academy of Sciences

Contributors: Morozov, Y. A., Morozov, M. Y., Kozlovsky, V. I., Okhotnikov, O. G.

Number of pages: 5

Publication date: 1 Jan 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Journal of Selected Topics in Quantum Electronics

Volume: 21

Issue number: 1

ISSN (Print): 1077-260X

Ratings:

Scopus rating (2015): CiteScore 6.1 SJR 1.475 SNIP 1.437

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: frequency conversion, nonlinear optics, Optical parametric oscillators, semiconductor device modeling, surfaceemitting lasers

DOIs:

10.1109/JSTQE.2014.2385310

#### **Bibliographical note**

EXT="Morozov, Yuri A."

Source: Scopus

Source ID: 84921395692

Research output: Contribution to journal > Article > Scientific > peer-review

### **High-gain 1.3 $\mu$ m GaInNAs semiconductor optical amplifier with enhanced temperature stability for all-optical signal processing at 10 Gb/s**

We report on the complete experimental evaluation of a GaInNAs/GaAs (dilute nitride) semiconductor optical amplifier that operates at 1.3  $\mu$ m and exhibits 28 dB gain and a gain recovery time of 100 ps. Successful wavelength conversion operation is demonstrated using pseudorandom bit sequence  $2^{27} - 1$  non-return-to-zero bit streams at 5 and 10 Gb/s, yielding error-free performance and showing feasibility for implementation in various signal processing functionalities. The operational credentials of the device are analyzed in various operational regimes, while its nonlinear performance is examined in terms of four-wave mixing. Moreover, characterization results reveal enhanced temperature stability with almost no gain variation around the 1320 nm region for a temperature range from 20°C to 50°C. The operational characteristics of the device, along with the cost and energy benefits of dilute nitride technology, make it very attractive for application in optical access networks and dense photonic integrated circuits.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Frontier Photonics, University of Milan Bicocca, Department of Informatics, Aristotle University of Thessaloniki, Aristotle University of Thessaloniki, School of Electrical and Computer Engineering, National Technical University of Athens, Information Technologies Institute, Center for Research and Technology Hellas

Contributors: Fitsios, D., Giannoulis, G., Korpijärvi, V. M., Viheriälä, J., Laakso, A., Iliadis, N., Dris, S., Spyropoulou, M., Avramopoulos, H., Kanellos, G. T., Pleros, N., Guina, M.

Number of pages: 7

Pages: 46-52

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Applied Optics

Volume: 54

Issue number: 1

ISSN (Print): 1559-128X

Ratings:

Scopus rating (2015): CiteScore 3.4 SJR 0.837 SNIP 1.229

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/AO.54.000046

### Bibliographical note

Siirretään Portfolio15<br/>Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2015-01-08<br/>Publisher name: Optical Society of America

Source: researchoutputwizard

Source ID: 5

Research output: Contribution to journal > Article > Scientific > peer-review

### Generation of bound states of pulses in a soliton laser with complex relaxation of a saturable absorber

A numerical model of a soliton fibre laser with a semiconductor saturable absorber mirror (SESAM), characterised by the complex dynamics of absorption relaxation, is considered. It is shown that stationary bound states of pulses can be formed in this laser as a result of their interaction via the dispersion-wave field. The stability of stationary bound states of several pulses is analysed. It is shown that an increase in the number of pulses in a stationary bound state leads eventually to its decay and formation of a random bunch. It is found that the bunch stability is caused by the manifestation of nonlinear self-phase modulation, which attracts pulses to the bunch centre. The simulation results are in qualitative agreement with experimental data.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Frontier Photonics, Ulyanovsk State University

Contributors: Zolotovskii, I. O., Korobko, D. A., Gumenyuk, R. V., Okhotnikov, O. G.

Number of pages: 9

Pages: 26-34

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Quantum Electronics

Volume: 45

Issue number: 1

ISSN (Print): 1063-7818

Ratings:

Scopus rating (2015): CiteScore 1.9 SJR 0.589 SNIP 1.177

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Statistical and Nonlinear Physics

Keywords: soliton fibre laser, semiconductor saturable absorber mirror, bound states of pulses, FIBER LASER, MODE-LOCKING, OPTICAL-FIBERS, DISPERSION, RECOVERY, GAIN, TECHNOLOGY, ABSORPTION, MIRRORS, SLOW DOIs:

10.1070/QE2015v045n01ABEH015558

Source: WOS

Source ID: 000349382000006

Research output: Contribution to journal > Article > Scientific > peer-review

### $\pi$ -Expanded $\alpha,\beta$ -unsaturated ketones: Synthesis, optical properties, and two-photon-induced polymerization

A library of  $\pi$ -expanded  $\alpha,\beta$ -unsaturated ketones was designed and synthesized. They were prepared by a combination of Wittig reaction, Sonogashira reaction, and aldol condensation. It was further demonstrated that the double aldol condensation can be performed effectively for highly polarized styrene- and diphenylacetylene-derived aldehydes. The strategic placement of two dialkylamino groups at the periphery of D- $\pi$ -A- $\pi$ -D molecules resulted in dyes with excellent solubility. These ketones absorb light in the region 400-550nm. Many of them display strong solvatochromism so that the emission ranges from 530-580nm in toluene to the near-IR region in benzonitrile. Ketones based on cyclobutanone as central moieties display very high fluorescence quantum yields in nonpolar solvents, which decrease drastically in polar

media. Photophysical studies of these new functional dyes revealed that they possess an enhanced two-photon absorption cross section when compared with simpler ketone derivatives. Due to strong polarization of the resulting dyes, values of two-photon absorption cross sections on the level of 200-300GM at 800nm were achieved, and thanks to that as well as the presence of the keto group, these new two-photon initiators display excellent performance so that the operating region is 5-75mW in some cases.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Tampere University of Technology, Frontier Photonics, Politechnika Warszawska, Foundation for Research and Technology-Hellas, Institute of Electronic Structure and Laser, Institute of Organic Chemistry of the Polish Academy of Sciences

Contributors: Nazir, R., Bourquard, F., Balčiūnas, E., Smoleń, S., Gray, D., Tkachenko, N. V., Farsari, M., Gryko, D. T.

Number of pages: 9

Pages: 682-690

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: ChemPhysChem

Volume: 16

Issue number: 3

ISSN (Print): 1439-4235

Ratings:

Scopus rating (2015): CiteScore 6.2 SJR 1.303 SNIP 0.889

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Atomic and Molecular Physics, and Optics

Keywords: Aldol reaction, Ketones, Photosensitizers, Polymerization, Two-photon absorption

DOIs:

10.1002/cphc.201402646

URLs:

<http://www.scopus.com/inward/record.url?scp=84920105777&partnerID=8YFLogxK> (Link to publication in Scopus)

Research output: Contribution to journal > Article > Scientific > peer-review

#### Supercontinuum generation as a signal amplifier

Supercontinuum white-light generation in optical fibers is a process that is known for its extreme sensitivity toward fluctuations of the input pulses, giving rise to a strong amplification of input noise. Such noise amplification has been recognized as a detrimental effect that prevents compression of the broad white-light spectra into a few-cycle pulse. Here, we show that the same effect can be exploited to amplify and recover faint modulation signals to an extent that seems impossible with any electronic method. We experimentally demonstrate the deterministic amplification of faint amplitude modulation signals by up to 60 dB. As we show from numerical simulations, this amplification process arises from the interaction dynamics between solitons and dispersive radiation in the fiber. The resulting all-optic signal restoration provides a new photonic building block that enables signal processing at virtually unlimited processing speeds.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Department of Physics, Research area: Optics, Research group: Nonlinear Fiber Optics, Frontier Photonics

Contributors: Orsila, L., Sand, J., Närhi, M., Genty, G., Steinmeyer, G.

Number of pages: 8

Pages: 757-764

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optica

Volume: 2

Issue number: 8

ISSN (Print): 2334-2536

Ratings:

Scopus rating (2015): CiteScore 3.5 SJR 4.539 SNIP 2.629

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: Nonlinear optics, fibers, Ultrafast nonlinear optics, Ultrafast processing

DOIs:

10.1364/OPTICA.2.000757

URLs:

<http://www.scopus.com/inward/record.url?scp=84941207046&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

ORG=orc,0.6

ORG=fys,0.4

Source: Scopus

Source ID: 84941207046

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Generation of a broad IR spectrum and N-soliton compression in a longitudinally inhomogeneous dispersion-shifted fibre**

The propagation of N-soliton pulses in an optical fibre with slowly decreasing, shifted anomalous dispersion has been studied experimentally and theoretically. Using a generalised nonlinear Schrodinger equation, we have constructed an adequate numerical model for light propagation in such fibre. Using numerical simulation, we have shown that the use of dispersion-decreasing fibres ensures higher average dispersive radiation intensity and better uniformity of the supercontinuum spectrum. A reduction in the third-order dispersion of such fibres enables supercontinuum generation with a bandwidth exceeding that in homogeneous fibres by several hundred nanometres even in the case of a medium-power subpicosecond source.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Ulyanovsk State University, Optoelectronics Research Centre, Tampere University of Technology, A. M. Prokhorov General Physics Institute, Russian Academy of Sciences

Contributors: Zolotovskii, I. O., Korobko, D. A., Okhotnikov, O. G., Stolyarov, D. A., Sysolyatin, A. A.

Number of pages: 9

Pages: 844-852

Publication date: 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Quantum Electronics

Volume: 45

Issue number: 9

ISSN (Print): 1063-7818

Ratings:

Scopus rating (2015): CiteScore 1.9 SJR 0.589 SNIP 1.177

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Statistical and Nonlinear Physics

Keywords: Dispersion-shifted fibres, Generation of a broad spectrum, Longitudinally inhomogeneous optical fibres.

DOIs:

10.1070/QE2015v045n09ABEH015690

Source: Scopus

Source ID: 84943269989

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Observation of stable-vector vortex solitons**

We report on the first experimental observation of stable-vector vortex solitons in nonlocal nonlinear media with a reorientational response, such as nematic liquid crystals. These solitons consist of two co-polarized, mutually trapped beams of different colors, a bright fundamental spatial soliton, and a nonlinear optical vortex. The nonlinear vortex component, which is normally unstable in nonlinear media, is stabilized and confined here by the highly nonlocal refractive potential induced by the soliton.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Frontier Photonics, Australian National University, Texas A and M University at Qatar

Contributors: Izdebskaya, Y., Assanto, G., Krolikowski, W.

Number of pages: 4

Pages: 4182-4185  
Publication date: 2015  
Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters  
Volume: 40  
Issue number: 17  
ISSN (Print): 0146-9592  
Ratings:

Scopus rating (2015): CiteScore 7 SJR 2.013 SNIP 1.496  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:

10.1364/OL.40.004182

URLs:

<http://www.scopus.com/inward/record.url?scp=84943279454&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84943279454

Research output: Contribution to journal > Article > Scientific > peer-review

#### Light-Induced Waveguides in Nematic Liquid Crystals

Spatial optical solitary waves in media with nonlinear refractive index are self-localized beams as well as waveguides induced by light. We review their guiding features in reorientational birefringent soft matter, namely nematic liquid crystals, for which a highly "nonlocal" response enhances the confinement, stabilization, and robustness of the generated optical solitary waves, termed "nematicons." The waveguiding properties of the spatial solitons in nematic liquid crystals are illustrated through the confinement of low-power signals and other solitary waves, as well as optical vortices.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Tampere University of Technology, University of Edinburgh

Contributors: Assanto, G., Smyth, N. F.

Publication date: 2015

Peer-reviewed: Yes

Early online date: 18 Jun 2015

#### Publication information

Journal: IEEE Journal of Selected Topics in Quantum Electronics

Volume: 22

Issue number: 2

Article number: 7128341

ISSN (Print): 1077-260X

Ratings:

Scopus rating (2015): CiteScore 6.1 SJR 1.475 SNIP 1.437

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Liquid crystals, Nonlinear optics, Optical solitons, Optical vortices, Solitons

DOIs:

10.1109/JSTQE.2015.2446762

URLs:

<http://www.scopus.com/inward/record.url?scp=84941047633&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84941047633

Research output: Contribution to journal > Article > Scientific > peer-review

#### Two-time coherence of pulse trains and the integrated degree of temporal coherence

We examine the temporal coherence properties of trains of nonidentical short optical pulses in the framework of the second-order coherence theory of nonstationary light. Considering Michelson's interferometric measurement of temporal coherence, we demonstrate that time-resolved interferograms reveal the full two-time temporal coherence function of the partially coherent pulse train. We also show that the result given by the time-integrated Michelson interferogram equals the true degree of temporal coherence only when the pulse train is quasistationary, i.e., the coherence time is a small fraction of the pulse duration. True two-time and integrated coherence functions produced by specific models representing perturbed trains of mode-locked pulses and supercontinuum pulse trains produced in nonlinear fibers are illustrated.



### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Nonlinear Fiber Optics, Research area: Optics, Frontier Photonics, Ita-Suomen yliopisto, Institute of Photonics

Contributors: Dutta, R., Friberg, A. T., Genty, G., Turunen, J.

Number of pages: 7

Pages: 1631-1637

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of the Optical Society of America A: Optics Image Science and Vision

Volume: 32

Issue number: 9

ISSN (Print): 1084-7529

Ratings:

Scopus rating (2015): CiteScore 3.4 SJR 0.918 SNIP 1.103

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Computer Vision and Pattern Recognition

DOIs:

10.1364/JOSAA.32.001631

URLs:

<http://www.scopus.com/inward/record.url?scp=84943414423&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84943414423

Research output: Contribution to journal > Article > Scientific > peer-review

### Soliton enhancement of spontaneous symmetry breaking

Spontaneous symmetry breaking (SSB) occurs when noise triggers an initially symmetric system to evolve toward one of its nonsymmetric states. Topological and optical SSB involve material reconfiguration/transition and light propagation/distribution in time or space, respectively. In anisotropic optical media, light beam propagation and distribution of the optic axis can be linked, thereby connecting topological and optical SSB. Using nonlinear soft matter, namely uniaxial liquid crystals, we report on simultaneous topological and optical SSB, showing that spatial solitons enhance the noise-driven transition of the medium from a symmetric to an asymmetric configuration, while acquiring a power-dependent transverse velocity in either of two specular directions with respect to the initial wavevector. Solitons enhance SSB by further distorting the optic axis distribution through nonlinear reorientation, resulting in power-tunable walk-off as well as hysteresis in beam refraction versus angle of incidence.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Nonlinear Optics, Frontier Photonics, University "Roma Tre", University of Southampton, United Kingdom

Contributors: Alberucci, A., Piccardi, A., Kravets, N., Buchnev, O., Assanto, G.

Number of pages: 7

Pages: 783-789

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Optica

Volume: 2

Issue number: 9

ISSN (Print): 2334-2536

Ratings:

Scopus rating (2015): CiteScore 3.5 SJR 4.539 SNIP 2.629

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: Bistability, Instabilities and chaos, Liquid crystals, Nonlinear optics, Self-action effects, Spatial solitons, Transverse effects in

DOIs:

10.1364/OPTICA.2.000783

URLs:

<http://www.scopus.com/inward/record.url?scp=84941123130&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84941123130

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Frequency modulation of semiconductor disk laser pulses

A numerical model is constructed for a semiconductor disk laser mode-locked by a semiconductor saturable absorber mirror (SESAM), and the effect that the phase modulation caused by gain and absorption saturation in the semiconductor has on pulse generation is examined. The results demonstrate that, in a laser cavity with sufficient second-order dispersion, alternating-sign frequency modulation of pulses can be compensated for. We also examine a model for tuning the dispersion in the cavity of a disk laser using a Gires - Tournois interferometer with limited thirdorder dispersion.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Ulyanovsk State University

Contributors: Zolotovskii, I. O., Korobko, D. A., Okhotnikov, O. G.

Number of pages: 7

Pages: 628-634

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: Quantum Electronics

Volume: 45

Issue number: 7

ISSN (Print): 1063-7818

Ratings:

Scopus rating (2015): CiteScore 1.9 SJR 0.589 SNIP 1.177

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Statistical and Nonlinear Physics

Keywords: Frequency modulation of pulses., Semiconductor disk laser

DOIs:

10.1070/QE2015v045n07ABEH015670

Source: Scopus

Source ID: 84938310088

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Theoretical treatment of the interaction between two-level atoms and periodic waveguides

Light transport in periodic waveguides coupled to two-level atoms is investigated theoretically. By using optical Bloch equations and a photonic modal formalism, we derive a convenient semi-analytical expression for calculating the scattering matrix of single atoms trapped in periodic waveguides. The expression that holds for both photonic and plasmonic waveguides represents a basic building block toward the study of collective effects arising from photonmediated multi-atom interactions in periodic waveguides.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Laboratoire Photonique Numérique et Nanosciences, CNRS

Contributors: Zang, X., Lalanne, P.

Number of pages: 4

Pages: 3869-3872

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 40

Issue number: 16

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2015): CiteScore 7 SJR 2.013 SNIP 1.496

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.40.003869

URLs:

<http://www.scopus.com/inward/record.url?scp=84942923805&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84942923805

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Enhanced nonlinearity by H-bonded polymer-dye complex in liquid crystal for holographic gratings**

We have studied a new heterogeneous liquid-crystalline material where H-bonded polymer-azo-dye complexes are used as dopants to the liquid crystal (LC) bulk at a very low concentration. Double enhancement of the holographic gratings' diffraction efficiency occurred in the complex-doped LC compared to dye-doped LC. The grating formation/relaxation processes in complex-doped LC showed anomalies that were explained by the presence of polymer with H bonds. The gratings appeared to be formed due to a change of both the absorption coefficient and refractive index. Using such complexes as dopants gives perspectives for tuning and control of the LC properties, and for possible optical applications.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Institute of Physics, National Academy of Sciences in Ukraine, Aalto University, HCL e 486.1, COMP Centre of Excellence, Department of Applied Physics, Aalto University, Succ. Centre-Ville

Contributors: Ouskova, E., Pshenychnyi, A., Sánchez-Ferrer, A., Lysenko, D., Vapaavuori, J., Kaivola, M.

Number of pages: 9

Pages: 1456-1464

Publication date: 1 Jul 2014

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of the Optical Society of America B

Volume: 31

Issue number: 7

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2014): CiteScore 3.8 SJR 1.167 SNIP 1.126

Original language: English

ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/JOSAB.31.001456

URLs:

<http://www.scopus.com/inward/record.url?scp=84903735673&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84903735673

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **A 1.33 $\mu$ m picosecond pulse generator based on semiconductor disk mode-locked laser and bismuth fiber amplifier**

We demonstrate that a combination of ultrafast wafer bonded semiconductor disk laser and a bismuth-doped fiber amplifier provides an attractive design for high power 1.33  $\mu$ m tandem hybrid systems. Over 0.5 W of average output power was achieved at a repetition rate of 827 MHz that corresponds to a pulse energy of 0.62 nJ. (C) 2014 Optical Society of America

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Research group:

Semiconductor Technology and Applications, Frontier Photonics, Russian Acad Sci, Russian Academy of Sciences, Fiber Opt Res Ctr, Tampere Univ Technol, Tampere University of Technology, Optoelect Res Ctr

Contributors: Heikkinen, J., Gumenyuk, R., Rantamäki, A., Leinonen, T., Melkumov, M., Dianov, E. M., Okhotnikov, O. G.

Number of pages: 10

Pages: 11446-11455

Publication date: 19 May 2014

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 22

Issue number: 10

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2014): CiteScore 7.2 SJR 2.313 SNIP 2.124

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: VERTICAL-CAVITY LASERS, AVERAGE OUTPUT POWER, WAFER FUSION, SUPERCONTINUUM GENERATION, EMITTING LASER, FS PULSES, NM, SURFACE, VECSEL, WAVELENGTH

DOIs:

10.1364/OE.22.011446

URLs:

<http://www.scopus.com/inward/record.url?scp=84901290354&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-05-12<br/>Publisher name: Optical Society of America <br /> publication\_forum: 64457

Source: researchoutputwizard

Source ID: 431

Research output: Contribution to journal > Article > Scientific > peer-review

### Influence of the P<sub>2</sub>O<sub>5</sub>/Al<sub>2</sub>O<sub>3</sub> co-doping on the local environment of erbium ions and on the 1.5 μm quantum efficiency of Er<sup>3+</sup>-borosilicate glasses

In this paper, the absorption properties of Er<sup>3+</sup>-doped borosilicate glasses with various P<sub>2</sub>O<sub>5</sub> and Al<sub>2</sub>O<sub>3</sub> content are measured for different silica concentrations. The Judd-Ofelt parameters ( $\Omega_2$ ,  $\Omega_4$  and  $\Omega_6$ ) have been calculated in order to investigate the local environment of the rare-earth cations. The compositional changes of  $\Omega_2$  and  $\Omega_6$  are attributed to changes in the bonding between Er<sup>3+</sup> and surrounding ligand groups due to structural modifications occurring with the introduction of P<sub>2</sub>O<sub>5</sub> and Al<sub>2</sub>O<sub>3</sub>. The luminescence quantum efficiency of the  $^4I_{13/2} \rightarrow ^4I_{15/2}$  transition slightly increases with the addition of P<sub>2</sub>O<sub>5</sub> whereas it decreases with the progressive replacement of P<sub>2</sub>O<sub>5</sub> by Al<sub>2</sub>O<sub>3</sub>. We noticed that it also increases when the silica content is higher.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Politecnico di Torino, nLIGHT Corporation, Johan Gadolin Process Chemistry Centre, Abo Akademi University

Contributors: Bourhis, K., Boetti, N. G., Koponen, J., Milanese, D., Petit, L.

Number of pages: 6

Pages: 926-931

Publication date: Mar 2014

Peer-reviewed: Yes

### Publication information

Journal: Optical Materials

Volume: 36

Issue number: 5

ISSN (Print): 0925-3467

Ratings:

Scopus rating (2014): CiteScore 3.8 SJR 0.721 SNIP 1.204

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Computer Science(all)

Keywords: Er doped borosilicate glasses, Judd-Ofelt parameters, Lifetime, Luminescence quantum efficiency

DOIs:

10.1016/j.optmat.2013.12.035

URLs:

<http://www.scopus.com/inward/record.url?scp=84893847084&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893847084

Research output: Contribution to journal > Article > Scientific > peer-review

### Role of cavity dispersion on soliton grouping in a fiber lasers

The effect of cavity dispersion on the dynamics of bound soliton states in a fiber laser has been studied both experimentally and numerically. The mode-locking mechanism in a laser was provided by the frequency-shifted feedback to avoid the influence of soliton attraction that could be induced by saturable absorption. It was found that phase-locked bound solitons are stable for dispersion below the "threshold" value of 0.2 ps/nm which depends on the other cavity parameters. For higher dispersion the bound states collapse resulting in the multiple weakly-interacting soliton regime, circulating randomly within the cavity. (C) 2014 Optical Society of America

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Ultrafast and intense lasers, Optoelectronics Research Centre, Tampere University of Technology, Frontier Photonics, Ulyanovsk State University

Contributors: Gumenyuk, R., Korobko, D. A., Zolotovskiy, I. O., Okhotnikov, O. G.

Number of pages: 10

Pages: 1896-1905

Publication date: 27 Jan 2014

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 22

Issue number: 2

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2014): CiteScore 7.2 SJR 2.313 SNIP 2.124

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: BOUND-STATES, PULSES, GENERATION

DOIs:

10.1364/OE.22.001896

URLs:

<http://www.scopus.com/inward/record.url?scp=84893374953&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-02-15<br/>Publisher name: Optical Society of America <br />

publication\_forum: 64457

Source: researchoutputwizard

Source ID: 379

Research output: Contribution to journal > Article > Scientific > peer-review

### An Optical Sensor for Volatile Amines Based on an Inkjet-Printed, Hydrogen-Bonded, Cholesteric Liquid Crystalline Film

A printable hydrogen-bonded cholesteric liquid crystal (CLC) polymer film is described, which can be used as a sensor for detection of gaseous trimethylamine (TMA). In this optical sensor the virgin CLC polymer network reflects green light. When anhydrous TMA gas penetrates the film, disruption of the hydrogen bonds occurs, with the simultaneous formation of carboxylate salts. The consequent reduction of the molecular order causes the green reflecting CLC film to become colorless. However, exposure to TMA in water-saturated nitrogen gas results in a red reflecting film. Due to the hygroscopic nature of the polymer salt that is formed by TMA, water vapor which is present in the environment is absorbed by the films. This leads to swelling of the film, resulting in an increase in pitch size and therefore a red shift of the reflection band. Interestingly, after exposure to ambient conditions, restoration of the green reflecting film takes place, showing that the sensor can be used multiple times. In a proof of principle experiment, it was shown that these CLC films can be used as optical sensors to detect volatile amines, that are produced by decaying fish. Facile determination of volatile amines in an optical fashion is possible with the use of hydrogen-bonded cholesteric liquid crystalline polymer films. Due to a response of the film to trimethylamine gas, the cholesteric reflector changes its color. This optical sensor is inkjet-printed on a foil, making it suitable for food packaging applications.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Functional Organic Materials and Devices, Eindhoven University of Technology, School of Mathematical Sciences

Contributors: Stumpel, J. E., Wouters, C., Herzer, N., Ziegler, J., Broer, D. J., Bastiaansen, C. W. M., Schenning, A. P. H. J.

Number of pages: 6  
Pages: 459-464  
Publication date: 2014  
Peer-reviewed: Yes

#### Publication information

Journal: Advanced Optical Materials  
Volume: 2

Issue number: 5  
ISSN (Print): 2195-1071  
Ratings:

Scopus rating (2014): CiteScore 2.9 SJR 1.812 SNIP 1.755

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: Amine detection, Cholesteric liquid crystals, Inkjet printing, Sensors, Stimuli-responsive materials

DOIs:

10.1002/adom.201300516

URLs:

<http://www.scopus.com/inward/record.url?scp=84900420820&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Stumpel, Jelle"

Source: Scopus

Source ID: 84900420820

Research output: Contribution to journal > Article > Scientific > peer-review

### Polymer stabilization enhances the orientational optical nonlinearity of oligothiophene-doped nematic liquid crystals

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Tokyo Institute of Technology, Aalto University

Contributors: Aihara, Y., Kinoshita, M., Wang, J., Mamiya, J. I., Priimagi, A., Shishido, A.

Number of pages: 5

Pages: 787-791

Publication date: Nov 2013

Peer-reviewed: Yes

#### Publication information

Journal: Advanced Optical Materials

Volume: 1

Issue number: 11

ISSN (Print): 2195-1071

Ratings:

Scopus rating (2013): CiteScore 0.9

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: Liquid crystals, Nonlinear optics, Oligothiophenes, Optical nonlinearity, Polymer stabilization

DOIs:

10.1002/adom.201300326

URLs:

<http://www.scopus.com/inward/record.url?scp=84888056420&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84888056420

Research output: Contribution to journal > Article > Scientific > peer-review

### Passive wireless antenna sensor for strain and crack sensing - Electromagnetic modeling, simulation, and testing

This research investigates a passive wireless antenna sensor designed for strain and crack sensing. When the antenna experiences deformation, the antenna shape changes, causing a shift in the electromagnetic resonance frequency of the antenna. A radio frequency identification (RFID) chip is adopted for antenna signal modulation, so that a wireless reader can easily distinguish the backscattered sensor signal from unwanted environmental reflections. The RFID chip captures its operating power from an interrogation electromagnetic wave emitted by the reader, which allows the antenna sensor to be passive (battery-free). This paper first reports the latest simulation results on radiation patterns, surface current density, and electromagnetic field distribution. The simulation results are followed with experimental results on the strain and crack

sensing performance of the antenna sensor. Tensile tests show that the wireless antenna sensor can detect small strain changes lower than  $20 \mu\epsilon$ , and can perform well at large strains higher than  $10\,000 \mu\epsilon$ . With a high-gain reader antenna, the wireless interrogation distance can be increased up to 2.1 m. Furthermore, an array of antenna sensors is capable of measuring the strain distribution in close proximity. During emulated crack and fatigue crack tests, the antenna sensor is able to detect the growth of a small crack.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering, Virginia Tech

Contributors: Yi, X., Cho, C., Cooper, J., Wang, Y., Tentzeris, M. M., Leon, R. T.

Publication date: Aug 2013

Peer-reviewed: Yes

#### Publication information

Journal: Smart Materials and Structures

Volume: 22

Issue number: 8

Article number: 085009

ISSN (Print): 0964-1726

Ratings:

Scopus rating (2013): CiteScore 4.4 SJR 1.006 SNIP 1.93

Original language: English

ASJC Scopus subject areas: Signal Processing, Atomic and Molecular Physics, and Optics, Civil and Structural Engineering, Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Electrical and Electronic Engineering

DOIs:

10.1088/0964-1726/22/8/085009

URLs:

<http://www.scopus.com/inward/record.url?scp=84881172175&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84881172175

Research output: Contribution to journal > Article > Scientific > peer-review

#### Optical vortices in antiguides

We address the question of whether an optical vortex can be trapped in a dielectric structure with a core of a lower refractive index than the cladding—namely an antiguide. Extensive numerical simulations seem to indicate that this inverse trapping of a vortex is not possible, at least in straightforward implementations. Yet, the interaction of a vortex beam with a curved antiguide produces interesting effects, namely a small but finite displacement of the optical energy center-of-mass and the creation of a symmetrical vortex-antivortex pair on the exterior of the antiguide.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, CNR-SPIN, University of Edinburgh, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Marrucci, L., Smyth, N. F., Assanto, G.

Number of pages: 3

Pages: 1618-1620

Publication date: 15 May 2013

Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 38

Issue number: 10

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2013): CiteScore 6.7 SJR 2.441 SNIP 2.042

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.38.001618

URLs:

<http://www.scopus.com/inward/record.url?scp=84878625298&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84878625298

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **A near-infrared optoelectronic approach to detection of road conditions**

We introduce and test an original approach for the optical assessment of road conditions due to various atmospheric perturbations such as the presence of ice, wet surfaces and rain. The technique is based on measuring diffused and reflected light under near infrared illumination, extracting the polarization contrast after reflection. Several tests, carried out on various types of asphalt and various thicknesses of water and ice layers, demonstrate that the system exhibits selectivity and robustness to allow the recognition of dry asphalt, water-layered, wet asphalt and asphalt with ice.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab

Contributors: Colace, L., Santoni, F., Assanto, G.

Number of pages: 4

Pages: 633-636

Publication date: May 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics and Lasers in Engineering

Volume: 51

Issue number: 5

ISSN (Print): 0143-8166

Ratings:

Scopus rating (2013): CiteScore 4.2 SJR 0.864 SNIP 1.851

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Mechanical Engineering

Keywords: Ice detection, Near-infrared, Optical sensors

DOIs:

10.1016/j.optlaseng.2013.01.003

URLs:

<http://www.scopus.com/inward/record.url?scp=84874118385&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84874118385

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Boundary element method for surface nonlinear optics of nanoparticles: Erratum**

We report a correction to the numerical procedure, in which the source vector lacked a factor 1/2 and the integration in Eq. (19) was incorrect. The errors are inconsequential for the main results.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics, Department of Electrical Engineering, Department of Physics, Frontier Photonics

Contributors: Makitalo, J., Suuriniemi, S., Kauranen, M.

Number of pages: 2

Pages: 10205-10206

Publication date: 22 Apr 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 21

Issue number: 8

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2013): CiteScore 7.3 SJR 2.337 SNIP 2.18



Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.21.010205

URLs:

<http://www.scopus.com/inward/record.url?scp=84877110384&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84877110384

Research output: Contribution to journal > Article > Scientific > peer-review

### Dipole polarizabilities of Pd<sub>N</sub> (N = 2-25) clusters

The dipole polarizabilities of Pd<sub>N</sub> (N = 2-25) clusters are studied using a scheme for decomposing the total polarizability of a system into site-specific contributions. Furthermore, the polarizabilities are partitioned into dipole and charge transfer components. The structure and size-specific aspects of the polarizabilities are analyzed. It is shown that the polarizabilities associated with the individual constituent atoms vary considerably with the structure of the cluster and the location of the atom or site within a given structure. For atoms at peripheral sites, the polarizabilities are substantially larger than atoms at the interior sites, and the more peripheral an atom is, the larger its polarizability. This indicates significant screening of the cluster interior by its surface. The oscillations in the total polarizability mainly come from charge transfer component oscillatory behavior and the later approaches the bulk polarizability per atom. The anisotropy of the total polarizability is closely related with the anisotropy of the cluster shape.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computational Science X (CompX), Northwest University China, National Laboratory of Solid State Microstructures, Nanjing University, Institute of Photonics and Photo-technology

Contributors: Ma, L., Wang, J., Wang, G.

Publication date: Jan 2013

Peer-reviewed: Yes

### Publication information

Journal: European Physical Journal D

Volume: 67

Issue number: 1

Article number: 6

ISSN (Print): 1434-6060

Ratings:

Scopus rating (2013): CiteScore 2.9 SJR 0.707 SNIP 0.799

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: Clusters and Nanostructures

DOIs:

10.1140/epjd/e2012-30550-1

URLs:

<http://www.scopus.com/inward/record.url?scp=84887675298&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84887675298

Research output: Contribution to journal > Article > Scientific > peer-review

### Deflection of nematicons through interaction with dielectric particles

We show that the simple interaction of spatial optical solitons in nematic liquid crystals with dielectric particles preserves in most cases the self-confinement of these robust nonlinear self-trapped beams, also known as nematicons. Employing spherical defects such as air bubbles and glass spheres, we report on the experimental observation of total internal reflection as well as refractive deflection of nematicons, with angular changes as large as nearly 90°. We also show multiple reflections and the interaction of a particle with two counterpropagating nematicons.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Taurida National University, Australian National University, Univ Roma Tre, Roma Tre University, Dept Elect Engr, NooEL, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y. S.

Number of pages: 6

Pages: 1432-1437

Publication date: 2013

Peer-reviewed: Yes

#### Publication information

Journal: Journal of the Optical Society of America B

Volume: 30

Issue number: 6

ISSN (Print): 0740-3224

Ratings:

Scopus rating (2013): CiteScore 4.3 SJR 1.348 SNIP 1.273

Original language: English

ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/JOSAB.30.001432

URLs:

<http://www.scopus.com/inward/record.url?scp=84878735978&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84878735978

Research output: Contribution to journal > Article > Scientific > peer-review

#### Calculation of the scalar diffraction field from curved surfaces by decomposing the three-dimensional field into a sum of Gaussian beams

We present a local Gaussian beam decomposition method for calculating the scalar diffraction field due to a two-dimensional field specified on a curved surface. We write the three-dimensional field as a sum of Gaussian beams that propagate toward different directions and whose waist positions are taken at discrete points on the curved surface. The discrete positions of the beam waists are obtained by sampling the curved surface such that transversal components of the positions form a regular grid. The modulated Gaussian window functions corresponding to Gaussian beams are placed on the transversal planes that pass through the discrete beam-waist position. The coefficients of the Gaussian beams are found by solving the linear system of equations where the columns of the system matrix represent the field patterns that the Gaussian beams produce on the given curved surface. As a result of using local beams in the expansion, we end up with sparse system matrices. The sparsity of the system matrices provides important advantages in terms of computational complexity and memory allocation while solving the system of linear equations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing Research Community (SPRC), Bilkent University

Contributors: Şahin, E., Onural, L.

Number of pages: 10

Pages: 527-536

Publication date: 2013

Peer-reviewed: Yes

#### Publication information

Journal: Journal of the Optical Society of America A: Optics Image Science and Vision

Volume: 30

Issue number: 3

ISSN (Print): 1084-7529

Ratings:

Scopus rating (2013): CiteScore 3.3 SJR 1.046 SNIP 1.331

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Computer Vision and Pattern Recognition

URLs:

<http://www.scopus.com/inward/record.url?scp=84875512966&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84875512966

Research output: Contribution to journal > Article > Scientific > peer-review

#### Spoof-plasmon relevant one-way collimation and multiplexing at beaming from a slit in metallic grating

Diode and collimator/multiplexer functions are suggested to be combined in one device that is based on a thin metallic grating with a single subwavelength slit. A proper choice of the structural (a)symmetry of the grating can result in obtaining one-way collimation and multiplexing with a single on-axis or off-axis, or two off-axis narrow outgoing beams. It is possible due to freedom in utilizing different combinations of the excitation conditions of the spoof surface plasmons at the four grating parts - right and left front-side and right and left back-side ones. Such a combining provides one with an efficient

tool to engineer one-way collimators and multiplexers with the desired characteristics. Strong asymmetry in transmission with respect to the incidence direction (forward vs backward case) can be obtained within a wide range of variation of the incident beam parameters, i.e., angle of incidence and frequency, while the outgoing radiation is concentrated within a narrow range of the observation angle variation. Most of the observed asymmetric transmission features can be qualitatively explained using the concept of the equivalent source placed inside the slit.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University, Hamburg University of Technology, Department of Electrical and Systems Engineering, University of Pennsylvania

Contributors: Cakmakyapan, S., Serebryannikov, A. E., Caglayan, H., Ozbay, E.

Number of pages: 13

Pages: 26636-26648

Publication date: 19 Nov 2012

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 20

Issue number: 24

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2012): CiteScore 6.5 SJR 2.562 SNIP 2.095

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.20.026636

URLs:

<http://www.scopus.com/inward/record.url?scp=84870590831&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 84870590831

Research output: Contribution to journal > Article > Scientific > peer-review

#### All-optical switching of a signal by a pair of interacting nematicons

We investigate a power tunable junction formed by two interacting spatial solitons self-trapped in nematic liquid crystals. By launching a counter-propagating copolarized probe we assess the guided-wave behavior induced by the solitons and demonstrate a novel all-optical switch. Varying soliton power the probe gets trapped into one or two or three guided-waves by the soliton-induced index perturbation, an effect supported by the nonlocal nonlinearity.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Taurida National University, University of Applied Sciences, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Rebling, J., Desyatnikov, A. S., Assanto, G., Kivshar, Y. S.

Number of pages: 7

Pages: 24701-24707

Publication date: 22 Oct 2012

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 20

Issue number: 22

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2012): CiteScore 6.5 SJR 2.562 SNIP 2.095

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.20.024701

URLs:

<http://www.scopus.com/inward/record.url?scp=84868234223&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84868234223

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Refraction of nonlinear light beams in nematic liquid crystals**

We use modulation theory to analyze the interaction of optical solitons and vortices with a dielectric interface between two regions of nematic liquid crystals. In the analysis we consider the role of nonlocality, anisotropy and nonlinear reorientation and compare modulation theory results with numerical results. Upon interacting with the interface, nematicons undergo transverse distortion but remain stable and eventually return to a steady state, whereas vortices experience an enhanced instability and can break up into bright beams or solitary waves.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Nonlinear Optics and OptoElectronics Lab, University of Edinburgh

Contributors: Assanto, G., Smyth, N. F., Xia, W.

Publication date: Sep 2012

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Nonlinear Optical Physics and Materials

Volume: 21

Issue number: 3

Article number: 1250033

ISSN (Print): 0218-8635

Ratings:

Scopus rating (2012): CiteScore 0.9 SJR 0.299 SNIP 0.324

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Physics and Astronomy (miscellaneous)

Keywords: Liquid crystal, modulation theory, nematicon, refraction, soliton

DOIs:

[10.1142/S0218863512500336](https://doi.org/10.1142/S0218863512500336)

URLs:

<http://www.scopus.com/inward/record.url?scp=84871342982&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84871342982

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Scalar diffraction field calculation from curved surfaces via Gaussian beam decomposition**

We introduce a local signal decomposition method for the analysis of three-dimensional (3D) diffraction fields involving curved surfaces. We decompose a given field on a two-dimensional curved surface into a sum of properly shifted and modulated Gaussian-shaped elementary signals. Then we write the 3D diffraction field as a sum of Gaussian beams, each of which corresponds to a modulated Gaussian window function on the curved surface. The Gaussian beams are propagated according to a derived approximate expression that is based on the Rayleigh-Sommerfeld diffraction model. We assume that the given curved surface is smooth enough that the Gaussian window functions on it can be treated as written on planar patches. For the surfaces that satisfy this assumption, the simulation results show that the proposed method produces quite accurate 3D field solutions.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing Research Community (SPRC), Bilkent University

Contributors: Şahin, E., Onural, L.

Number of pages: 11

Pages: 1459-1469

Publication date: 1 Jul 2012

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of the Optical Society of America A: Optics Image Science and Vision

Volume: 29

Issue number: 7  
ISSN (Print): 1084-7529  
Ratings:

Scopus rating (2012): CiteScore 3.2 SJR 1.065 SNIP 1.198

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Computer Vision and Pattern Recognition

DOIs:

10.1364/JOSAA.29.001459

URLs:

<http://www.scopus.com/inward/record.url?scp=84863743776&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84863743776

Research output: Contribution to journal > Article > Scientific > peer-review

### **Composite chiral metamaterials with negative refractive index and high values of the figure of merit**

A composite chiral metamaterial (CCMM) is designed and studied both numerically and experimentally. The CCMM is constructed by the combination of a continuous metallic wires structure and a purely chiral metamaterial (CMM) that consists of conjugated Rosettes. For the CMM, only very small, useful bands of negative index can be obtained for circularly polarized waves. These bands are all above the chiral resonance frequencies because of the high value of the effective parameter of relative permittivity  $\hat{\epsilon}$ . After the addition of the continuous metallic wires, which provide negative permittivity, the high value of  $\hat{\epsilon}$  can be partially compensated. Thus, a negative index band for the left circularly polarized wave that is below the chiral resonance frequency is obtained for the CCMM. At the same time, a negative index band for the right circularly polarized wave that is above the chiral resonance frequency is also obtained. Furthermore, both negative index bands correspond to the transmission peaks and have high values of the figure of merit. Therefore, the CCMM design that is proposed here is more suitable than the CMM for the construction of chiral metamaterials with a negative index.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University, Nanotechnology Research Center, University of Crete, Iowa State University

Contributors: Li, Z., Alici, K. B., Caglayan, H., Kafesaki, M., Soukoulis, C. M., Ozbay, E.

Number of pages: 11

Pages: 6146-6156

Publication date: 12 Mar 2012

Peer-reviewed: Yes

### **Publication information**

Journal: Optics Express

Volume: 20

Issue number: 6

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2012): CiteScore 6.5 SJR 2.562 SNIP 2.095

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.20.006146

URLs:

<http://www.scopus.com/inward/record.url?scp=84858982033&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 84858982033

Research output: Contribution to journal > Article > Scientific > peer-review

### **Development of a new illumination procedure for photodynamic therapy of the abdominal cavity**

A homogeneous illumination of intra-abdominal organs is essential for successful photodynamic therapy of the abdominal cavity. Considering the current lack of outstanding light-delivery systems, a new illumination procedure was assessed. A rat model of peritoneal carcinomatosis was used. Four hours after intraperitoneal injection of hexaminolevulinate, a square illuminating panel connected to a 635-nm laser source was inserted vertically into the abdominal cavity. The abdominal incision was sutured and a pneumoperitoneum created prior to illumination. Light dosimetry was based on the calculation

of the peritoneal surface by MRI. The rats were treated with a light dose of 20, 10, 5 or 2.5 J/cm<sup>2</sup> administered continuously with an irradiance of 7 mW/cm<sup>2</sup>. The homogeneity of the cavity illumination was assessed by quantification of the photobleaching of the tumor lesions according to their localization and by scoring of that of the liver and of the bowel immediately after treatment. Photobleaching quantification for tumor lesions relied on the calculation of the fluorescence intensity ratio (after/before treatment) after recording of the lesions during blue-light laparoscopy and determination of their fluorescence intensity with Sigmascan Pro software. The procedure led to a homogeneous treatment of the abdominal cavity. No statistical difference was observed for the photobleaching values according to the localization of the lesions on the peritoneum ( $p = 0.59$ ) and photobleaching of the liver and of the intestine was homogeneous. We conclude that this procedure can successfully treat the major sites involved in peritoneal carcinomatosis.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Lille University Hospital - CHRU, Univ Lille Nord de France, GDR 3049

Contributors: Cuyon, L., Lesage, J. C., Betrouni, N., Mordon, S.

Publication date: Mar 2012

Peer-reviewed: Yes

#### Publication information

Journal: JOURNAL OF BIOMEDICAL OPTICS

Volume: 17

Issue number: 3

Article number: 038001

ISSN (Print): 1083-3668

Ratings:

Scopus rating (2012): CiteScore 4.9 SJR 1.292 SNIP 1.329

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Biomaterials, Biomedical Engineering

Keywords: Hexaminolevulinate, Light dosimetry, Peritoneal carcinomatosis, Photobleaching, Photodynamic therapy

DOIs:

10.1117/1.JBO.17.3.038001

URLs:

<http://www.scopus.com/inward/record.url?scp=84864951116&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84864951116

Research output: Contribution to journal > Article > Scientific > peer-review

#### Second-harmonic generation from coupled plasmon modes in a single dimer of gold nanospheres

We show that a dimer made of two gold nanospheres exhibits a remarkable efficiency for second-harmonic generation under femtosecond optical excitation. The detectable nonlinear emission for the given particle size and excitation wavelength arises when the two nanoparticles are as close as possible to contact, as in situ controlled and measured using the tip of an atomic force microscope. The excitation wavelength dependence of the second-harmonic signal supports a coupled plasmon resonance origin with radiation from the dimer gap. This nanometer-size light source might be used for high-resolution near-field optical microscopy.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, CNRS Centre National de la Recherche Scientifique, Laboratoire de Photonique Quantique et Moléculaire-ENS Cachan, UMR 8537, Institut Laue-Langevin, Ecole Normale Supérieure de Cachan and CNRS, ESPCI ParisTech and CNRS, UMR 7587

Contributors: Slablab, A., Le Xuan, L., Zielinski, M., De Wilde, Y., Jacques, V., Chauvat, D., Roch, J. F.

Number of pages: 8

Pages: 220-227

Publication date: 2 Jan 2012

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 20

Issue number: 1

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2012): CiteScore 6.5 SJR 2.562 SNIP 2.095

Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/OE.20.000220  
Source: Scopus  
Source ID: 84855424195  
Research output: Contribution to journal › Article › Scientific › peer-review

### Third order nonlinear optical response of TTF-based molecular corners

Comparative study of the nonlinear optical response of pyrrolo-tetrathiafulvalene polygons has been carried out. These materials are of great importance for photonics, because they can be used as building blocks for more complicated molecular systems like rotaxanes, catenanes which are promising candidates for opto-electronic applications like optical computing, optical switching etc. During this work the third order nonlinear susceptibility ( $\chi^{(3)}$ ) has been determined by the Degenerate Four Wave Mixing experiment, while the imaginary part of the  $\chi^{(3)}$ , which is related with the nonlinear absorption was determined by "open-aperture" Z-scan measurements. Moreover measurements have been carried out in order to provide information about the optical limiting efficiency of the materials. High  $\chi^{(3)}$  has been found reaching  $2.30 \times 10^{-21} \text{ m}^2/\text{V}^2$ , corresponding to second order hyperpolarizability  $\gamma$  values of about  $6.5 \times 10^{-45} \text{ m}^5/\text{V}^2$ .

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Frontier Photonics, CNRS, Centre National de la Recherche Scientifique (CNRS), Universite de Bordeaux - PRES, Lab Bordelais Rech Informat, PICTURA Res Grp, UMR 5800, Univ Angers, Centre National de la Recherche Scientifique (CNRS), University of Nantes Angers Le Mans, University of Angers, CNRS UMR 6200, Inst Sci & Technol Mol Angers, LUNAM Université, Laboratoire MOLTECH-Anjou  
Contributors: Iliopoulos, K., Czaplicki, R., Ouazzani, H. E., Balandier, J., Chas, M., Goeb, S., Sallé, M., Gindre, D., Sahraoui, B.  
Number of pages: 8  
Pages: 205-212  
Publication date: 2012  
Peer-reviewed: Yes

### Publication information

Journal: Nonlinear Optics, Quantum Optics  
Volume: 43  
Issue number: 1-4  
ISSN (Print): 1543-0537  
Ratings:  
Scopus rating (2012): CiteScore 0.7 SJR 0.211 SNIP 0.272  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Statistical and Nonlinear Physics, Instrumentation , Computer Science(all), Electronic, Optical and Magnetic Materials  
Keywords: Degenerate four wave mixing (DFWM), Nonlinear optical response, TTF derivatives, Z-scan  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84862149419&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84862149419  
Research output: Contribution to journal › Article › Scientific › peer-review

### Features of randomized electric-field assisted domain inversion in lithium tantalate

We report on bulk and guided-wave second-harmonic generation via random Quasi-Phase-Matching in Lithium Tantalate. By acquiring the far-field profiles at several wavelengths, we extract statistical information on the distribution of the quadratic nonlinearity as well as its average period, both at the surface and in the bulk of the sample. By investigating the distribution in the two regions we demonstrate a non-invasive approach to the study of poling dynamics.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Frontier Photonics, Building No. 9, Univ Roma Tre, Roma Tre University, Dept Elect Engrn, NooEL, University "Roma Tre"  
Contributors: Stivala, S., Buccheri, F., Curcio, L., Oliveri, R. L., Busacca, A. C., Assanto, G.  
Number of pages: 6  
Pages: 25780-25785  
Publication date: 5 Dec 2011

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 19

Issue number: 25

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2011): CiteScore 6.4 SJR 2.58 SNIP 2.558

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=82955226248&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 82955226248

Research output: Contribution to journal › Article › Scientific › peer-review

### Localized nonlinear wavepackets with radial-azimuthal modulated nonlinearity and an external potential

We analytically investigated two-dimensional localized nonlinear waves in Kerr media with radial and azimuthal modulation of the nonlinearity and in the presence of an external potential. The solutions have been derived through the similarity transformation. We demonstrate that the properties of nonlinear waves are determined by two parameters: a whole number  $n$  (the index of the Jacobi elliptical waves) and an integer  $m$  (the topological charge). Our results indicate that the dynamic evolution, including cnoidal and snoidal waves, can be strongly affected by these two parameters, providing an approach to controlling nonlinear waves by an appropriate radial-azimuthal modulation of the nonlinearity, with an appropriate external potential.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Shunde Polytechnic, Texas A and M University at Qatar, NooEL, University "Roma Tre"

Contributors: Zhong, W. P., Belić, M. R., Assanto, G.

Publication date: Nov 2011

Peer-reviewed: Yes

### Publication information

Journal: Physica Scripta

Volume: 84

Issue number: 5

Article number: 055001

ISSN (Print): 0031-8949

Ratings:

Scopus rating (2011): CiteScore 1.6 SJR 0.428 SNIP 0.706

Original language: English

ASJC Scopus subject areas: Condensed Matter Physics, Atomic and Molecular Physics, and Optics, Mathematical Physics

DOIs:

10.1088/0031-8949/84/05/055001

URLs:

<http://www.scopus.com/inward/record.url?scp=80755143598&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80755143598

Research output: Contribution to journal › Article › Scientific › peer-review

### Progress in direct nanoparticle deposition for the development of the next generation fiber lasers

This paper outlines the most recent work at nLIGHT Oy (formerly Liekki Oy). We give an overview of the current state of the nLIGHT active fiber fabrication technology, discuss the capability of the manufacturing process, and review our results and the results of other groups on the reliability aspects of the manufactured fibers. We also present refractive index tailored and gain tailored Yb doped fibers as examples of recent fiber development.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, NLIGHT Corp

Contributors: Koponen, J. J., Petit, L., Kokki, T., Aallos, V., Paul, J., Ihalainen, H.



Publication date: Nov 2011

Peer-reviewed: Yes

#### Publication information

Journal: Optical Engineering

Volume: 50

Issue number: 11

Article number: 111605

ISSN (Print): 0091-3286

Ratings:

Scopus rating (2011): CiteScore 1.5 SJR 0.471 SNIP 0.976

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering(all)

Keywords: fiber applications, fiber characterization, fiber lasers, fiber optics

DOIs:

10.1117/1.3613944

URLs:

<http://www.scopus.com/inward/record.url?scp=80054802088&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80054802088

Research output: Contribution to journal › Article › Scientific › peer-review

#### Dipole azimuthons and vortex charge flipping in nematic liquid crystals

We demonstrate self-trapped laser beams carrying phase singularities in nematic liquid crystals. We experimentally observe the astigmatic transformation of vortex beams into spiraling dipole azimuthons accompanied by power-dependent charge-flipping of the on-axis phase singularity. The latter topological reactions involve triplets of vortex lines and resemble pitchfork bifurcations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y. S.

Number of pages: 10

Pages: 21457-21466

Publication date: 24 Oct 2011

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 19

Issue number: 22

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2011): CiteScore 6.4 SJR 2.58 SNIP 2.558

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.19.021457

URLs:

<http://www.scopus.com/inward/record.url?scp=80054909130&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80054909130

Research output: Contribution to journal › Article › Scientific › peer-review

#### Light bullets in the spatiotemporal nonlinear Schrödinger equation with a variable negative diffraction coefficient

We report approximate analytical solutions to the (3+1)-dimensional spatiotemporal nonlinear Schrödinger equation, with the uniform self-focusing nonlinearity and a variable negative radial diffraction coefficient, in the form of three-dimensional solitons. The model may be realized in artificial optical media, such as left-handed materials and photonic crystals, with the anomalous sign of the group-velocity dispersion (GVD). The same setting may be realized through the interplay of the self-defocusing nonlinearity, normal GVD, and positive variable diffraction. The Hartree approximation is utilized to achieve a suitable separation of variables in the model. Then, an inverse procedure is introduced, with the aim to select a suitable profile of the modulated diffraction coefficient supporting desirable soliton solutions (such as dromions, single- and

multilayer rings, and multisoliton clusters). The validity of the analytical approximation and stability of the solutions is tested by means of direct simulations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Shunde Polytechnic, University of Belgrade, Univ Roma Tre, Roma Tre University, Dept Elect Engn, NooEL, University "Roma Tre", Mediterranean Technology Park, Texas A and M University at Qatar

Contributors: Zhong, W. P., Belić, M., Assanto, G., Malomed, B. A., Huang, T.

Publication date: 3 Oct 2011

Peer-reviewed: Yes

#### Publication information

Journal: Physical Review A

Volume: 84

Issue number: 4

Article number: 043801

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2011): CiteScore 5 SJR 2.316 SNIP 1.266

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.84.043801

URLs:

<http://www.scopus.com/inward/record.url?scp=80053467722&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80053467722

Research output: Contribution to journal › Article › Scientific › peer-review

#### Modulation analysis of nonlinear beam refraction at an interface in liquid crystals

A theoretical investigation of solitary wave refraction in nematic liquid crystals is undertaken. A modulation theory based on a Lagrangian formulation of the governing optical solitary wave equations is developed. The resulting low-dimensional equations are found to give solutions in excellent agreement with full numerical solutions of the governing equations, as well as with previous experimental studies. The analysis deals with a number of types of refraction from a more to a less optically dense medium, the most famous being the Goos-Hänchen shift upon total internal reflection.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre", University of Edinburgh

Contributors: Assanto, G., Smyth, N. F., Xia, W.

Publication date: 13 Sep 2011

Peer-reviewed: Yes

#### Publication information

Journal: Physical Review A

Volume: 84

Issue number: 3

Article number: 033818

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2011): CiteScore 5 SJR 2.316 SNIP 1.266

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.84.033818

URLs:

<http://www.scopus.com/inward/record.url?scp=80052701634&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80052701634

Research output: Contribution to journal › Article › Scientific › peer-review

### **Photoinduced bending upon pulsed irradiation in azobenzene-containing crosslinked liquid-crystalline polymers**

We have investigated the photoresponsive behavior of homogeneously aligned low-azobenzene-concentration crosslinked liquid-crystalline polymers. We compared the thermal contraction and photocontraction of the films, and show that upon UV irradiation, they bend efficiently towards the actinic light source. The photoinduced bending is studied both under continuous-wave irradiation and irradiation with nanosecond pulses. Pulsed irradiation revealed that the photomechanical response can take place within sub-millisecond time scale, and that even a single laser pulse can cause the sample to bend.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Tokyo Institute of Technology, Aalto University, Chuo University

Contributors: Shimamura, A., Priimagi, A., Mamiya, J. I., Kinoshita, M., Ikeda, T., Shishido, A.

Number of pages: 9

Pages: 405-413

Publication date: Sep 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Nonlinear Optical Physics and Materials

Volume: 20

Issue number: 4

ISSN (Print): 0218-8635

Ratings:

Scopus rating (2011): CiteScore 0.8 SJR 0.245 SNIP 0.207

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Physics and Astronomy (miscellaneous)

Keywords: Azobenzene, Liquid crystal, Photocontraction, Photomobile materials, Pulsed irradiation

DOIs:

10.1142/S0218863511006200

URLs:

<http://www.scopus.com/inward/record.url?scp=84861871012&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84861871012

Research output: Contribution to journal > Article > Scientific > peer-review

### **Single-layer one-dimensional nonpolarizing guided-mode resonance filters under normal incidence**

We demonstrate that properly designed one-dimensional guided-mode resonance filters (GMRFs) with only one grating layer can exhibit a nonpolarizing resonant filtering effect under normal incidence. A sinusoidal profile nonpolarizing GMRF is realized by photoinduced surface-relief grating formation on thin films of polymer- azobenzene complexes and subsequent atomic layer deposition, showing the feasibility of fabrication of such compact GMRFs.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Aalto University, Tsinghua University, Ita-Suomen yliopisto, Department of Physics and Mathematics

Contributors: Alasaarela, T., Zheng, D., Huang, L., Priimagi, A., Bai, B., Tervonen, A., Honkanen, S., Kuittinen, M., Turunen, J.

Number of pages: 3

Pages: 2411-2413

Publication date: 1 Jul 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 36

Issue number: 13

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2011): CiteScore 5.6 SJR 2.519 SNIP 2.437

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.36.002411

URLs:

<http://www.scopus.com/inward/record.url?scp=79959926937&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79959926937

Research output: Contribution to journal › Article › Scientific › peer-review

### **Integrated Bragg reflectors in low-index media: Enabling strategies for wavelength tunability in electro-optic liquid crystals**

This paper reports two configurations of Bragg reflectors based on liquid crystals confined between two small glass plates. Both approaches employ the efficient electro-optic effect in liquid crystals, which allows tunability of the reflectors by using low voltages. The molecular reorientation induced by an applied electric field implies a refractive index modulation seen by polarized light propagating into the liquid crystal. We show design criteria and profile optimization of the electrodes to induce a liquid crystal refractive index periodic modulation, providing a wavelength selective propagation of confined light in the liquid crystal. The two proposed device configurations differ for the top-bottom electrode configuration in one case and coplanar electrodes in the other case. Modeling of both configurations has been carried by calculating the applied electric field distribution and its interaction with the liquid crystal elastic properties taking into account the boundary conditions due to the alignment layer on the inner faces of the glass substrates. The calculated performance in terms of high wavelength selectivity and ultrawide spectral tuning range indicate that the two designed structures can be proposed for both optical filtering and to produce novel low power integrated distributed feedback resonators in dense wavelength division multiplexed fiber optic systems.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Sapienza University, Univ Roma Tre, Roma Tre University, Dept Elect Engn, NooEL, University "Roma Tre"

Contributors: Asquini, R., Gilardi, G., D'Alessandro, A., Assanto, G.

Publication date: Jul 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Optical Engineering

Volume: 50

Issue number: 7

Article number: 071108

ISSN (Print): 0091-3286

Ratings:

Scopus rating (2011): CiteScore 1.5 SJR 0.471 SNIP 0.976

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering(all)

Keywords: Bragg gratings, Electro-optics, Integrated optics, Liquid crystals, tunable filters, Waveguides

DOIs:

10.1117/1.3559210

URLs:

<http://www.scopus.com/inward/record.url?scp=80455123674&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80455123674

Research output: Contribution to journal › Article › Scientific › peer-review

### **Three-dimensional spatiotemporal vector solitary waves**

We investigate three-dimensional (3D) spatiotemporal vector solitary waves in spherical coordinates. The exact 3D analytical nonstationary (slowly expanding) solutions are obtained by the separation of variables and the Hirota bilinear method. Novel 3D spatiotemporal vector solitary waves are built with the help of spherical harmonics include multipole and necklace rings.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Shunde Polytechnic, University of Belgrade, NooEL, University "Roma Tre", Texas A and M University at Qatar

Contributors: Zhong, W. P., Belić, M., Assanto, G., Huang, T.

Publication date: 14 May 2011

Peer-reviewed: Yes

### Publication information

Journal: JOURNAL OF PHYSICS B: ATOMIC MOLECULAR AND OPTICAL PHYSICS

Volume: 44

Issue number: 9

Article number: 095403

ISSN (Print): 0953-4075

Ratings:

Scopus rating (2011): CiteScore 3.3 SJR 1.061 SNIP 0.932

Original language: English

ASJC Scopus subject areas: Condensed Matter Physics, Atomic and Molecular Physics, and Optics

DOIs:

10.1088/0953-4075/44/9/095403

URLs:

<http://www.scopus.com/inward/record.url?scp=79955403154&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79955403154

Research output: Contribution to journal › Article › Scientific › peer-review

### Self-trapping of scalar and vector dipole solitary waves in Kerr media

We report solutions for expanding dipole-type optical solitary waves in two-dimensional Kerr media with the self-focusing nonlinearity, using exact analytical (Hirota) and numerical methods. Such localized beams carry intrinsic vorticity and exhibit symmetric shapes for both scalar and vector solitary modes. When vector beams are close to the scalar limit, simulations demonstrate their stability over propagation distances exceeding 50 diffraction lengths. In fact, the continuous expansion helps the vortical beams avoid the instability against the splitting, collapse, or decay, making them "convectively stable" patterns.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Shunde Polytechnic, University of Belgrade, Univ Roma Tre, Roma Tre University, Dept Elect Engn, NooEL, University "Roma Tre", Tel Aviv University, Texas A and M University at Qatar

Contributors: Zhong, W. P., Belić, M. R., Assanto, G., Malomed, B. A., Huang, T.

Publication date: 27 Apr 2011

Peer-reviewed: Yes

### Publication information

Journal: Physical Review A

Volume: 83

Issue number: 4

Article number: 043833

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2011): CiteScore 5 SJR 2.316 SNIP 1.266

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.83.043833

URLs:

<http://www.scopus.com/inward/record.url?scp=79960630934&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79960630934

Research output: Contribution to journal › Article › Scientific › peer-review

### Micro-Raman characterization of Germanium thin films evaporated on various substrates

We perform an extensive micro-Raman analysis of Germanium thin films physically evaporated on several substrates including silicon, silicon oxide and glass. We investigate the dependence of crystal quality on thin film deposition parameters such as substrate temperature and growth rate. We also study the continuous transitional change of the material structure from amorphous to crystalline phases. Ge films obtained by this simple and low cost technique are a viable solution towards the realization of virtual substrates and devices.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, Universit Degli Studi dell'Aquila

Contributors: Sorianello, V., Colace, L., Assanto, G., Nardone, M.

Number of pages: 4

Pages: 492-495

Publication date: Apr 2011

Peer-reviewed: Yes

### Publication information

Journal: Microelectronic Engineering

Volume: 88

Issue number: 4

ISSN (Print): 0167-9317

Ratings:

Scopus rating (2011): CiteScore 2.8 SJR 0.813 SNIP 1.148

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Atomic and Molecular Physics, and Optics, Condensed Matter Physics

Keywords: Germanium, Raman characterization, Thin films

DOIs:

10.1016/j.mee.2010.10.028

URLs:

<http://www.scopus.com/inward/record.url?scp=79751538206&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79751538206

Research output: Contribution to journal › Article › Scientific › peer-review

### Optical power monitors in Ge monolithically integrated on SOI chips

We report on the fabrication and operation of optical power monitors monolithically integrated on silicon-on-insulator optical chips. The devices consist of near-infrared waveguide pn heterojunction photodiodes in evaporated germanium. The low temperature growth of Ge is compatible with silicon waveguide technology. The photodetectors exhibit typical responsivities of 10-30 mA/W; the power monitors are used with front-end trans-impedance amplifiers based on commercially available operational amplifiers and can operate with optical signals as small as 10 nW, with errors below 0.2% and 2% at 1 and 0.1  $\mu$ W, respectively.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab

Contributors: Colace, L., Sorianello, V., Romagnoli, M., Socci, L., Assanto, G.

Number of pages: 4

Pages: 514-517

Publication date: Apr 2011

Peer-reviewed: Yes

### Publication information

Journal: Microelectronic Engineering

Volume: 88

Issue number: 4

ISSN (Print): 0167-9317

Ratings:

Scopus rating (2011): CiteScore 2.8 SJR 0.813 SNIP 1.148

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Atomic and Molecular Physics, and Optics, Condensed Matter Physics

Keywords: Germanium, Integrated optoelectronics, Photodetectors, Powermonitor, Silicon-on-insulator

DOIs:

10.1016/j.mee.2010.10.033

URLs:

<http://www.scopus.com/inward/record.url?scp=79751538504&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79751538504

Research output: Contribution to journal › Article › Scientific › peer-review

### **Thermal evaporation of Ge on Si for near infrared detectors: Material and device characterization**

Using a low-temperature process, we thermally evaporated Ge thin films on Si substrates and investigated both structural and electrical properties of samples grown at various temperatures. The characterization included X-ray diffraction, atomic force microscopy and Hall measurements and aimed at determining a suitable temperature range in terms of crystal quality and transport properties. Finally, we employed Ge films on Si to fabricate near infrared photodiodes and test them in terms of dark current and responsivity.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, Centro S3, Institute IMEM-CNR

Contributors: Sorianello, V., Colace, L., Assanto, G., Notargiacomo, A., Armani, N., Rossi, F., Ferrari, C.

Number of pages: 4

Pages: 526-529

Publication date: Apr 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Microelectronic Engineering

Volume: 88

Issue number: 4

ISSN (Print): 0167-9317

Ratings:

Scopus rating (2011): CiteScore 2.8 SJR 0.813 SNIP 1.148

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Atomic and Molecular Physics, and Optics, Condensed Matter Physics

Keywords: Germanium, Photodetectors, Thermal evaporation

DOIs:

10.1016/j.mee.2010.09.024

URLs:

<http://www.scopus.com/inward/record.url?scp=79751530052&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79751530052

Research output: Contribution to journal › Article › Scientific › peer-review

### **On beam propagation in anisotropic media: One-dimensional analysis**

We theoretically investigate light beam propagation in (1 + 1)D homogeneous anisotropic uniaxials where ordinary and extraordinary waves are decoupled, accounting for the vectorial character of the electromagnetic field and addressing the nonparaxial limit.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Nonlinear Optics and OptoElectronics Lab

Contributors: Alberucci, A., Assanto, G.

Number of pages: 3

Pages: 334-336

Publication date: 1 Feb 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 36

Issue number: 3

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2011): CiteScore 5.6 SJR 2.519 SNIP 2.437

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.36.000334

Source: Scopus

Source ID: 79551678951

Research output: Contribution to journal › Article › Scientific › peer-review

### **Multimode nematic waveguides**

We report on the first (to our knowledge) experimental observation of higher-order modes guided by soliton-induced waveguides in nematic liquid crystals. We find that the nematic waveguides operate in a bounded power region specific to each guided mode. Below this region, the guided beams diffract; above this region, the mode mixing and coupling give rise to an unstable output.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y. S.

Number of pages: 3

Pages: 184-186

Publication date: 15 Jan 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters

Volume: 36

Issue number: 2

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2011): CiteScore 5.6 SJR 2.519 SNIP 2.437

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=79251511208&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79251511208

Research output: Contribution to journal › Article › Scientific › peer-review

### **Nonlinear pulse compression by the second-harmonic generation in quasiphase and group-velocity matched samples**

We investigate numerically the second-harmonic generation from near infrared 100 fs pulses in periodically and aperiodically poled lithium niobate crystals, taking into account the group-velocity mismatch, the group-velocity dispersion, and self-action effects. For the first time, we show that a tenfold pulse compression can be obtained at both fundamental and second-harmonic frequencies. The mechanism of compression and the pertinent quality factors are discussed.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Academy of Sciences of the Republic of Uzbekistan, NooEL, University "Roma Tre"

Contributors: Sapaev, U. K., Kulagin, I. A., Usmanov, T., Assanto, G.

Number of pages: 6

Pages: 41-46

Publication date: Jan 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: JOURNAL OF RUSSIAN LASER RESEARCH

Volume: 32

Issue number: 1

ISSN (Print): 1071-2836

Ratings:

Scopus rating (2011): CiteScore 1 SJR 0.281 SNIP 0.573

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Engineering (miscellaneous)

Keywords: cascading, frequency doubling, lithium niobate, nonlinear pulse compression, parametric effects, quasiphase matching



DOIs:

10.1007/s10946-011-9187-1

URLs:

<http://www.scopus.com/inward/record.url?scp=79952937918&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79952937918

Research output: Contribution to journal > Article > Scientific > peer-review

### **Efficient production of NV colour centres in nanodiamonds using high-energy electron irradiation**

Nanodiamond powders with an average size of 50 nm have been irradiated using high-energy electron beam. After annealing and chemical treatment, nanodiamond colloidal solutions were obtained and deposited on silica coverslips by spin-coating. The fluorescence of nanodiamonds was studied by confocal microscopy together with atomic force microscopy. We evaluated the proportion of luminescent nanodiamonds as a function of the irradiation duration and showed that large quantities, exceeding hundreds of mg, of luminescent nanodiamonds can be produced within 1 h of electron irradiation.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Laboratoire de Physique Quantique et Moléculaire

Contributors: Dantelle, G., Slablab, A., Rondin, L., Lainé, F., Carrel, F., Bergonzo, P., Perruchas, S., Gacoin, T., Treussart, F., Roch, J. F.

Number of pages: 4

Pages: 1655-1658

Publication date: Sep 2010

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Luminescence

Volume: 130

Issue number: 9

ISSN (Print): 0022-2313

Ratings:

Scopus rating (2010): SJR 0.909 SNIP 1.103

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Chemistry(all), Biochemistry, Biophysics

Keywords: Diamond, Luminescence, NV centre

DOIs:

10.1016/j.jlumin.2009.12.003

URLs:

<http://www.scopus.com/inward/record.url?scp=77955274026&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 77955274026

Research output: Contribution to journal > Article > Scientific > peer-review

### **One-way transmission through the subwavelength slit in nonsymmetric metallic gratings**

An approach for obtaining one-way transmission in the beaming regime is suggested that is based on the directional radiation of surface plasmons in nonsymmetric metallic gratings with a single slit. In contrast to the various nonsymmetric one-way diffraction gratings that have recently been proposed, the possibility of obtaining of narrow beams is demonstrated. Strong directional selectivity can appear a wide range of the observation angles, while the angle of incidence is retained.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University, Hamburg University of Technology, Nanotechnology Research Center

Contributors: Cakmakyapan, S., Serebryannikov, A. E., Caglayan, H., Ozbay, E.

Number of pages: 3

Pages: 2597-2599

Publication date: 1 Aug 2010

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters  
Volume: 35  
Issue number: 15  
ISSN (Print): 0146-9592  
Ratings:

Scopus rating (2010): SJR 2.637 SNIP 2.263

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.35.002597

URLs:

<http://www.scopus.com/inward/record.url?scp=77955225027&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 77955225027

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Coupling effect between two adjacent chiral structure layers**

A pair of mutually twisted metallic cross-wires can produce giant optical activity. When this single chiral layer is stacked layer by layer in order to build a thick chiral metamaterial, strong coupling effects are found between the two adjacent chiral layers. We studied these coupling effects numerically and experimentally. The results show that the existing coupling between chiral layers can make the chiral properties of a two-layered chiral metamaterial different from the constituting single chiral layers. It is explained qualitatively that the coupling effects are generated from the coupling of metallic cross-wires belonging to different chiral layers. Our experimental results are in good agreement with the simulation results

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University, Nanotechnology Research Center, Iowa State University, University of Crete

Contributors: Li, Z., Caglayan, H., Colak, E., Zhou, J., Soukoulis, C. M., Ozbay, E.

Number of pages: 9

Pages: 5375-5383

Publication date: 15 Mar 2010

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 18

Issue number: 6

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2010): SJR 2.906 SNIP 2.419

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.18.005375

URLs:

<http://www.scopus.com/inward/record.url?scp=77949635894&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 77949635894

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Frequency dependent steering with backward leaky waves via photonic crystal interface layer**

A Photonic Crystal (PC) with a surface defect layer (made of dimers) is studied in the microwave regime. The dispersion diagram is obtained with the Plane Wave Expansion Method. The dispersion diagram reveals that the dimer-layer supports a surface mode with negative slope. Two facts are noted: First, a guided (bounded) wave is present, propagating along the surface of the dimer-layer. Second, above the light line, the fast traveling mode couple to the propagating spectra and as a result a directive (narrow beam) radiation with backward characteristics is observed and measured. In

this leaky mode regime, symmetrical radiation patterns with respect to the normal to the PC surface are attained. Beam steering is observed and measured in a 70° angular range when frequency ranges in the 11.88-13.69GHz interval. Thus, a PC based surface wave structure that acts as a frequency dependent leaky wave antenna is presented. Angular radiation pattern measurements are in agreement with those obtained via numerical simulations that employ the Finite Difference Time Domain Method (FDTD). Finally, the backward radiation characteristics that in turn suggest the existence of a backward leaky mode in the dimer-layer are experimentally verified using a halved dimer-layer structure.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Nanotechnology Research Center, Department of Electrical and Electronics Engineering, University of Siena, University of California

Contributors: Colak, E., Caglayan, H., Cakmak, A. O., Villa, A. D., Capolino, F., Ozbay, E.

Number of pages: 12

Pages: 9879-9890

Publication date: 8 Jun 2009

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 17

Issue number: 12

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2009): SJR 3.039 SNIP 2.659

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.17.009879

URLs:

<http://www.scopus.com/inward/record.url?scp=66849104295&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 66849104295

Research output: Contribution to journal › Article › Scientific › peer-review

#### Coherent nonlinear emission from a single KTP nanoparticle with broadband femtosecond pulses

We demonstrate that the intensity of the second harmonic (SH) generated in KTiOPO<sub>4</sub> nanoparticles excited with femtosecond laser pulses increases with decreasing duration of the infrared pump pulses. The SH intensity scales, approximately, as the inverse of the laser pulse duration ranging between 13 fs and 200 fs. The SH intensity enhancement requires careful compensation of the high-order spectral phase, being achieved with a genetic algorithm. Using ultrashort laser pulses improves the signal-to-noise ratio and will allow the detection of 10-nm size particles. Finally, we demonstrate that the spectrum of broadband (100 nm) pulses can be shaped to generate non-degenerate sum-frequency mixing. This opens up access to the polarization degrees of freedom of this second-order nonlinear process at the nanoscale.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Medical University of Warsaw, Laboratoire de Photonique Quantique et Moléculaire-ENS Cachan, Ecole Normale Supérieure de Cachan and CNRS, Laboratoire de Physique de la Matière Condensée-Ecole Polytechnique-CNRS, Institute of Experimental Physics, Ecole Polytechnique, Institute of Physical Chemistry of the Polish Academy of Sciences

Contributors: Wnuk, P., Xuan, L. L., Slablab, A., Tard, C., Perruchas, S., Gacoin, T., Roch, J., Chauvat, D., Radzewicz, C.

Number of pages: 7

Pages: 4652-4658

Publication date: 16 Mar 2009

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 17

Issue number: 6

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2009): SJR 3.039 SNIP 2.659

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.17.004652

URLs:

<http://www.scopus.com/inward/record.url?scp=62549124515&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 62549124515

Research output: Contribution to journal › Article › Scientific › peer-review

### Experimental observation of subwavelength localization using metamaterial-based cavities

We report subwavelength localization of electromagnetic fields within cavities based on metamaterials. Cavity resonances are observed in the transmission spectrum of a split-ring resonator and composite metamaterials cavity structures. These cavity resonances are shown to exhibit high-quality factors. Since the unit cells of metamaterials are much smaller than the operation wavelength, subwavelength localization is possible within these metamaterial cavity structures. In the present Letter, we show that the electromagnetic field is localized into a region of  $\lambda/8$ , where  $\lambda$  is the cavity resonance wavelength.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University, Harvard University

Contributors: Caglayan, H., Bulu, I., Loncar, M., Ozbay, E.

Number of pages: 3

Pages: 88-90

Publication date: 1 Jan 2009

Peer-reviewed: Yes

### Publication information

Journal: Optics Letters

Volume: 34

Issue number: 1

ISSN (Print): 0146-9592

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Scopus rating (2009): SJR 3.077 SNIP 2.636

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.34.000088

URLs:

<http://www.scopus.com/inward/record.url?scp=58149525298&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 58149525298

Research output: Contribution to journal › Article › Scientific › peer-review

### Cavity formation in split ring resonators

We report that it is possible to obtain a cavity structure by the deformation of a unit cell of an split ring resonator (SRR) structure. We presented the Q-factor of the cavity resonance as 192 for an SRR-based single cavity. Subsequently, we brought two and three cavities together with an intercavity distance of two metamaterial unit cells and investigated the transmission spectrum of SRR-based interacting 2-cavity and 3-cavity systems. The splitting of eigenmodes due to the interaction between the localized electromagnetic cavity modes was observed. Eventually, in taking full advantage of the effective medium theory, we modeled SRR-based cavities as 1D Fabry-Perot reflectors (FPRs) with a subwavelength cavity at the center. Finally, we observed that at the cavity resonance, the effective group velocity was reduced by a factor of 67 for an SRR-based single cavity compared to the electromagnetic waves propagating in free space.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Nanotechnology Research Center, Harvard University  
Contributors: Caglayan, H., Bulu, I., Loncar, M., Ozbay, E.  
Number of pages: 5  
Pages: 200-204  
Publication date: Dec 2008  
Peer-reviewed: Yes

#### Publication information

Journal: Photonics and Nanostructures - Fundamentals and Applications  
Volume: 6  
Issue number: 3-4  
ISSN (Print): 1569-4410  
Ratings:

Scopus rating (2008): SJR 1.212 SNIP 1.169

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Hardware and Architecture, Condensed Matter Physics, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: Cavity, Metamaterials, Split ring resonator

DOIs:

10.1016/j.photonics.2008.09.001

URLs:

<http://www.scopus.com/inward/record.url?scp=56049112536&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 56049112536

Research output: Contribution to journal > Article > Scientific > peer-review

#### Surface wave splitter based on metallic gratings with sub-wavelength aperture

We investigated the splitting of surface electromagnetic waves trapped at the output surface of a one-dimensional metallic grating structure. The output gratings of the structure asymmetrically such that the output surfaces at the different sides of the subwavelength aperture can support surface waves at different frequencies. The transmission amplitude as measured at the left side is 1,000 times of that at the right side at 16 GHz. At 24 GHz, the transmission measured at the right side is 20 times that of the left side of the structure. Therefore, surface waves are guided into the different sides of the aperture at different frequencies via metallic gratings. The experimental results are in agreement with the theoretical results.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Nanotechnology Research Center, Bilkent University

Contributors: Caglayan, H., Ozbay, E.

Number of pages: 6

Pages: 19091-19096

Publication date: 10 Nov 2008

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 16

Issue number: 23

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2008): SJR 3.204 SNIP 2.404

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.16.019091

URLs:

<http://www.scopus.com/inward/record.url?scp=56149096115&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 56149096115

Research output: Contribution to journal › Article › Scientific › peer-review

### **Experimental observation of cavity formation in composite metamaterials**

In this paper, we investigated one of the promising applications of left-handed metamaterials: composite metamaterial based cavities. Four different cavity structures operating in the microwave regime were constructed, and we observed cavity modes on the transmission spectrum with different quality factors. The effective permittivity and permeability of the CMM structure and cavity structure were calculated by use of a retrieval procedure. Subsequently, in taking full advantage of the effective medium theory, we modeled CMM based cavities as one dimensional Fabry-Perot resonators with a subwavelength cavity at the center. We calculated the transmission from the Fabry-Perot resonator model using the one-dimensional transfer matrix method, which is in good agreement with the measured result. Finally, we investigated the Fabry-Perot resonance phase condition for a CMM based cavity, in which the condition was satisfied at the cavity frequency. Therefore, our results show that it is possible to treat metamaterial based cavities as one-dimensional Fabry-Perot resonators with a subwavelength cavity.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Nanotechnology Research Center, Bilkent University, Harvard University

Contributors: Caglayan, H., Bulu, I., Loncar, M., Ozbay, E.

Number of pages: 9

Pages: 11132-11140

Publication date: 21 Jul 2008

Peer-reviewed: Yes

### **Publication information**

Journal: Optics Express

Volume: 16

Issue number: 15

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2008): SJR 3.204 SNIP 2.404

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.16.011132

URLs:

<http://www.scopus.com/inward/record.url?scp=47849094123&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 47849094123

Research output: Contribution to journal › Article › Scientific › peer-review

### **Study of the field emitted by a source placed inside a two-dimensional left-handed metamaterial**

We studied the properties of electromagnetic waves that were emitted from a source placed inside a left-handed medium based on a two-dimensional labyrinth. While the arguments of geometrical optics suggest that the field emitted from the source would be focused outside the left-handed medium no matter where the source was placed, our results proved the contrary. We found that the field emitted from the source was focused outside the left-handed medium when the source was placed inside the medium at a certain distance away from the interface. Moreover, our results showed that the field emitted from the source was focused on the subwavelength dimensions outside the left-handed medium.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Nanotechnology Research Center

Contributors: Bulu, I., Caglayan, H., Aydin, K., Ozbay, E.

Number of pages: 3

Pages: 850-852

Publication date: 1 Apr 2007

Peer-reviewed: Yes

### **Publication information**

Journal: Optics Letters  
Volume: 32  
Issue number: 7  
ISSN (Print): 0146-9592  
Ratings:

Scopus rating (2007): SJR 3.443 SNIP 2.111

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.32.000850

URLs:

<http://www.scopus.com/inward/record.url?scp=33947171527&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 33947171527

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Plasmonic structures with extraordinary transmission and highly directional beaming properties**

We studied the grating-coupling phenomena between surface plasmons and electromagnetic waves in the microwave spectrum. We first present the experimental and theoretical results of an enhanced microwave transmission through a subwavelength circular annular aperture with and without metallic gratings. We demonstrate that a 145-fold enhancement factor could be obtained with a subwavelength circular annular aperture that was surrounded by periodic metallic gratings. This was assisted by the guided mode of the coaxial waveguide and by coupling to the surface plasmons. We present the angular transmission distributions from circular annular apertures, and circular annular apertures surrounded by concentric periodic grooves. At the surface mode resonance frequency, the transmitted electromagnetic waves from the subwavelength circular annular aperture surrounded by concentric periodic grooves have a strong angular confinement with an angular divergence of  $\pm 3^\circ$ . We demonstrate that only the output surface is responsible for the beaming effect. Furthermore, we present the field distributions and showed that there is no beaming effect at the off-resonance frequency.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Nanotechnology Research Center, Bilkent University

Contributors: Caglayan, H., Bulu, I., Ozbay, E.

Number of pages: 6

Pages: 2491-2496

Publication date: Dec 2006

Peer-reviewed: Yes

#### **Publication information**

Journal: Microwave and Optical Technology Letters

Volume: 48

Issue number: 12

ISSN (Print): 0895-2477

Ratings:

Scopus rating (2006): SJR 0.564 SNIP 0.685

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Annular aperture, Beaming, Enhanced transmission, Grating, Subwavelength aperture, Surface plasmon

DOIs:

10.1002/mop.22015

URLs:

<http://www.scopus.com/inward/record.url?scp=33750546040&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 33750546040

Research output: Contribution to journal › Article › Scientific › peer-review

### **Designing materials with desired electromagnetic properties**

In this work, we suggest and demonstrate a robust method to tune the plasma frequencies of wire mediums. The method we suggest involves the use of two or more wire arrangements in the unit cell. By incorporating the method we suggested it is possible to tune the plasma frequencies of wire mediums effectively by use of lower metal densities. In addition, we study the effective permittivities and permeabilities of labyrinth based metamaterials. Our results show that the effective permeability of the labyrinth based metamaterial medium is negative above a certain frequency. The results of the effective permittivity calculations for the labyrinth based metamaterial medium reveal that the labyrinth structure exhibits a strong dielectric response near the magnetic resonance frequency. Finally, we design labyrinth based left-handed mediums that have several desired properties such as simultaneous  $\mu, \epsilon = -1$  and  $\mu, \epsilon = 0$ .

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Bilkent University, Nanotechnology Research Center  
Contributors: Bulu, I., Caglayan, H., Ozbay, E.  
Number of pages: 5  
Pages: 2611-2615  
Publication date: Dec 2006  
Peer-reviewed: Yes

#### **Publication information**

Journal: Microwave and Optical Technology Letters  
Volume: 48  
Issue number: 12  
ISSN (Print): 0895-2477  
Ratings:  
Scopus rating (2006): SJR 0.564 SNIP 0.685  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Electrical and Electronic Engineering  
Keywords: Effective medium, Metamaterials, Negative index, Split ring  
DOIs:  
10.1002/mop.21988  
URLs:  
<http://www.scopus.com/inward/record.url?scp=33750556414&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"  
Source: Scopus  
Source ID: 33750556414  
Research output: Contribution to journal > Article > Scientific > peer-review

### **Experimental demonstration of subwavelength focusing of electromagnetic waves by labyrinth-based two-dimensional metamaterials**

We studied focusing in a two-dimensional metamaterial that was based on a labyrinth structure. We theoretically showed that the labyrinth-based metamaterial exhibits negative indices of refraction between 6 and 6.4 GHz. We experimentally studied the focusing effect by measuring electric field intensities on the output side of the metamaterial when the source was placed in front of the input side of the metamaterial. Our experimental results showed that it is in fact possible to focus the source field with half-widths as small as  $\lambda/4$  by using the labyrinth-based metamaterial.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Bilkent University, Department of Physics and the Nanotechnology Research Center  
Contributors: Bulu, I., Caglayan, H., Ozbay, E.  
Number of pages: 3  
Pages: 814-816  
Publication date: 2006  
Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Letters  
Volume: 31  
Issue number: 6  
ISSN (Print): 0146-9592



Ratings:

Scopus rating (2006): SJR 3.126 SNIP 2.359

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.31.000814

URLs:

<http://www.scopus.com/inward/record.url?scp=33645749640&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 33645749640

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Experimental demonstration of labyrinth-based left-handed metamaterials**

In this present work, we propose and demonstrate a resonant structure that solves two major problems related to the split-ring resonator structure. One of the problems related to the split-ring resonator structure is the bianisotropy, and the other problem is the electric coupling to the magnetic resonance of the split-ring resonator structure. These two problems introduce difficulties in obtaining isotropic left-handed metamaterial mediums. The resonant structure that we propose here solves both of these problems. We further show that in addition to the magnetic resonance, when combined with a suitable wire medium, the structure that we propose exhibits left-handed transmission band. We believe that the structure we proposed may have important consequences in the design of isotropic negative index metamaterial mediums.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University

Contributors: Bulu, I., Caglayan, H., Ozbay, E.

Number of pages: 10

Pages: 10238-10247

Publication date: 12 Dec 2005

Peer-reviewed: Yes

#### **Publication information**

Journal: Optics Express

Volume: 13

Issue number: 25

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2005): SJR 3.313 SNIP 2.328

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OPEX.13.010238

URLs:

<http://www.scopus.com/inward/record.url?scp=28944440815&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 28944440815

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Beaming of light and enhanced transmission via surface modes of photonic crystals**

We report beaming and enhanced transmission of electromagnetic waves by use of surface corrugated photonic crystals. The modes of a finite-size photonic crystal composed of dielectric rods in free space have been analyzed by the plane-wave expansion method. We show the existence of surface propagating modes when the surface of the finite-size photonic crystal is corrugated. We theoretically and experimentally demonstrate that the transmission through photonic crystal waveguides can be substantially increased by the existence of surface propagating modes at the input surface. In addition, the power emitted from the photonic crystal waveguide is confined to a narrow angular region when an appropriate surface corrugation is added to the output surface of the photonic crystal.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Bilkent University, Nanotechnology Research Center  
Contributors: Bulu, I., Caglayan, H., Ozbay, E.  
Number of pages: 3  
Pages: 3078-3080  
Publication date: 15 Nov 2005  
Peer-reviewed: Yes

#### Publication information

Journal: Optics Letters

Volume: 30

Issue number: 22

ISSN (Print): 0146-9592

Ratings:

Scopus rating (2005): SJR 3.245 SNIP 2.429

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OL.30.003078

URLs:

<http://www.scopus.com/inward/record.url?scp=27844587333&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 27844587333

Research output: Contribution to journal > Article > Scientific > peer-review

#### Highly directional enhanced radiation from sources embedded inside three-dimensional photonic crystals

We have experimentally studied emission of microwave radiation from a monopole source embedded in a three-dimensional photonic crystal. We have demonstrated enhancement of microwave radiation at the band edge and cavity mode frequencies. Furthermore, we have shown that it is possible to obtain highly directive microwave radiation sources operating at the band edge of the three-dimensional photonic crystal. We have measured half power beam widths of  $13^\circ$  for both E and H planes, corresponding to a maximum directivity of 245.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University

Contributors: Caglayan, H., Bulu, I., Ozbay, E.

Number of pages: 8

Pages: 7645-7652

Publication date: 19 Sep 2005

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 13

Issue number: 19

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2005): SJR 3.313 SNIP 2.328

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OPEX.13.007645

URLs:

<http://www.scopus.com/inward/record.url?scp=25144437095&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 25144437095

### Highly directive radiation and negative refraction using photonic crystals

In this article, we present an experimental and numerical study of certain optical properties of two-dimensional dielectric photonic crystals (PCs). By modifying the band structure of a two-dimensional photonic crystal through its crystal parameters, we show how it is possible to confine the angular distribution of radiation from an embedded omnidirectional source. We then demonstrate that the anomalous band dispersions of PCs give rise to completely novel optical phenomena, in particular, the negative refraction of electromagnetic waves at the interface of a PC. We investigate the spectral negative refraction, which utilizes a transverse magnetic (TM)-polarized upper band of a PC, in detail and show that a high degree of isotropy can be achieved for the corresponding effective index of refraction. The presence of nearly a isotropic negative refractive index leads to focusing of omnidirectional sources by a PC slab lens, which can surpass certain limitations of conventional (positive refractive) lenses. These examples indicate the potential of PCs for photonics applications utilizing the band structure.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University

Contributors: Ozbay, E., Bulu, I., Aydin, K., Caglayan, H., Alici, K. B., Guven, K.

Number of pages: 8

Pages: 217-224

Publication date: Feb 2005

Peer-reviewed: Yes

#### Publication information

Journal: Laser Physics

Volume: 15

Issue number: 2

ISSN (Print): 1054-660X

Ratings:

Scopus rating (2005): SJR 0.343 SNIP 0.32

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Instrumentation, Condensed Matter Physics, Industrial and Manufacturing Engineering

URLs:

<http://pleiades.online/cgi-perl/search.pl?type=abstract&name=lasphys&number=2&year=5&page=217>

URLs:

<http://www.scopus.com/inward/record.url?scp=16244395788&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, H."

Source: Scopus

Source ID: 16244395788

Research output: Contribution to journal › Article › Scientific › peer-review

### Extraordinary grating-coupled microwave transmission through a subwavelength annular aperture

We studied coupling phenomena between surface plasmons and electromagnetic waves in the microwave spectrum using circular apertures surrounded by array of grooves. We first present experimental and theoretical results of enhanced microwave transmission through a subwavelength circular aperture with concentric periodic grooves around the surface plasmon resonance frequency. This is followed by transmission studies through circular annular apertures and circular annular apertures surrounded by concentric periodic grooves. We demonstrated that 145 fold enhancement factor could be obtained with a subwavelength circular annular aperture surrounded by concentric periodic grooves. Our results show that, high transmission from a circular annular aperture with grooves is assisted by the guided mode of the coaxial waveguide and coupling to the surface plasmons.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University

Contributors: Caglayan, H., Bulu, I., Ozbay, E.

Number of pages: 6

Pages: 1666-1671

Publication date: 2005

Peer-reviewed: Yes

### Publication information

Journal: Optics Express

Volume: 13

Issue number: 5

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2005): SJR 3.313 SNIP 2.328

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OPEX.13.001666

URLs:

<http://www.scopus.com/inward/record.url?scp=17444385299&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 17444385299

Research output: Contribution to journal > Article > Scientific > peer-review

### Physics and applications of photonic crystals

In this article, we investigate how the photonic band gaps and the variety of band dispersions of photonic crystals can be utilized for various applications and how they further give rise to completely novel optical phenomena. The enhancement of spontaneous emission through coupled cavity waveguides in a one-dimensional silicon nitride photonic microcrystal is investigated. We then present the highly directive radiation from sources embedded in two-dimensional photonic crystals. The manifestation of novel and intriguing optical properties of photonic crystals are exemplified experimentally by the negative refraction and the focusing of electromagnetic waves through a photonic crystal slab with subwavelength resolution.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University

Contributors: Ozbay, E., Bulu, I., Aydin, K., Caglayan, H., Guven, K.

Number of pages: 9

Pages: 87-95

Publication date: Oct 2004

Peer-reviewed: Yes

### Publication information

Journal: Photonics and Nanostructures - Fundamentals and Applications

Volume: 2

Issue number: 2

ISSN (Print): 1569-4410

Ratings:

Scopus rating (2004): SJR 1.381 SNIP 1.278

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Hardware and Architecture, Electrical and Electronic Engineering

Keywords: Coupled cavity waveguide, Left-handed material, Negative refraction, Photonic crystal, Spontaneous emission

DOIs:

10.1016/j.photonics.2004.08.001

URLs:

<http://www.scopus.com/inward/record.url?scp=4544365267&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 4544365267

Research output: Contribution to journal > Article > Scientific > peer-review

129  
Xe adsorbed in  $\text{AlPO}_4$ -11 molecular sieve: Molecular dynamics simulation of adsorbate dynamics and NMR chemical shift

Molecular dynamics simulation of  $^{129}\text{Xe}$  adsorbed in the  $\text{AlPO}_4\text{-11}$  molecular sieve has been carried out in the constant NVT ensemble at  $T = 300\text{ K}$ . The host material was modeled as a fully dynamic framework. Single-particle and pair distribution functions of the adsorbed gas in the unidirectional channels of the material with different adsorbate loadings are presented. Self-diffusion coefficients,  $D_{\text{Xe}}$ , have been calculated for the dynamics of the adsorbates between the adsorption cells in  $\text{AlPO}_4\text{-11}$ . The dynamic framework is shown to decrease the effective potential barrier for intercellular jumps. An estimate is given for the jump frequency. The NMR chemical shifts of Xe were evaluated using parametrizations based on first principles calculations of Xe-Xe and Xe-OH<sub>2</sub> model systems. No adjustable parameters were used to improve agreement with experimental results. The results of a phenomenological three-site dynamic averaging model proposed earlier by others were reproduced with a good accuracy using chemical shift parameters from gradient corrected density-functional theory. Finally, the approximations inherent to the present computational approach are discussed.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: University of Oulu, Department of Physical Sciences  
Contributors: Kantola, J. H., Vaara, J., Rantala, T. T., Jokisaari, J.  
Number of pages: 9  
Pages: 6470-6478  
Publication date: 22 Oct 1997  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Chemical Physics  
Volume: 107  
Issue number: 16  
ISSN (Print): 0021-9606  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1063/1.475135  
URLs:  
<http://www.scopus.com/inward/record.url?scp=0000022450&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 0000022450  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Inequivalence of single $\text{CH}_a$ and $\text{CH}_b$ methylene bonds in the interior of a diunsaturated lipid bilayer from a molecular dynamics simulation

Orientalional order parameters for individual  $\text{CH}_a$  and  $\text{CH}_b$  bonds are local measures for the alignment of the bonds in a membrane interior. Experimental values exist for some lipid systems but no results are available from molecular dynamics (MD) simulations, although they are increasingly used to study biomembranes. We present such detailed analysis of a one nanosecond MD simulation for a PLPC (16:0/18:2<sup>Δ9,12</sup>) bilayer. The results show marked inequivalence for the  $\text{CH}_a$  and  $\text{CH}_b$  bonds of the methylene segments in the beginning and in the double bond region of the diunsaturated sn-2 chain. They also suggest slight inequivalences in the saturated chain.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Ita-Suomen yliopisto, University of Oulu, Department of Physical Sciences  
Contributors: Hyvönen, M., Ala-Korpela, M., Vaara, J., Rantala, T. T., Jokisaari, J.  
Number of pages: 6  
Pages: 55-60  
Publication date: 4 Apr 1997  
Peer-reviewed: Yes

#### Publication information

Journal: Chemical Physics Letters  
Volume: 268  
Issue number: 1-2  
ISSN (Print): 0009-2614  
Original language: English  
ASJC Scopus subject areas: Physical and Theoretical Chemistry, Spectroscopy, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1016/S0009-2614(97)00171-1

Source: Scopus

Source ID: 0031552317

Research output: Contribution to journal > Article > Scientific > peer-review

### Analysis of the magic numbers observed for metallocarbohedrane clusters

A local-density approximation calculation is performed on various  $M_8C_{12}$  structures, including  $Ti_8C_{12}$ ,  $V_8C_{12}$ ,  $VTi_7C_{12}$  and  $ScTi_7C_{12}$ . It is found that the magic numbers observed during the experimental discovery of these species does not depend on the details of the electronic structure, but rather can be described as a chemical system derived from ethylene.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Oulu, College at Fredonia, State University of New York, Washington State University Pullman

Contributors: Rantala, T. T., Jelski, D. A., Bowser, J. R., Xia, X., George, T. F.

Number of pages: 3

Pages: 255-257

Publication date: Mar 1993

Peer-reviewed: Yes

#### Publication information

Journal: Zeitschrift für Physik D Atoms, Molecules and Clusters

Volume: 26

Issue number: 1 Supplement

ISSN (Print): 0178-7683

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Physics and Astronomy(all)

Keywords: 31.90.+s, 36.40.+d, 71.45.Nt

DOIs:

10.1007/BF01425682

Source: Scopus

Source ID: 34250076509

Research output: Contribution to journal > Article > Scientific > peer-review

### Structure of the Si<sub>45</sub> cluster

Six structures for the  $Si_{45}$  cluster are compared using a tight-binding model. Two new structures are proposed which appear to be the low-energy isomers and to explain much of the existing experimental data. Cluster reactivity is distinguished from cluster stability, and several reasons are discussed which may lead to a reactive or unreactive species. These criteria are applied to the  $Si_{45}$  isomers, and the results are also correlated with experimental data.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: College at Fredonia, University of Oulu, State University of New York, Washington State University Pullman

Contributors: Jelski, D. A., Swift, B. L., Rantala, T. T., Xia, X., George, T. F.

Number of pages: 9

Pages: 8552-8560

Publication date: 1991

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Chemical Physics

Volume: 95

Issue number: 11

ISSN (Print): 0021-9606

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1063/1.461813

Source: Scopus

Source ID: 0000394576

Research output: Contribution to journal > Article > Scientific > peer-review

### **Effects of repulsion and dispersion forces in liquid crystals: Alignment and deformation of H<sub>2</sub> solute**

The roles of steric repulsions and dispersional attractions in determining the behavior of solute molecules in liquid crystals are investigated by computer simulations of simple model systems. These systems involve a hydrogen molecule (H<sub>2</sub>) dissolved in a rigid lattice consisting of parallel, infinitely long cylinders, which interact pairwise additively with the H atoms of the solute. The thermal motion of the H<sub>2</sub> molecule (at 300 K) is simulated by Monte Carlo and molecular-dynamics methods, which are shown to lead to identical results for all the studied properties, including the centrifugal distortion. The resulting orientational order parameters *S* are invariably positive at all densities and structures of the lattice, irrespective of the details of the functional form of the interaction potential. The main role of the attractive forces is to pull the solute against the hard cores of the solvent molecules, thus enhancing the effects of the repulsions (increasing *S*). The implication is that the negative experimental *S* values observed in several liquid crystals cannot be attributed to the effects of repulsion and dispersion forces; the presence of other interactions, such as electrostatic forces, appears to be essential. The repulsive forces lead to slight orientation-dependent compression of H<sub>2</sub>, with the result that the nuclear dipolar and quadrupolar couplings DHH and BD are changed by -0.7% and -1.1%, respectively (regardless of the lattice structure and the detailed form of the interaction potential). This points to the inference that the stretching-mode contributions to the orientation-dependent molecular deformations in liquid crystals are generally small, and gives support to the frequently made assumption that NMR spectral parameters of partially oriented molecules can normally be analyzed in terms of a model that includes only the bending-mode deformations.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: University of Oulu  
Contributors: Lounila, J., Rantala, T. T.  
Number of pages: 11  
Pages: 6641-6651  
Publication date: 1991  
Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A  
Volume: 44  
Issue number: 10  
ISSN (Print): 1050-2947  
Original language: English  
ASJC Scopus subject areas: Physics and Astronomy(all), Atomic and Molecular Physics, and Optics  
DOIs:  
10.1103/PhysRevA.44.6641  
Source: Scopus  
Source ID: 0042460918  
Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Linear and nonlinear optical properties of small silicon clusters**

Electronic contributions to the optical properties of small silicon clusters are examined. Geometries and the electronic structures of the clusters are established using the tight-binding model, and linear as well as nonlinear polarizabilities of the clusters are evaluated using one-electron density matrix techniques. Kleinman's conjecture for hyperpolarizabilities is shown to be violated in the frequency-degenerate case, which is of practical importance. The nonlinear polarizabilities are found to depend primarily on the symmetry of the cluster and prove to be high for the low-symmetry clusters. Possible experiments and applications are discussed.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Departments of Chemistry and Physics and Astronomy, State University of New York, Institute of Automation and Electrometry of SB RAS, College at Fredonia  
Contributors: Rantala, T. T., Stockman, M. I., Jelski, D. A., George, T. F.  
Number of pages: 12  
Pages: 7427-7438  
Publication date: 1990  
Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Chemical Physics  
Volume: 93  
Issue number: 10

ISSN (Print): 0021-9606  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
DOIs:  
10.1063/1.459417  
Source: Scopus  
Source ID: 0000430589  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Potential energy curves for diatomic molecules calculated with numerical basis functions**

A computational scheme for molecules is presented for the evaluation of total energy properties such as potential energy curves and vibrational frequencies. The calculations are performed within the local density approximation utilizing the LCAO MO scheme with numerical basis functions, and multipole expansion of the molecular charge density is used to obtain the molecular potential. The total energy expression is written in terms of matrix elements already used for solving one-electron equations, and hence any evaluation of explicit integrals over charge density is avoided. The accuracy of the method and the effect of basis set incompleteness are studied for the CO and N<sub>2</sub> molecules and compared with fully numerical (basis-free) results.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Chalmers University of Technology  
Contributors: Rantala, T. T., Wästberg, B., Rosén, A.  
Number of pages: 8  
Pages: 261-268  
Publication date: 15 Nov 1986  
Peer-reviewed: Yes

#### **Publication information**

Journal: Chemical Physics  
Volume: 109  
Issue number: 2-3  
ISSN (Print): 0301-0104  
Original language: English  
ASJC Scopus subject areas: Physical and Theoretical Chemistry, Spectroscopy, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1016/0301-0104(86)87056-2  
Source: Scopus  
Source ID: 2842530832  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Analysis of the reactivity of small cobalt clusters**

The electronic structures of small cobalt clusters have been calculated within the local spin density approximation using the LCAO method. The calculations were done for simple geometries with the optimized number of interatomic bonds, and both for the bond length of the cobalt dimer and the bulk metal. The Fermi energy is found to be smaller for Co<sub>N</sub> clusters with N=3, 4, 5 and N>10 than for the other ones. The variation of the Fermi energy with the cluster size correlates in a striking way with the observed H<sub>2</sub> tendency for chemisorption as found for cobalt clusters in a supersonic beam. Furthermore, the magnetic moments are somewhat smaller for these active clusters. In addition the lowest unoccupied levels of majority spin appear close to the highest occupied levels of minority spin which is not the case for the inert clusters.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Chalmers University of Technology  
Contributors: Rosén, A., Rantala, T. T.  
Number of pages: 5  
Pages: 205-209  
Publication date: Jun 1986  
Peer-reviewed: Yes

#### **Publication information**

Journal: Zeitschrift für Physik D Atoms, Molecules and Clusters



Volume: 3  
Issue number: 2  
ISSN (Print): 0178-7683  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Physics and Astronomy(all)  
Keywords: 31.20G, 36.40  
DOIs:  
10.1007/BF01384808  
Source: Scopus  
Source ID: 2842527792  
Research output: Contribution to journal › Article › Scientific › peer-review

### **A finite cluster approach to the electron-hole pair damping of the adsorbate vibration: CO adsorbed on Cu(100)**

A finite cluster method is applied to describe the energy transfer from the adsorbate vibrations to the electron-hole pair excitations. For CO stretch vibration on Cu(100) surface a value of 0.5 meV is found for the consequent damping (corresponding to the lifetime of  $1.3 \cdot 10^{-12}$  s) in an agreement with a recently measured vibrational line width. The mechanism behind the electron-hole pair excitations is found to be charge oscillations between the molecular  $2\pi^*$  resonance and the substrate, caused by the molecular vibration. Cluster size effects have been found to be negligible.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Chalmers University of Technology, University of California, Santa Barbara  
Contributors: Rantala, T. T., Rosén, A., Hellsing, B.  
Number of pages: 9  
Pages: 173-181  
Publication date: 1986  
Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Electron Spectroscopy and Related Phenomena  
Volume: 39  
Issue number: C  
ISSN (Print): 0368-2048  
Original language: English  
ASJC Scopus subject areas: Physical and Theoretical Chemistry, Spectroscopy, Atomic and Molecular Physics, and Optics, Surfaces and Interfaces  
DOIs:  
10.1016/0368-2048(86)85045-9  
Source: Scopus  
Source ID: 0001168090  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Anomalous Auger-electron spectra of metallic calcium**

A1 K $\alpha$ -excited L<sub>2,3</sub> MM and L<sub>2,3</sub> MV Auger-electron spectra of Ca have been measured in ultrahigh vacuum from a metallic sample evaporated onto an Ag substrate. An interpretation of the spectra is made by applying a line-fitting procedure. The lineshape and the solid-state-free-atom kinetic-energy shift are also studied. The extrinsic loss structure in the L<sub>2,3</sub> MM Auger-electron emission is found to be similar to that in 2p photoelectron emission. Spin-density-functional (SDF) calculations for the singularity index describing the intrinsic lineshape give a value of  $\sim 0.35$  for both processes. Thus the experimental 2p<sub>3/2</sub> photoelectron line broadened from 1.2 to  $\sim 5$  eV FWHM has been used as a standard line in the line fitting of the L<sub>2,3</sub> MM transitions. The term splitting of the L<sub>2,3</sub> M<sub>2,3</sub> M<sub>2,3</sub> transition is larger than in the corresponding free-atom spectrum. This result is also supported by the SDF calculations. The L<sub>2,3</sub> M<sub>2,3</sub> V spectrum is anomalously sharp, probably both because of the structure of the local density of states at the site of the core-ionized atom and because of differences in the transition probabilities into the different parts of the band. The experimental solid-state shift is 20.3 eV for the L<sub>2,3</sub> M<sub>2,3</sub> M<sub>2,3</sub>:<sup>1</sup>D transition, and the binding-energy shifts are 8.3 and 6.1 eV for the 2p and 3p levels, respectively. The SDF shifts for the above transitions are 19.9 (configurational average), 9.4 and 8.0 eV, consecutively, in agreement with the experimental values. The calculations also show a localized d-type (atomic-like) structure for the screening of the initial- and final-state core hole (s). This is the origin of the large values of both the singularity index and the solid-state shift.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, University of Oulu, University of Turku  
Contributors: Väyrynen, J., Rantala, T. T., Minni, E., Suoninen, E.  
Number of pages: 13  
Pages: 293-305  
Publication date: 1983  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Electron Spectroscopy and Related Phenomena

Volume: 31

Issue number: 3

ISSN (Print): 0368-2048

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Spectroscopy, Atomic and Molecular Physics, and Optics, Surfaces and Interfaces

DOIs:

10.1016/0368-2048(83)85077-4

Source: Scopus

Source ID: 0342803978

Research output: Contribution to journal › Article › Scientific › peer-review

#### Direct measurement of the kinetic energy shift between the molecular and atomic $M_{4.5}N_{4.5}N_{4.5}$ Auger spectra of iodine

The  $M_{4.5}N_{4.5}N_{4.5}$  Auger electron spectrum of iodine has been measured from molecular and atomic iodine vapours. The energy shift of  $3.25 \pm 0.10$  eV between molecular and atomic Auger spectra has been determined using a least-squares fitting procedure to spectra containing both molecular and atomic contributions. Different initial and final state splittings for atomic and molecular spectra, as well as the extra-atomic relaxation energy, are discussed.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Oulu

Contributors: Rantala, T., Väyrynen, J., Kumpula, R., Aksela, S.

Number of pages: 3

Pages: 384-386

Publication date: 1 Oct 1979

Peer-reviewed: Yes

#### Publication information

Journal: Chemical Physics Letters

Volume: 66

Issue number: 2

ISSN (Print): 0009-2614

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Spectroscopy, Condensed Matter Physics, Atomic and Molecular Physics, and Optics, Surfaces and Interfaces

DOIs:

10.1016/0009-2614(79)85040-X

URLs:

<http://www.scopus.com/inward/record.url?scp=49249145180&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 49249145180

Research output: Contribution to journal › Article › Scientific › peer-review

#### GaSb-based SESAM mode-locked Tm: YAG ceramic laser at 2 $\mu$ m

Tunable and mode-locked laser operation near 2  $\mu$ m based on different Tm-doped YAG ceramics, 4 at.% and 10 at.%, is demonstrated. Several designs of GaSb-based surface-quantum-well SESAMs are characterized and studied as saturable absorbers for mode-locking. Best mode-locking performance was achieved using an antireflection-coated near-surface quantum-well SESAM, resulting in a pulse duration of  $\sim 3$  ps and  $\sim 150$  mW average output power at 89 MHz. All mode-locked Tm:YAG ceramic lasers operated at 2012 nm, with over 133 nm demonstrated tuning for continuous-wave operation.

#### General information

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Frontier Photonics, Max Born Institute, Campus Sescelades, Universitat Rovira i Virgili, Física i Cristal·lografia de Materials i Nanomaterials, Dipartimento di Fisica, EII'Università di Pisa, NEST Istituto Nanoscienze-CNR, Key Laboratory of Transparent Opto-functional Inorganic Materials, Chinese Academy of Sciences, Shanghai Institute of Microsystem and Information Technology and Shanghai Jiaotong University, Research Institute of Micro/nanometer Science and Technology, Shanghai Institute of Ceramics Chinese Academy of Sciences

Contributors: Gluth, A., Wang, Y., Petrov, V., Paajaste, J., Suomalainen, S., Härkönen, A., Guina, M., Steinmeyer, G., Mateos, X., Veronesi, S., Tonelli, M., Li, J., Pan, Y., Guo, J., Griebner, U.

Number of pages: 9

Pages: 1361-1369

Publication date: 26 Jan 2015

Peer-reviewed: Yes

#### Publication information

Journal: Optics Express

Volume: 23

Issue number: 2

ISSN (Print): 1094-4087

Ratings:

Scopus rating (2015): CiteScore 7.1 SJR 1.91 SNIP 1.645

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1364/OE.23.001361

Source: Scopus

Source ID: 84921765474

Research output: Contribution to journal > Review Article > Scientific > peer-review

#### Short-Term and Long-Term Stability in Ytterbium-Doped High-Power Fiber Lasers and Amplifiers

In this paper we discuss recent progress in exploring short-term and long-term stability of high power Yb-doped fiber lasers and amplifiers. Long-term stability is associated with photodarkening effects that can significantly reduce operational lifetime of a high-power laser system. Short-term stability is associated with so-called transverse modal instabilities that degrade output beam quality at average powers above a certain threshold. In this paper we review ongoing studies that provide experimental characterization, and explore physical causes and mitigation strategies of the different physical phenomena involved. Those studies are critical for achieving stable operation of high power fiber lasers.

#### General information

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Frontier Photonics, nLIGHT Corporation, University of Michigan

Contributors: Ye, C., Petit, L., Koponen, J. J., Hu, I. N., Galvanuskas, A.

Publication date: 1 Sep 2014

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Journal of Selected Topics in Quantum Electronics

Volume: 20

Issue number: 5

Article number: 6762841

ISSN (Print): 1077-260X

Ratings:

Scopus rating (2014): CiteScore 8 SJR 1.884 SNIP 2.057

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

Keywords: Fiber amplifiers, fiber lasers, high-power, large-mode-area (LMA), mode instability, photodarkening (PD), transverse mode instability, ytterbium-doped

DOIs:

10.1109/JSTQE.2014.2310657

URLs:

<http://www.scopus.com/inward/record.url?scp=84939157468&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939157468

Research output: Contribution to journal > Review Article > Scientific > peer-review

### **Comment on "solitons in highly nonlocal nematic liquid crystals: Variational approach"**

In their recent paper, Aleksić numerically study the propagation of spatial solitary waves in nematic liquid crystals in the presence of noise. As expected, and reported earlier in their previous work on the same topic, the authors find that optical solitary waves in the presence of perturbations are no longer stationary, oscillate in amplitude and width as they propagate, and eventually decay to linear waves. Surprisingly, they conclude that spatial solitary waves are difficult to observe in nematic liquid crystals, in contrast to numerous experimental reports and the vast literature on the topic. We argue with such a conclusion in light of the behavior of wave-packet solutions of nonlinear Schrödinger-type equations.

#### **General information**

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Frontier Photonics, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre", University of Edinburgh

Contributors: Assanto, G., Smyth, N. F.

Publication date: 17 Apr 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Physical Review A

Volume: 87

Issue number: 4

Article number: 047801

ISSN (Print): 1050-2947

Ratings:

Scopus rating (2013): CiteScore 5.5 SJR 2.305 SNIP 1.164

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1103/PhysRevA.87.047801

URLs:

<http://www.scopus.com/inward/record.url?scp=84877744227&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84877744227

Research output: Contribution to journal > Review Article > Scientific > peer-review

### **Parametric conversion in micrometer and submicrometer structured ferroelectric crystals by surface poling**

We report on recent technological improvements concerning nonlinear patterning of lithium niobate and lithium tantalate in the micrometer and submicrometer scales using surface periodic poling for ferroelectric domain inversion. The fabricated samples were employed for frequency doubling via quasiphase-matching both in bulk and guided wave geometries, including forward and backward configurations and wavelength conversion in bands C and L. We also investigated short-period quasiperiodic samples with randomly distributed mark-to-space ratios.

#### **General information**

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Frontier Photonics, Building No. 9, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Busacca, A. C., Stivala, S., Curcio, L., Assanto, G.

Publication date: 2012

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Optics

Volume: 2012

Article number: 606892

ISSN (Print): 1687-9384

Ratings:

Scopus rating (2012): CiteScore 0.4 SJR 0.184 SNIP 0.437

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

DOIs:

10.1155/2012/606892

URLs:

<http://www.scopus.com/inward/record.url?scp=84858185701&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84858185701

Research output: Contribution to journal › Review Article › Scientific › peer-review

### **Backscattering-based wireless communication and power transfer to small biomedical implants**

In this paper and presentation, we will focus on different aspects of backscattering-based wireless communication and power transfer to small biomedical implants. We will present three different antenna topologies for data and power transfer through tissue, in vitro and in vivo studies on implantable intracranial pressure (ICP) sensors and give insight and analysis on wireless link reliability in tissue environment. We will also present radio frequency identification (RFID)-based implant platform and communication method. Moreover, we will focus on differences and challenges of in vivo environment compared to laboratory phantoms and tissue models. In our studies, different types of implantable antennas have been tested to investigate reliability, accuracy and sensitivity of the brain implants: A hybrid near field-far field system with a piezoresistive sensor for ICP monitoring [2], [4], a UHF band split-ring resonator system [3] and LC tank based miniature implantable antenna [5]. This paper will present these implant antennas and wireless power transfer in tissue environment present in human head.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group

Contributors: Ukkonen, L., Sydänheimo, L., Ma, S., Björninen, T.

Publication date: 2020

#### **Host publication information**

Title of host publication: Microfluidics, BioMEMS, and Medical Microsystems XVIII

Publisher: SPIE

Editors: Gray, B. L., Becker, H.

Article number: 112350A

ISBN (Print): 9781510632332

ISBN (Electronic): 9781510632349

#### **Publication series**

Name: Progress in Biomedical Optics and Imaging - Proceedings of SPIE

Volume: 11235

ISSN (Print): 1605-7422

ISSN (Electronic): 2410-9045

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Biomaterials, Atomic and Molecular Physics, and Optics, Radiology Nuclear Medicine and imaging

Keywords: implant antennas, Wireless biomedical implants, wireless power transfer

DOIs:

10.1117/12.2552183

#### **Bibliographical note**

jufoid=65546

Source: Scopus

Source ID: 85082726318

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Embroidered and e-textile conductors embedded inside 3D-printed structures**

This paper discusses the fabrication and wireless performance evaluation of textile-integrated passive ultra-high frequency (UHF) radiofrequency identification (RFID) tags, which are embedded inside flexible additively manufactured wireless platforms. Two different methods are utilized to fabricate the tag antenna, including embroidery with conductive thread and conductive e-textiles. After antenna fabrication, RFID ICs (integrated circuits) are attached to the antenna patterns, to achieve fully functional RFID tags. These two types of tags are embedded inside flexible 3D-printed platforms, which can protect the tags from mechanical stresses and moisture. Our preliminary results show that the peak read ranges of both types of platforms are higher than 6 meters, which are suitable for versatile wireless applications.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech

Contributors: Khan, Z., He, H., Chen, X., Ukkonen, L., Virkki, J.

Number of pages: 6

Pages: 1675-1680

Publication date: 1 Dec 2019

### Host publication information

Title of host publication: 2019 Photonics and Electromagnetics Research Symposium - Fall, PIERS - Fall 2019 - Proceedings

Publisher: IEEE

Article number: 9021681

ISBN (Electronic): 9781728153049

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Mathematical Physics

DOIs:

10.1109/PIERS-Fall48861.2019.9021681

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Eco-friendly flexible wireless platforms by 3D printing pen

We present a new type of 3D printing pen fabrication of flexible passive UHF (ultra-high frequency) RFID (radio frequency identification) platforms. The used 3D printing material is cost-effective and fully biodegradable. The tag antenna is fabricated from conductive thread. This antenna and antenna-IC interconnections are fixed inside the 3D-printed platforms with 3D-printed fasteners. Thus, our solution requires no additional process steps or chemicals. For wireless evaluation, the platforms are firstly bended around different size cylinders, with and without a 3D-printed top layer. Further, the reliability of the platforms in high moisture is also tested, by keeping the platforms in water for 1 minute. Based on these preliminary tests, our manufacturing method enables establishment of highly reliable eco-friendly platforms with excellent wireless performance. The developed solutions have versatile future applications, especially in the field of wearable electronics, where lightweight, cost-effective, flexible, and waterproof platforms are needed.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech

Contributors: Mehmood, A., Chen, X., He, H., Ukkonen, L., Virkki, J.

Number of pages: 4

Pages: 2422-2425

Publication date: 1 Dec 2019

### Host publication information

Title of host publication: 2019 Photonics and Electromagnetics Research Symposium - Fall, PIERS - Fall 2019 - Proceedings

Publisher: IEEE

Article number: 9021887

ISBN (Electronic): 9781728153049

### Publication series

Name: 2019 Photonics and Electromagnetics Research Symposium - Fall, PIERS - Fall 2019 - Proceedings

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Mathematical Physics

DOIs:

10.1109/PIERS-Fall48861.2019.9021887

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Maintenance-free moisture sensor on dishcloth substrate

In this study, a passive UHF RFID-based moisture sensor is fabricated and evaluated. The sensor tag can sense the high humidity of the environment and indicate it with a permanent change in its backscattered signal. The sensor tag antenna and antenna-IC interconnections are fabricated on a biodegradable dishcloth material using conductive thread. The sensors are tested in an anechoic chamber and in normal office conditions, when initially dry, after dipped into water for 1 minute, and again after 24 hours of drying in air. These sensor tags initially show read ranges of 6-9 meters throughout the global UHF RFID frequency band. When wet, the read range decreases to 5 meters, while after 24 hours of drying, the read ranges of the tags permanently decrease to around 2-4 meters. The dishcloth material comes thicker when wet, also causing a change to the embroidered antenna structure, finally causing the permanent change in the backscattered signal. In normal office conditions, moisture causes the average backscattered signal an obvious change from around -66 dBm to -69 dBm.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, City University of Hong Kong

Contributors: Chen, X., He, H., Yang, Y., Gou, M., Sydanheimo, L., Ukkonen, L., Virkki, J.  
Number of pages: 4  
Pages: 2418-2421  
Publication date: 1 Dec 2019

#### Host publication information

Title of host publication: 2019 Photonics and Electromagnetics Research Symposium - Fall, PIERS - Fall 2019 - Proceedings

Publisher: IEEE

Article number: 9021487

ISBN (Electronic): 9781728153049

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Mathematical Physics

DOIs:

10.1109/PIERS-Fall48861.2019.9021487

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Passive UHF RFID-based user interface on a wooden surface

We present a passive ultra-high frequency (UHF) radio frequency identification (RFID)-based human-technology interface platform. The platform comprises of two dipole antennas and three integrated circuits (IC), each with a unique ID. The platform, which is fixed on a wooden table by cutting the antennas and antenna-IC interconnections from copper tape, can be used for push button and swipe controlling. Each IC can be activated, i.e., connected to the antennas, by touching with finger. As the RFID reader can be connected to any application through WIFI, these ICs can act as wireless input points integrated into furniture, items, and textiles, where they can be used as inputs to desired digital actions. The platform allows all connected devices to be controlled accurately and effortlessly, which will take the convenience of implementation and utilization of these systems to a new level. As a preliminary trial, the platform was tested by two people giving 200 random inputs and 98% and 99% success rates were achieved. Based on these results, this type of passive RFID-based solutions could be used for administrating interfaces that would administer wide variety of interaction modalities, such as touch or tangible interaction on flat surfaces (e.g., tabletop surfaces, walls, doors).

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Computing Sciences, Tampere University

Contributors: Mehmood, A., Vianto, V., He, H., Chen, X., Buruk, O. O., Ukkonen, L., Virkki, J.

Number of pages: 4

Pages: 1760-1763

Publication date: 1 Dec 2019

#### Host publication information

Title of host publication: 2019 Photonics and Electromagnetics Research Symposium - Fall, PIERS - Fall 2019 - Proceedings

Publisher: IEEE

Article number: 9021441

ISBN (Electronic): 9781728153049

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Mathematical Physics

DOIs:

10.1109/PIERS-Fall48861.2019.9021441

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Double-asymmetric-structure 1.5 $\mu$ m high power laser diodes

Design considerations for high pulsed power and brightness 1.5  $\mu$ m laser emitters for laser radar applications, based on comprehensive semi-analytical theory, are presented. A strongly asymmetric waveguide design with a bulk active layer positioned very near the p-emitter interface is chosen to minimize the current-induced losses at high power while maintaining a single, broad transverse mode. Moderate to high doping of the n-side of the Optical Confinement Layer and high p-doping of the p-cladding layer are used to reduce the residual current-induced losses and the electric resistance of the structure. For pulsed room-temperature operation, short laser resonators are found to be advantageous. First experimental results are presented. An as-cleaved sample with a stripe width of 90  $\mu$ m and a resonator 2 mm long exhibits an output power of about 18 W at a pumping current amplitude of 80 A, with 1 mm long resonators showing higher power output. Further improvements are predicted by structure optimization as well as increase in internal quantum efficiency and thermal performance.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, University of Oulu, Ioffe Physico-Technical Institute, University of York

Contributors: Hallman, L., Ryzkin, B. S., Avrutin, E. A., Aho, A. T., Viheriälä, J., Guina, M., Kostamovaara, J. T.

Number of pages: 2

Pages: 19-20

Publication date: 1 Oct 2019

#### Host publication information

Title of host publication: Proceedings of the 2019 IEEE High Power Diode Lasers and Systems Conference, HPD 2019 -

Co-located with Photonex 2019

Publisher: IEEE

ISBN (Electronic): 9781728130972

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: efficiency, high power lasers, laser diodes, modelling

DOIs:

10.1109/HPD48113.2019.8938671

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Double-side pumped membrane external-cavity surface-emitting laser (MECSEL) with increased efficiency emitting > 3 W in the 780 nm region

We demonstrate a double-side pumped MECSEL emitting more than 3 W of output power in the 780 nm wavelength region. The laser exhibits an efficiency as high as 34.4 %.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics

Contributors: Kahle, H., Phung, H., Penttinen, J., Rajala, P., Tukiainen, A., Ranta, S., Guina, M.

Publication date: 1 May 2019

#### Host publication information

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8749958

#### Bibliographical note

INT=phys,"Rajala, Patrik"

Source: Scopus

Source ID: 85069191246

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Optical Frequency Comb Photoacoustic Spectroscopy

We combine for the first time a mid-infrared optical frequency comb Fourier transform spectrometer with cantilever-enhanced photoacoustic detection and measure high-resolution broadband spectra of the fundamental band of methane in a few milliliter sample volume.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Energy Technology and Thermal Process Chemistry, University of Helsinki

Contributors: Sadiq, I., Mikkonen, T., Vainio, M., Toivonen, J., Foltynowicz, A.

Publication date: 1 May 2019

#### Host publication information

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics



DOIs:

10.23919/CLEO.2019.8749688

Source: Scopus

Source ID: 85069190764

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Frequency Comb Generation in a Continuous-Wave Pumped Second-Order Nonlinear Waveguide Resonator**

Optical frequency comb generation has been experimentally studied using an integrated system based on a lithium niobate waveguide resonator featuring a strong quadratic nonlinearity. Our theoretical model shows good agreement with the experimental results.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Paderborn University, University of Helsinki, VTT Technical Research Centre of Finland

Contributors: Abdallah, Z., Stefszky, M., Ulvila, V., Silberhorn, C., Vainio, M.

Publication date: 1 May 2019

#### **Host publication information**

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8750403

Source: Scopus

Source ID: 85069196416

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **High-Q resonance train in a plasmonic metasurface**

We experimentally demonstrate a plasmonic surface that supports a series of high-quality-factor ( $Q \approx 100$ ) surface lattice resonances. These resonances are enabled by tuning the thickness of the top-cladding layer to confine higher order diffraction-orders.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, University of Ottawa, Canada, Iridian Spectral Technologies, University of Rochester Institute of Optics

Contributors: Saad-Bin-Alam, M., Reshef, O., Huttunen, M. J., Carlow, G., Sullivan, B., Menard, J. M., Dolgaleva, K., Boyd, R. W.

Publication date: 1 May 2019

#### **Host publication information**

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8750206

Source: Scopus

Source ID: 85069156893

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Noise measurements from reconstructed digital breast tomosynthesis**

In this work, we investigated and measured the noise in Digital Breast Tomosynthesis (DBT) slices considering the back-projection (BP) algorithm for image reconstruction. First, we presented our open-source DBT reconstruction toolbox and validated with a freely available virtual clinical trials (VCT) software, comparing our results with the reconstruction toolbox available at the Food and Drug Administration's (FDA) repository. A virtual anthropomorphic breast phantom was generated in the VCT environment and noise-free DBT projections were simulated. Slices were reconstructed by both

toolboxes and objective metrics were measured to evaluate the performance of our in-house reconstruction software. For the noise analysis, commercial DBT systems from two vendors were used to obtain x-ray projections of a uniform polymethyl methacrylate (PMMA) physical phantom. One system featured an indirect thallium activated cesium iodide (CsI(Tl)) scintillator detector and the other a direct amorphous selenium (a-Se) detector. Our in-house software was used to reconstruct raw projections into tomographic slices, and the mean pixel value, noise variance, signal-to-noise ratio (SNR) and the normalized noise power spectrum (NNPS) were measured. In addition, we investigated the adequacy of a heteroskedastic Gaussian model, with an affine variance function, to describe the noise in the reconstruction domain. The measurements show that the variance and SNR from reconstructed slices report similar spatial and signal dependency from previously reported in the projection domain. NNPS showed that the reconstruction process correlates the noise of the DBT slices in the case of projections degraded with almost uncorrelated noise.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, University of São Paulo, Pio XII Foundation, University of Pennsylvania

Contributors: Vimieiro, R. B., Borges, L. R., Caron, R. F., Barufaldi, B., Bakic, P. R., Maidment, A. D., Vieira, M. A.

Publication date: 1 Mar 2019

### Host publication information

Title of host publication: Medical Imaging 2019 : Physics of Medical Imaging

Publisher: SPIE, IEEE

Editors: Schmidt, T. G., Chen, G., Bosmans, H.

Article number: 109480C

ISBN (Electronic): 9781510625433

### Publication series

Name: Progress in Biomedical Optics and Imaging - Proceedings of SPIE

Volume: 10948

ISSN (Print): 1605-7422

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Biomaterials, Atomic and Molecular Physics, and Optics, Radiology Nuclear Medicine and imaging

Keywords: Back-projection, Digital breast tomosynthesis, Image reconstruction, Noise measurements, Virtual clinical trials  
DOIs:

10.1117/12.2512977

Source: Scopus

Source ID: 85068400087

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Thin form-factor super multiview head-up display system

We propose a virtual-image head-up display (HUD) based on the super multiview (SMV) display technology.

Implementation-wise, the HUD provides a compact solution, consisting of a thin form-factor SMV display and a combiner placed on the windshield of the vehicle. Since the utilized display is at most few centimeters thick, it does not need extra installation space that is usually required by most of the existing virtual image HUDs. We analyze the capabilities of the proposed system in terms of several HUD related quality factors such as resolution, eyebox width, and target image depth. Subsequently, we verify the analysis results through experiments carried out using our SMV-HUD demonstrator. We show that the proposed system is capable of visualizing images at the typical virtual image HUD depths of 2 – 3m, in a reasonably large eyebox, which is slightly over 30cm in our demonstrator. For an image at the target virtual image depth of 2.5m, the field of view of the developed system is  $11^\circ \times 16^\circ$  and the spatial resolution is around 240x60 pixels in vertical and horizontal directions, respectively. There is, however, plenty of room for improvement regarding the resolution, as we actually utilize an LCD at moderate resolution (216 ppi) and off-the-shelf lenticular sheet in our demonstrator.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences

Contributors: Akpınar, U., Sahin, E., Suominen, O., Gotchev, A.

Publication date: 13 Jan 2019

### Host publication information

Title of host publication: Stereoscopic Displays and Applications XXX

### Publication series

Name: IS&T International Symposium on Electronic Imaging

ISSN (Electronic): 2470-1173

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

DOIs:

10.2352/ISSN.2470-1173.2019.3.SDA-631

### **Bibliographical note**

jufoid=84313

Source: Scopus

Source ID: 85081086336

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Additional lossless compression of JPEG images based on BPG**

The task of additional lossless compression of JPEG images is considered. We propose to decode JPEG image and recompress it using lossy BPG (Better Portable Graphics) codec based on a subset of the HEVC open video compression standard. Then the decompressed and smoothed BPG image is used for calculation and quantization of DCT coefficients in 8x8 image blocks using quantization tables of the source JPEG image. A difference between obtained quantized DCT coefficients and quantized DCT coefficients of the source JPEG image (prediction error) is calculated. The difference is lossless compressed by a proposed context modeling and arithmetical coding. In this way the source JPEG image is replaced by two files: compressed BPG image and the compressed difference which needed for lossless restoration of the source JPEG image. It is shown that the proposed approach provides compression ratios comparable with state of the art PAQ8, WinZip and STUFFIT file archivers. At the same time BPG images may be used for fast preview of compressed JPEG images.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Kharkiv National Aerospace University

Contributors: Ponomarenko, M., Miroshnichenko, O., Lukin, V., Egiazarian, K.

Publication date: 13 Jan 2019

### **Host publication information**

Title of host publication: Image Processing: Algorithms and Systems XVII

### **Publication series**

Name: IS and T International Symposium on Electronic Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Context modelling, Discrete cosine transform, JPEG, JPEG additional compression

DOIs:

10.2352/ISSN.2470-1173.2019.11.IPAS-263

Source: Scopus

Source ID: 85080092000

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Phase masks optimization for broadband diffractive imaging**

The task of optimization of phase masks for broadband diffractive imaging to minimize chromatic aberrations and to provide given value of Depth of Focus (DoF) is considered. Different schemes of multilevel phase mask (MPM) forming by combining pixels of two Fresnel lenses are analyzed. The Fresnel lenses are calculated for the same focal distance but for very different wavelengths. A possibility of adding to the optimized mask a cubic component is taking into account as well as usage of discrete phase masks with optimized number of levels. It is shown that the proposed approach in the combination with inverse imaging allows to significantly increase image quality for a focus distance in comparison to refractive lens-based optical systems. Moreover, it is shown that by changing of aforementioned parameters it is possible to increase or decrease DoF value depending from a given goal of optimization. It is demonstrated by numerical analysis that the proposed approach significantly increases robustness of designed MPM to Gaussian additive noise in MPM introduced due to fabrication errors.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: Computational Imaging-CI

Contributors: Ponomarenko, M., Katkovnik, V., Egiazarian, K.

Publication date: 13 Jan 2019

### **Host publication information**

Title of host publication: Image Processing: Algorithms and Systems XVII

### **Publication series**

Name: IS and T International Symposium on Electronic Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Diffractive optical elements, Inverse imaging, Lensless imaging, Multilevel phase mask design  
DOIs:  
10.2352/ISSN.2470-1173.2019.11.IPAS-258  
Source: Scopus  
Source ID: 85080039777  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Combined no-reference IQA metric and its performance analysis**

The problem of increasing efficiency of blind image quality assessment is considered. No-reference image quality metrics both independently and as components of complex image processing systems are employed in various application areas where images are the main carriers of information. Meanwhile, existing no-reference metrics have a significant drawback characterized by a low adequacy to image perception by human visual system (HVS). Many well-known no-reference metrics are analyzed in our paper for several image databases. A method of combining several no-reference metrics based on artificial neural networks is proposed based on multi-database verification approach. The effectiveness of the proposed approach is confirmed by extensive experiments.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Kharkiv National Aerospace University  
Contributors: Ieremeiev, O., Lukin, V., Ponomarenko, N., Egiazarian, K.  
Publication date: 13 Jan 2019

#### **Host publication information**

Title of host publication: Image Processing: Algorithms and Systems XVII

#### **Publication series**

Name: IS and T International Symposium on Electronic Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Combined metrics, Full-reference metrics, Image visual quality assessment, Robust metrics  
DOIs:  
10.2352/ISSN.2470-1173.2019.11.IPAS-260  
Source: Scopus  
Source ID: 85080028392  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Random lasing control with optical spatial solitons in nematic liquid crystals**

We discuss the synergy of reorientational self-focusing and random lasing in a dye-doped nematic liquid crystalline material. The laser emission resulting from amplification and multiple scattering inside the medium can be either modulated or triggered depending on the energy of the visible pump beam and the power of the near-infrared spatial soliton, respectively exciting the two nonlinear responses. Moreover, the presence of the self-induced waveguide improves the properties of the emitted beam, i. e., directionality and profile. Finally, the laser light can be re-directed by steering the spatial soliton with the aid of an external low-frequency electric field.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Physics, Research group: Nonlinear Optics, University "Roma Tre", Case Western Reserve University, Univ Roma Tre, Roma Tre University, Dept Elect Engrn, NooEL  
Contributors: Piccardi, A., Perumbilavil, S., Kauranen, M., Strangi, G., Assanto, G.  
Number of pages: 5  
Pages: 289-293  
Publication date: 2019

#### **Host publication information**

Title of host publication: PHOTOPTICS 2019 - Proceedings of the 7th International Conference on Photonics, Optics and Laser Technology  
Publisher: SCITEPRESS  
Editors: Ribeiro, P., Raposo, M., Andrews, D.  
ISBN (Electronic): 9789897583643  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: Nematic Liquid Crystals, Optical Spatial Solitons, Random Laser

DOIs:

10.5220/0007575102890293

#### Bibliographical note

EXT="Assanto, Gaetano"

Source: Scopus

Source ID: 85064602881

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Tunable Reflection Type Plasmon Induced Transparency with Graphene

Plasmon induced transparency (PIT) has always been investigated in transmission mode, which makes the design dependent upon the type of substrate. In this work, we propose a first tunable reflection type PIT (RPIT) device based on simple design of two parallel gold strips on graphene. We have numerically investigated the design by using Finite Difference Time-Domain (FDTD) method. This response is tunable by changing the Fermi level ( $E_f$ ) of graphene. High tunability of 215 nm shift was observed by changing the  $E_f$  of graphene from 0 to 0.8 eV. The spectral contrast ratio of our device is 99.2%.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Photonics, Department of Electrical and Electronics Engineering, Bilkent University, Nanotechnology Research Center

Contributors: Habib, M., Ozbay, E., Caglayan, H.

Number of pages: 3

Pages: 170-172

Publication date: 13 Nov 2018

#### Host publication information

Title of host publication: 2018 12th International Congress on Artificial Materials for Novel Wave Phenomena, METAMATERIALS 2018

Publisher: IEEE

ISBN (Electronic): 9781538647028

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Acoustics and Ultrasonics, Atomic and Molecular Physics, and Optics, Radiation

DOIs:

10.1109/MetaMaterials.2018.8534142

#### Bibliographical note

EXT="Habib, M."

Source: Scopus

Source ID: 85058538366

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Metal/Polymer Back Reflectors with Diffraction Gratings for Light Trapping in III-V Solar Cells

We report on the fabrication, characterization and simulation of diffraction gratings for back contact reflectors in III-V solar cells. The gratings are designed for thin-film solar cells incorporating absorbers with bandgap slightly lower than GaAs, such as InAs/GaAs quantum dot or GaInNAs solar cells. Metal/polymer back reflectors with a blazed grating or a pyramid grating were fabricated by nanoimprint lithography. The gratings are compared in terms of diffraction ability, which is the feature responsible for increasing the absorption. The pyramid grating showed higher diffraction of light compared to the blazed grating. The diffraction efficiency measurements were in agreement with the numerical simulations. The model validation enables tailoring the properties of the reflectors for other type of solar cells by adjusting the optimal dimensions of the gratings for different wavelengths.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Photonics, Research group: ORC, Research group: Nanophotonics, Politecnico di Torino, Dispelix Oy, University of Eastern Finland

Contributors: Aho, T., Guina, M., Elsehrawy, F., Cappelluti, F., Raappana, M., Tukiainen, A., Khairul Alam, A. B. M., Vartiainen, I., Kuittinen, M., Niemi, T.

Number of pages: 5

Pages: 2847-2851

Publication date: Nov 2018

### Host publication information

Title of host publication: 2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) : A Joint Conference of 45th IEEE PVSC, 28th PVSEC & 34th EU PVSEC

Publisher: IEEE

ISBN (Electronic): 978-1-5386-8529-7

### Publication series

Name: CONFERENCE RECORD OF THE IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE

Publisher: IEEE

ISSN (Print): 0160-8371

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Electronic versions:

WCPEC-7 Manuscript\_Timo Aho

DOIs:

10.1109/PVSC.2018.8547661

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910213977>

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Fluorescence bandwidth of 280nm from broadband Ce<sup>3+</sup>-doped silica fiber pumped with blue laser diode

Fluorescence properties of a Ce<sup>3+</sup>-doped silica fiber at different pump wavelengths between 405nm to 450 nm are investigated. With 405 nm pump wavelength and a fiber length of ~130-140 cm broadband fluorescence of ~280nm is achieved.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Photonics, Research group: Nanophotonics, Aston University, Fiber Optics Research Center of the Russian Academy of Sciences, Russian Academy of Sciences

Contributors: Yadav, A., Chichkov, N. B., Gumenyuk, R., Zherebtsov, E., Melkumov, M. A., Yashkov, M. V., Dianov, E. M., Rafailov, E. U.

Number of pages: 1

Pages: 133-133

Publication date: 13 Aug 2018

### Host publication information

Title of host publication: 2018 International Conference Laser Optics (ICLO)

Publisher: IEEE

Article number: 8435861

ISBN (Electronic): 9781538636121

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: Broadband source, Ce-doped fiber, Ce ions, Fluorescence

DOIs:

10.1109/LO.2018.8435861

Source: Scopus

Source ID: 85052525711

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Light propagation analysis in nervous tissue for wireless optogenetic nanonetworks

In recent years, numerous methods have been sought for developing novel solutions to counter neurodegenerative diseases. An objective that is being investigated by researchers is to develop cortical implants that are able to wirelessly stimulate neurons at the single cell level. This is a major development compared to current solutions that use electrodes, which are only able to target a population of neurons, or optogenetics, which requires optical fiber-leads to be embedded deep into the brain. In this direction, the concept of wireless optogenetic nanonetworks has been recently introduced. In such architecture, miniature devices are implanted in the cortex for neuronal stimulation through optogenetics. One of the aspects that will determine the topology and performance of wireless optogenetic nanonetworks is related to light propagation in genetically-engineered neurons. In this paper, a channel model that captures the peculiarities of light propagation in neurons is developed. First, the light propagation behavior using the modified Beer-Lambert law is analyzed based on the photon transport through the nervous tissue. This includes analyzing the scattering light diffraction and diffusive reflection that results from the absorption of neural cell chromophores, as well as validating the results by means of extensive multiphysics simulations. Then, analysis is conducted on the path loss through cells at different layers of the cortex by taking into account the multi-path phenomenon. Results show that there is a light focusing effect in the soma of neurons that can potentially help the to stimulate the target cells.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electronics and Communications Engineering, State University of New York

Contributors: Wirdatmadja, S., Johari, P., Balasubramaniam, S., Bae, Y., Stachowiak, M. K., Jornet, J. M.

Publication date: 2018

### Host publication information

Title of host publication: Optogenetics and Optical Manipulation 2018

Publisher: SPIE

Article number: 104820R

ISBN (Electronic): 9781510614499

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Biomaterials, Atomic and Molecular Physics, and Optics, Radiology Nuclear Medicine and imaging

Keywords: Light propagation, Optogenetics, Single-neuron stimulation, Wireless nanonetworks

DOIs:

10.1117/12.2288786

### Bibliographical note

jufoid=65546

Source: Scopus

Source ID: 85047010302

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Methods and tools for denoising of complex-valued images based on block-matching and high order singular value decomposition

Noise suppression in complex-valued data is an important task for a wide class of applications, in particular concerning the phase retrieval in coherent imaging. The approaches based on BM3D techniques are ones of the most successful in the field. In this paper, we propose and develop a new class of BM3Dstyle algorithms, which use high order (3D and 4D) singular value decomposition (HOSVD) for transform design in complex domain. This set of the novel algorithms is implemented as a toolbox In Matlab. This development is produced for various types of the complex-domain sparsity: directly in complex domain, real/imaginary and phase/ amplitude parts of complexvalued variables. The group-wise transform design is combined with the different kinds of thresholding including multivariable Wiener filtering. The toolbox includes iterative and non-iterative novel complex-domain algorithms (filters). The efficiency of the developed algorithms is demonstrated on denoising problems with an additive Gaussian complex-valued noise. A special set of the complex-valued test-images was developed with spatially varying correlated phase and amplitudes imitating data typical for optical interferometry and holography. It is shown that for this class of the test-images the developed algorithms demonstrate the stateof- the-art performance.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing

Contributors: Ponomarenko, M., Katkovnik, V., Egiazarian, K.

Publication date: 2018

### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Block matching, Complex domain, Higher-order singular value decomposition, Image denoising, Phase imaging, Sparsity

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-306

### Bibliographical note

jufoid=84313

Source: Scopus

Source ID: 85052877244

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Deep p-Fibonacci scattering networks

Recently, the use of neural networks for image classification has become widely spread. Thanks to the availability of increased computational power, better performing architectures have been designed, such as the Deep Neural networks. In this work, we propose a novel image representation framework exploiting the Deep p- Fibonacci scattering network. The

architecture is based on the structured p-Fibonacci scattering over graph data. This approach allows to provide good accuracy in classification while reducing the computational complexity. Experimental results demonstrate that the performance of the proposed method is comparable to state-of-the-art unsupervised methods while being computationally more efficient.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, University "Roma Tre"  
Contributors: Battisti, F., Carli, M., De Paola, E., Egiazarian, K.  
Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI  
Publisher: Society for Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
DOIs:  
10.2352/ISSN.2470-1173.2018.13.IPAS-193

#### Bibliographical note

jufoid=84313  
EXT="Battisti, F."  
EXT="Carli, M."  
Source: Scopus  
Source ID: 85052873638  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Blind estimation of white Gaussian noise variance in highly textured images

In the paper, a new method of blind estimation of noise variance in a single highly textured image is proposed. An input image is divided into 8x8 blocks and discrete cosine transform (DCT) is performed for each block. A part of 64 DCT coefficients with lowest energy calculated through all blocks is selected for further analysis. For the DCT coefficients, a robust estimate of noise variance is calculated. Corresponding to the obtained estimate, a part of blocks having very large values of local variance calculated only for the selected DCT coefficients are excluded from the further analysis. These two steps (estimation of noise variance and exclusion of blocks) are iteratively repeated three times. For the verification of the proposed method, a new noise-free test image database TAMPERE17 consisting of many highly textured images is designed. It is shown for this database and different values of noise variance from the set {25, 49, 100, 225}, that the proposed method provides approximately two times lower estimation root mean square error than other methods.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Don State Technical University  
Contributors: Ponomarenko, M., Gapon, N., Voronin, V., Egiazarian, K.  
Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI  
Publisher: Society for Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Blind estimation of noise characteristics, Discrete cosine transform (DCT), Noise free test image database  
DOIs:  
10.2352/ISSN.2470-1173.2018.13.IPAS-382

#### Bibliographical note

jufoid=84313  
Source: Scopus  
Source ID: 85052856410  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Robust linearized combined metrics of image visual quality

Existing full-reference metrics still do not provide a desirable degree of adequacy to a human visual perception, for evaluation of images with different types and levels of distortions. One reason for this is that it is difficult to incorporate the peculiarities of human visual system in the metrics design. In this paper, a robust approach to full-reference metrics' design is proposed, based on a combination of several existing full-reference metrics. A preliminary linearization (fitting) of



the dependence of MOS with respect to the components metrics is performed in order to compensate shortcomings of each component. The proposed method is tested on several known databases, and demonstrate better performance than existing metrics.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Kharkiv National Aerospace University

Contributors: Ieremeiev, O., Lukin, V., Ponomarenko, N., Egiazarian, K.

Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Combined metrics, Full-reference metrics, Image visual quality assessment, Robust metrics

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-260

#### Bibliographical note

jufoid=84313

EXT="Ponomarenko, Nikolay"

EXT="Lukin, Vladimir"

Source: Scopus

Source ID: 85052901571

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Combined local and global image enhancement algorithm

We present a new image enhancement algorithm based on combined local and global image processing. The basic idea is to apply  $\alpha$ -rooting image enhancement approach for different image blocks. For this purpose, we split image in moving windows on disjoint blocks with different size (8 by 8, 16 by 16, 32 by 32 and, i.e.). The parameter  $\alpha$  for every block driven through optimization of measure of enhancement (EME). The resulting image is a weighted mean of all processing blocks. This strategy for image enhancement allows getting more contrast image with the following properties: irregular lighting and brightness gradient. Some experimental results are presented to illustrate the performance of the proposed algorithm.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Don State Technical University, College of Staten Island

Contributors: Voronin, V., Semenishchev, E., Ponomarenko, M., Agaian, S.

Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-220

#### Bibliographical note

jufoid=84313

Source: Scopus

Source ID: 85052861928

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Compression of signs of DCT coefficients for additional lossless compression of JPEG images

One of the main approaches to additional lossless compression of JPEG images is decoding of quantized values of discrete cosine transform (DCT) coefficients and further more effective recompression of the coefficients. Values of amplitudes of DCT coefficients are highly correlated and it is possible to effectively compress them. At the same time, signs of DCT coefficients, which occupy up to 20% of compressed image, are often considered unpredictable. In the paper, a new and effective method for compression of signs of quantized DCT coefficients is proposed. The proposed method takes into account both correlation between DCT coefficients of the same block and correlation between DCT coefficients of neighbor blocks. For each of 64 DCT coefficients, positions of 3 reference coefficients inside the block are

determined and stored in the compressed file. Four reference coefficients with fixed positions are used from the neighbor blocks. For all reference coefficients, 15 frequency models to predict signs of a given coefficient are used. All 7 probabilities (that the sign is negative) are mixed by logistic mixing. For test set of JPEG images, we show that the proposed method allows compressing signs of DCT coefficients by 1.1 ... 1.3 times, significantly outperforming nearest analogues.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Kharkiv National Aerospace University

Contributors: Miroshnichenko, O., Ponomarenko, M., Lukin, V., Egiazarian, K.

Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Discrete cosine transform, JPEG, JPEG additional compression, Sign compression

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-385

#### Bibliographical note

jufoid=84313

EXT="Lukin, Vladimir"

Source: Scopus

Source ID: 85052859716

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Conversion of sparsely-captured light field into alias-free fullparallax multiview content

We propose shearlet decomposition based light field (LF) reconstruction and filtering techniques for mitigating artifacts in the visualized contents of 3D multiview displays. Using the LF reconstruction capability, we first obtain the densely sampled light field (DSLFF) of the scene from a sparse set of view images. We design the filter via tiling the Fourier domain of epipolar image by shearlet atoms that are directionally and spatially localized versions of the desired display passband. In this way, it becomes possible to process the DSLFF in a depth-dependent manner. That is, the problematic areas in the 3D scene that are outside of the display depth of field (DoF) can be selectively filtered without sacrificing high details in the areas near the display, i.e. inside the DoF. The proposed approach is tested on a synthetic scene and the improvements achieved by means of the quality of the visualized content are verified, where the visualization process is simulated using a geometrical optics model of the human eye.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Electronics and Telecommunication Research Institute (ETRI)

Contributors: Sahin, E., Vagharshakyan, S., Bregovic, R., Lee, G., Gotchev, A.

Number of pages: 5

Pages: 1441-1445

Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Stereoscopic Displays and Applications XXIX

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

DOIs:

10.2352/ISSN.2470-1173.2018.04.SDA-144

#### Bibliographical note

jufoid=84313

Source: Scopus

Source ID: 85052854954

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### High power VECSEL prototype emitting at 625 nm

We demonstrate an OP-VECSEL prototype emitting more than 6W of CW output power at 625 nm. We employ dilute nitride (GaInNAs) quantum wells emitting fundamentally at 1250 nm together with intracavity frequency doubling.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Photonics  
Contributors: Penttinen, J., Leinonen, T., Rantamäki, A., Korpijärvi, V., Kantola, E., Guina, M.  
Number of pages: 3  
Publication date: Oct 2017

### Host publication information

Title of host publication: Advanced Solid State Lasers 2017 : Nagoya, Aichi Japan 1–5 October 2017  
Publisher: Optical Society of America  
Article number: ATu1A.8  
ISBN (Electronic): 978-0-9600380-7-7  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Keywords: VECSEL  
Electronic versions:  
ASSL17\_Penttinen. Embargo ended: 5/10/18  
DOIs:  
10.1364/ASSL.2017.ATu1A.8  
URLs:  
<http://urn.fi/URN:NBN:fi:tty-201712222495>. Embargo ended: 5/10/18  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Evaluation of long-term post process inactivation of bioleaching microorganisms

The H2020 BioMORe project ([www.biomore.info](http://www.biomore.info), Grant Agreement #642456) tests the feasibility of in-situ bioleaching of copper in deep subsurface deposits in the Rudna Mine, Poland. Copper is leached using biologically produced ferric iron solution, which is recycled back to the in-situ reactor after re-oxidation by iron-oxidizing bacteria (IOB). From a post operational point of view, it is important that the biological processes applied during the operation can be controlled and terminated. Our goal was to determine the possibility to use natural saline mine water for the inactivation of introduced IOB remaining in the in-situ reactor after completion of the leaching process of the Kupferschiefer ore. Aerobic and anaerobic microcosms containing acid-leached (pH 2) sandstone or black shale from the Kupferschiefer in the Rudna mine were further leached with the effluent from an iron-oxidizing bioreactor, at a temperature of 30°C, for 10 days, to simulate in-situ leaching. After the removal of the iron solution, residing IOB were inactivated by filling the microcosms with saline water (65 g L<sup>-1</sup> Cl<sup>-</sup>) originating from the mine. The saline water completely inactivated the IOB and the naturally occurring saline water of the mine can be used for long-term post process inactivation of bioleaching microorganisms.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, VTT Technical Research Centre of Finland  
Contributors: Bomberg, M., Miettinen, H., Wahlström, M., Kaartinen, T., Ahoranta, S., Lakaniemi, A., Kinnunen, P.  
Number of pages: 4  
Pages: 57-60  
Publication date: 2017

### Host publication information

Title of host publication: 22nd International Biohydrometallurgy Symposium  
Publisher: Trans Tech Publications Ltd  
ISBN (Print): 9783035711806

### Publication series

Name: Solid State Phenomena  
Volume: 262 SSP  
ISSN (Electronic): 1662-9779  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Materials Science(all), Condensed Matter Physics  
Keywords: In situ bioleaching, Inactivation, Iron-oxidizing bacteria  
DOIs:  
10.4028/www.scientific.net/SSP.262.57

### Bibliographical note

EXT="Kinnunen, Päivi"  
Source: Scopus  
Source ID: 85028980141

### **Pipeline for effective denoising of digital mammography and digital breast tomosynthesis**

Denoising can be used as a tool to enhance image quality and enforce low radiation doses in X-ray medical imaging. The effectiveness of denoising techniques relies on the validity of the underlying noise model. In full-field digital mammography (FFDM) and digital breast tomosynthesis (DBT), calibration steps like the detector offset and flat-fielding can affect some assumptions made by most denoising techniques. Furthermore, quantum noise found in X-ray images is signal-dependent and can only be treated by specific filters. In this work we propose a pipeline for FFDM and DBT image denoising that considers the calibration steps and simplifies the modeling of the noise statistics through variance-stabilizing transformations (VST). The performance of a state-of-the-art denoising method was tested with and without the proposed pipeline. To evaluate the method, objective metrics such as the normalized root mean square error (N-RMSE), noise power spectrum, modulation transfer function (MTF) and the frequency signal-to-noise ratio (SNR) were analyzed. Preliminary tests show that the pipeline improves denoising. When the pipeline is not used, bright pixels of the denoised image are under-filtered and dark pixels are over-smoothed due to the assumption of a signal-independent Gaussian model. The pipeline improved denoising up to 20% in terms of spatial N-RMSE and up to 15% in terms of frequency SNR. Besides improving the denoising, the pipeline does not increase signal smoothing significantly, as shown by the MTF. Thus, the proposed pipeline can be used with state-of-the-art denoising techniques to improve the quality of DBT and FFDM images.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, University of São Paulo, University of Pennsylvania

Contributors: Borges, L. R., Bakic, P. R., Foi, A., Maidment, A. D., Vieira, M. A.

Publication date: 2017

#### **Host publication information**

Title of host publication: Medical Imaging 2017 : Physics of Medical Imaging

Publisher: SPIE

Article number: 1013206

ISBN (Electronic): 9781510607095

#### **Publication series**

Name: Progress in biomedical optics and imaging

ISSN (Electronic): 1605-7422

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Biomaterials, Radiology Nuclear Medicine and imaging

Keywords: Denoising, Digital breast tomosynthesis, Full field digital mammography, Variance stabilization

Electronic versions:

Borges-Pipeline-SPIE2017

DOIs:

10.1117/12.2255058

URLs:

<http://urn.fi/URN:NBN:fi:tty-201907151960>

#### **Bibliographical note**

jufoid=65546

Source: Scopus

Source ID: 85020415748

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Full-reference metrics multidistortional analysis**

This paper is devoted to analysis and further improvement of full-reference metrics of image visual quality. The effectiveness of a metric is characterized by the rank correlation factors between the obtained array of mean opinion scores (MOS) and the corresponding array of given metric values. This allows to determine the correspondence of a considered metric to a human visual system (HVS). Results obtained on the database TID2013 show that Spearman correlation for the best existing metrics (PSNRHMA, FSIM, SFF, etc.) does not exceed 0.85. In this paper, extended verification tools that allow to detect the shortcomings of the metrics taking into account combined distortions is proposed. An example for further improvement of the PSNRHMA metric is presented.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Kharkiv National Aerospace University

Contributors: Ieremeiev, O., Lukin, V., Ponomarenko, N., Egiazarian, K.  
Number of pages: 9  
Pages: 27-35  
Publication date: 2017

#### Host publication information

Title of host publication: Image Processing: Algorithms and Systems XV

#### Publication series

Name: Electronic Imaging  
ISSN (Print): 2470-1173  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Full-reference metrics, Image visual quality assessment, Metrics analysis, Metrics verification, Multiple distortions  
DOIs:  
10.2352/ISSN.2470-1173.2017.13.IPAS-202

#### Bibliographical note

jufoid=84313  
EXT="Ponomarenko, Nikolay"  
EXT="Lukin, Vladimir"  
Source: Scopus  
Source ID: 85040625876  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### BM3D-HVS: Content-Adaptive denoising for improved visual quality

We introduce a content-Adaptive approach to image denoising where the filter design is based on mean opinion scores (MOSs) from preliminary experiments with volunteers who evaluated the quality of denoised image fragments. This allows to tune the filter parameters so to improve the perceptual quality of the output image, implicitly accounting for the peculiarities of the human visual system (HVS). A modification of the BM3D image denoising filter (Dabov et al., IEEE TIP, 2007), namely BM3DHVS, is proposed based on this framework. We show that it yields a higher visual quality than the conventional BM3D. Further, we have also analyzed the MOSs against popular full-reference visual quality metrics such as SSIM (Wang et al., IEEE TIP, 2004), its extension FSIM (Zhang et al., IEEE TIP, 2011), and the noreference IL-NIQE (Zhang et al., IEEE TIP, 2015) over each image fragment. Both the Spearman and the Kendall rank order correlation show that these metrics do not correspond well to the human perception. This calls for new visual quality metrics tailored for the benchmarking and optimization of image denoising methods.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Kharkiv National Aerospace University, Noiseless Imaging Ltd  
Contributors: Egiazarian, K., Danielyan, A., Ponomarenko, N., Foia, A., Ieremeiev, O., Lukin, V.  
Number of pages: 8  
Pages: 48-55  
Publication date: 2017

#### Host publication information

Title of host publication: Image Processing: Algorithms and Systems XV

#### Publication series

Name: Electronic Imaging  
ISSN (Print): 2470-1173  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
DOIs:  
10.2352/ISSN.2470-1173.2017.13.DPMI-083

#### Bibliographical note

EXT="Danielyan, Aram"  
EXT="Lukin, Vladimir"  
jufoid=84313  
Source: Scopus  
Source ID: 85040604686  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Single-frequency 571nm VECSEL for photo-ionization of magnesium

We report the development of an intracavity-frequency-doubled vertical external-cavity surface-emitting laser (VECSEL) emitting at 571 nm for photoionization of magnesium. The laser employs a V-cavity geometry with a gain chip at the end of one cavity arm and a lithium triborate (LBO) crystal for second harmonic generation. The gain chip has a bottom-emitting design with ten GaInAs quantum wells of 7 nm thickness, which are strain compensated by GaAsP. The system is capable of producing up to  $2.4 \pm 0.1$  W (total power in two separate output beams) in the visible. The free-running relative intensity noise was measured to be below  $-55$  dBc/Hz over all frequencies from 1 Hz to 1 MHz. With acoustic isolation and temperature regulation of the laser breadboard, the mode-hop free operation time is typically over 5 hrs. To improve the long-term frequency stability, the laser can be locked to a Doppler-free transition of molecular iodine. To estimate the short-term linewidth, the laser was tuned to the resonance of a reference cavity. From analysis of the on-resonance Hänsch-Couillaud error signal we infer a linewidth of  $50 \pm 10$  kHz. Light at 285 nm is generated with an external build-up cavity containing a  $\beta$ -barium borate (BBO) crystal. The UV light is used for loading  $25\text{Mg}^+$  ions in a surface-electrode RF Paul trap. These results demonstrate the applicability and versatility of high-power, single-frequency VECSELs with intracavity harmonic generation for applications in atomic and molecular physics.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, National Institute of Standards and Technology, Time and Frequency Division, Boulder, Colorado

Contributors: Burd, S., Leinonen, T., Penttinen, J., Allcock, D., Slichter, D., Srinivas, R., Wilson, A., Guina, M., Leibfried, D., Wineland, D.

Number of pages: 8

Publication date: 2 Jun 2016

#### Host publication information

Title of host publication: Proceedings of SPIE : Vertical External Cavity Surface Emitting Lasers (VECSELs) VI

Volume: 9734

Place of publication: San Francisco

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ISBN (Electronic): 9781628419696

#### Publication series

Name: SPIE Conference Proceedings

ISSN (Print): 0277-786X

ISSN (Electronic): 1996-756X

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: VECSEL, OPSEL, SDL, frequency doubling, SHG, ion trapping, single-frequency, photoionization, doppler-free spectroscopy, magnesium

DOIs:

10.1117/12.2213398

#### Bibliographical note

JUFOID=71479

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Intensity-based pointwise processing in dynamic laser speckle analysis

Intensity-based pointwise algorithms for 2D evaluation of activity in optical metrology with dynamic speckle analysis are studied. They are applied to a temporal sequence of correlated speckle patterns formed at laser illumination of the object surface. A new algorithm is proposed that provides the same quality of the 2D activity map but at less computational effort.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: 3D MEDIA, Korea Electronics Technology Institute, Bulgarian Academy of Sciences

Contributors: Stoykova, E., Berberova, N., Nazarova, D., Gotchev, A.

Number of pages: 2

Pages: 1-2

Publication date: 7 Jan 2016

#### Host publication information

Title of host publication: 2015 11th Conference on Lasers and Electro-Optics Pacific Rim, CLEO-PR 2015

Volume: 2

Publisher: IEEE

ISBN (Print): 9781467371094

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Electronic versions:

Stoykova\_CLEOPR-2015-26F2\_3

DOIs:

10.1109/CLEOPR.2015.7376008

URLs:

<http://urn.fi/URN:NBN:fi:tty-201606174269>

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Localization of light at vanishingly small disorder-levels with heavy photons**

We show that the key parameter driving the spatial extent of localized modes formed in randomly-perturbed periodic media near the band edge is the effective photon mass rather than the group index.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, CNRS, Université de Bordeaux, ICMCB, Laboratoire Photonique, CNRS-Univ.

Bourgogne, University of Ottawa, Canada, University of York

Contributors: Baron, A., Faggiani, R., Zang, X., Lalouat, L., Schulz, S. A., Vynck, K., O'Regan, B., Cluzel, B., De Fornel, F., Krauss, T. F., Lalanne, P.

Publication date: 10 Aug 2015

#### **Host publication information**

Title of host publication: 2015 Conference on Lasers and Electro-Optics, CLEO 2015

Volume: 2015-August

Publisher: Optical Society of America OSA

Article number: 7183319

ISBN (Electronic): 9781557529688

ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials

Keywords: Geometry, Indexes, Microscopy, Nonhomogeneous media, Optical waveguides, Photonics

DOIs:

10.1364/CLEO\_QELS.2015.FW1C.4

URLs:

<http://www.scopus.com/inward/record.url?scp=84954056218&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84954056218

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Dilute nitride SOAs for high-speed data processing in variable temperature conditions**

We present the first experimental study of a Dilute Nitride SOA with high-speed gain dynamics and attractive thermal characteristics as a data processing element at 10Gb/s and at different operating temperatures.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Aristotle University of Thessaloniki, School of Electrical and Computer Engineering, National Technical University of Athens

Contributors: Giannoulis, G., Korpijärvi, V. M., Iliadis, N., Mäkelä, J., Viheriälä, J., Apostolopoulos, D., Guina, M., Avramopoulos, H.

Publication date: 13 Mar 2015

#### **Host publication information**

Title of host publication: Optical Fiber Communication Conference, OFC 2015

Publisher: OSA - The Optical Society

ISBN (Print): 9781557529374

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Networks and Communications, Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84930886920&partnerID=8YFLogxK> (Link to publication in Scopus)  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Interstitial photodynamic therapy and glioblastoma: Light fractionation study on a preclinical model: Preliminary results**

**Background:** Glioblastoma is a high-grade cerebral tumor with local recurrence and poor outcome. Photodynamic therapy (PDT) is a local treatment based on the light activation of a photosensitizer (PS) in the presence of oxygen to form cytotoxic species. Fractionation of light delivery may enhance treatment efficiency by restoring tissue oxygenation. **Objectives:** To evaluate the efficiency of light fractionation using MRI imaging, including diffusion and perfusion, compared to histological data. **Materials and Methods:** Thirty-nine "Nude" rats were grafted with human U87 cells into the right putamen. After PS precursor intake (5-ALA), an optic fiber was introduced into the tumor. The rats were randomized in three groups: without illumination, with monofractionated illumination and the third one with multifractionated light. Treatment effects were assessed with early MRI including diffusion and perfusion sequences. The animals were eventually sacrificed to perform brain histology. **Results:** On MRI, we observed elevated diffusion values in the center of the tumor among treated animals, especially in multifractionated group. Perfusion decreased around the treatment site, all the more in the multifractionated group. Histology confirmed our MRI findings, with a more extensive necrosis and associated with a rarified angiogenic network in the treatment area, after multifractionated PDT. However, we observed more surrounding edema and neovascularization in the peripheral ring after multifractionated PDT. **Conclusion:** Fractionated interstitial PDT induced specific tumoral lesions. The multifractionated scheme was more efficient, inducing increased tumoral necrosis, but it also caused significant peripheral edema and neovascularization. Diffusion and perfusion MRI imaging were able to predict the histological lesions.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Lille University Hospital, Univ Paris 06, Centre National de la Recherche Scientifique (CNRS), Pierre & Marie Curie University - Paris 6, Institut de Recherche pour le Developpement (IRD), Inria, Institut National de la Sante et de la Recherche Medicale (Inserm), Univ Sorbonne, CNRS,ICM,UMR S 1127,UMR 7225,U1127, INSERM,Inria Paris Rocquencourt,Inst Cerveau & Mo

Contributors: Leroy, H. A., Vermandel, M., Tétard, M. C., Lejeune, J. P., Mordon, S., Reyns, N.

Publication date: 2015

#### **Host publication information**

Title of host publication: Optical Techniques in Neurosurgery, Neurophotonics, and Optogenetics II

Volume: 9305

Publisher: SPIE

Article number: 93050D

ISBN (Electronic): 9781628413953

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Biomaterials, Radiology Nuclear Medicine and imaging

DOIs:

10.1117/12.2079347

URLs:

<http://www.scopus.com/inward/record.url?scp=84928128691&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928128691

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Mode-locked 1.33 $\mu\text{m}$ semiconductor disk laser with a bismuth-doped fiber amplifier**

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Research group: Semiconductor Technology and Applications, Frontier Photonics, Fiber Optics Research Center, Russian Academy of Sciences

Contributors: Rantamäki, A., Heikkinen, J., Gumenyuk, R., Lyytikäinen, J., Saarinen, E. J., Leinonen, T., Melkumov, M., Dianov, E. M., Okhotnikov, O. G.

Number of pages: 2

Pages: 123-124

Publication date: 16 Dec 2014

#### **Host publication information**

Title of host publication: ISLC 2014, IEEE 24th International Semiconductor Laser Conference, 7-10 September, 2014, Mallorca, Spain



Publisher: The Institute of Electrical and Electronics Engineers, Inc.  
Article number: 6987481  
ISBN (Print): 9781479957217

#### Publication series

Name: IEEE International Semiconductor Laser Conference  
ASJC Scopus subject areas: Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1109/ISLC.2014.194  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84920126178&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-12-30<br/>Publisher name: IEEE  
Source: researchoutputwizard  
Source ID: 1348  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Bistable optical propagation in nematic liquid crystals

We demonstrate bistability when beams propagate and self-focus in nematic liquid crystals. Sample configurations subject to the Fréedericksz threshold support diffracting as well as self-confined beams for the same input power, leading to hysteresis.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, University of Southampton, United Kingdom  
Contributors: Piccardi, A., Alberucci, A., Kravets, N., Buchnev, O., Kaczmarek, M., Assanto, G.  
Publication date: 21 Jul 2014

#### Host publication information

Title of host publication: Nonlinear Photonics, NP 2014  
Publisher: Optical Society of America OSA  
ISBN (Print): 9781557528209  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Mechanics of Materials  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84919754065&partnerID=8YFLogxK> (Link to publication in Scopus)  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### 160W single-frequency laser based on active tapered double-clad fiber amplifier

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Tampere University of Technology, Frontier Photonics, A. M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow State University, Tampere University of Technology, Institute of Radio Engineering and Electronics of the Russian Academy of Sciences  
Contributors: Trikshev, A. I., Kurkov, A. S., Tsvetkov, V. B., Filatova, S. A., Kertulla, J., Filippov, V., Chamorovskiy, Y. K., Okhotnikov, O. G.  
Publication date: 2013

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers  
ISBN (Print): 9781479905942  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84898722786&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84898722786  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

## Detection of KC1 and KOH using collinear photofragmentation and atomic absorption spectroscopy

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Physics, Photonics, Frontier Photonics, Optics Laboratory, Department of Physics, Tampere University of Technology

Contributors: Sorvajarvi, T., Rossi, J., Toivonen, J.

Publication date: 2013

### Host publication information

Title of host publication: The European Conference on Lasers and Electro-Optics, CLEO\_Europe 2013

ISBN (Print): 9781479905942

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84898750873&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84898750873

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

## Spatial solitons in a self-focusing medium with tunable nonlinearity

We employ a suitably designed planar cell with inter-digitated electrodes and nematic liquid crystals to investigate the role of nonlinearity in generation and propagation of spatial solitons.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, University of Southampton, United Kingdom

Contributors: Piccardi, A., Alberucci, A., Assanto, G., Kaczmarek, M.

Publication date: 2011

### Host publication information

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557529152

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/NLO.2011.NWE7

Source: Scopus

Source ID: 84894325209

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

## Dark solitons in nematic liquid crystals

We demonstrate the formation of dark spatial solitons in nematic liquid crystals, with an azo-dye dopant providing the self-defocusing response. A collinear copolarized beam is used to probe the guiding properties of the soliton. NLO/ISOM/ODS

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Nonlinear Optics and OptoElectronics Lab, Beam Engineering for Advanced Measurements Co

Contributors: Piccardi, A., Alberucci, A., Assanto, G., Tabiryanyan, N.

Publication date: 2011

### Host publication information

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557529152

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/NLO.2011.NWE4

URLs:

<http://www.scopus.com/inward/record.url?scp=84894332639&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84894332639

### **Multimode waveguides in nematic liquid crystals**

We report on the first experimental observation of higher-order modes guided by soliton-induced waveguides in nematic liquid crystals, identifying the power domains where guided modes are supported.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y. S.

Number of pages: 2

Pages: 1912-1913

Publication date: 2011

#### **Host publication information**

Title of host publication: Conference on Lasers and Electro-Optics/Pacific Rim, CLEOPR 2011

ISBN (Print): 9780977565771

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893575091&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893575091

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Spatial solitons carrying phase singularities in nematic liquid crystals**

We demonstrate self-trapped laser beams carrying optical vortices in nematic liquid crystals. We experimentally observe astigmatic transformations of vortex beams into spiralling dipole azimuthons accompanied by a nontrivial power-dependent charge-flipping of on-axis phase dislocations.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y.

Number of pages: 2

Pages: 444-445

Publication date: 2011

#### **Host publication information**

Title of host publication: Conference on Lasers and Electro-Optics/Pacific Rim, CLEOPR 2011

ISBN (Print): 9780977565771

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893535991&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893535991

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Self-assembled monolayers (SAMs) of porphyrin deposited inside solid-core photonic crystal fibre (SCPCF)**

Photochemical and physical properties of solid-core photonic crystal fibre (SCPCF) modified inside with porphyrin films attached via self-assembled monolayer (SAM) technique are reported. Porphyrins can be utilized to develop different gas sensors.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Chemistry and Bioengineering, Chemistry and Bioengineering, Optoelectronics Research Centre, Frontier Photonics, Russian Academy of Sciences

Contributors: Veselov, A., Efimov, A., Chamorovskiy, A., Okhotnikov, O., Kosolapov, A., Levchenko, A., Lemmetyinen, H., Tkachenko, N.

Publication date: 2011

### Host publication information

Title of host publication: Access Networks and In-house Communications, ANIC 2011

ISBN (Print): 9781557529138

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893608733&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893608733

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Third harmonic generation enhancement in nematic liquid crystals via nonlocal solitons propagation

We demonstrate type I third harmonic generation enhanced by the tight localization of fs laser light in nonlocal spatial solitons excited in nematic liquid crystals.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Physics, Frontier Photonics, Sapienza University, INRS Énergie, Matériaux et Télécommunications, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Peccianti, M., Pasquazi, A., Assanto, G., Morandotti, R.

Publication date: 2011

### Host publication information

Title of host publication: CLEO: Science and Innovations, CLEO\_SI 2011

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893600063&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893600063

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Directional selectivity through the subwavelength slit in metallic gratings

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Bilkent University, Nanotechnology Research Center

Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.

Publication date: 2011

### Host publication information

Title of host publication: 2011 Conference on Lasers and Electro-Optics : Laser Science to Photonic Applications, CLEO 2011

Article number: 5951099

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=80052115222&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 80052115222

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Theory of near-IR metatronic nanocircuits using transparent conducting oxides (TCO)

We theoretically investigate TCO nanorods functioning as optical nanocircuits in NIR regimes. Using the circuit theory and FDTD simulations, we explore the nanoscale circuit element functionalities controlled by the polarization of incident E-field.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Electrical and Systems Engineering, University of Pennsylvania  
Contributors: Caglayan, H., Engheta, N.  
Publication date: 2011

### Host publication information

Title of host publication: Frontiers in Optics 2011  
Publisher: Optical Society of America  
ISBN (Print): 9781557529176  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/FIO.2011.FTuG2  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84893520875&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

EXT="Caglayan, Humeyra"  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Directional selectivity through the subwavelength slit in metallic gratings

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Bilkent University, Nanotechnology Research Center  
Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.  
Publication date: 2011

### Host publication information

Title of host publication: CLEO: Applications and Technology  
ISBN (Print): 9781557529107  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/CLEO\_AT.2011.JTuI67  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84893621842&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84893621842  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Directional selectivity through the subwavelength slit in metallic gratings

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Bilkent University, Nanotechnology Research Center  
Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.  
Publication date: 2011

### Host publication information

Title of host publication: CLEO: Science and Innovations 2011  
ISBN (Print): 9781557529107  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/CLEO\_AT.2011.JTuI67

URLs:

<http://www.scopus.com/inward/record.url?scp=84893590543&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 84893590543

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Directional selectivity through the subwavelength slit in metallic gratings**

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Bilkent University, Nanotechnology Research Center

Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.

Number of pages: 3

Publication date: 2011

#### **Host publication information**

Title of host publication: Quantum Electronics and Laser Science Conference, QELS 2011

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/CLEO\_AT.2011.JTuI67

URLs:

<http://www.scopus.com/inward/record.url?scp=84894054350&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Nematicon routing in liquid crystal light valve**

Using external beams on the photoconductive layer of a liquid crystal light valve we demonstrate all-optical control of soliton induced waveguides in nematics. Using this approach we implement a half-adder and a 3-bit demultiplexer.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, CNRS

Contributors: Piccardi, A., Alberucci, A., Bertolozzo, U., Residori, S., Assanto, G.

Publication date: 2010

#### **Host publication information**

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557528964

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84896750605&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84896750605

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Soliton self-deflection via power-dependent walk-off**

We demonstrate and model power-dependent self-bending of spatial solitons in nematic liquid crystals. The deflection is explained by nonlinear changes in walk-off, as induced by the rotation of the optic axis via reorientation.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University "Roma Tre", Nonlinear Optics and OptoElectronics Lab  
Contributors: Piccardi, A., Alberucci, A., Assanto, G.  
Publication date: 2010

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers  
ISBN (Print): 9781557528964  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/NP.2010.NMD1

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Controlled wettability of paperboard by nanoparticles using liquid flame spray process

Liquid flame spray process (LFS) was used for depositing  $\text{TiO}_x$  and  $\text{SiO}_x$  nanoparticles on paperboard to control wetting properties of the surface. By the LFS process it is possible to create either superhydrophobic or superhydrophilic surfaces. Changes in the wettability are related to structural properties, which were characterized using scanning electron microscope (SEM) and atomic force microscope (AFM). The surface properties can be ascribed as a correlation between wetting properties of the paperboard and the surface texture created by nanoparticles.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Materials Science, Department of Physics, Abo Akad Univ, Abo Akademi University, Dept Phys, Institute of Paper Converting, Institute of Physics  
Contributors: Stepien, M., Saarinen, J. J., Teisala, H., Tuominen, M., Aromaa, M., Kuusipalo, J., Mäkelä, J., Toivakka, M.  
Number of pages: 3  
Pages: 1390-1392  
Publication date: 2010

#### Host publication information

Title of host publication: International Conference on Nanotechnology for the Forest Products Industry 2010  
ISBN (Print): 9781618390011  
ASJC Scopus subject areas: Forestry, Atomic and Molecular Physics, and Optics  
URLs:

<http://www.scopus.com/inward/record.url?scp=80052429203&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80052429203

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Single $\text{KTIPO}_4$ nanocrystals for nonlinear probing of local optical fields and interaction with a metallic nanostructure

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: ESPCI, Laboratoire de Physique de la Matière Condensée-Ecole Polytechnique-CNRS, ENS de Cachan, Laboratoire de Photonique Quantique et Moléculaire UMR 8537, Laboratoire Photons Et Matière-UPR A0005, Ecole Polytechnique, Cristal Laser S.A., Laboratoire de Photonique Quantique et Moléculaire-ENS Cachan  
Contributors: Le Xuan, L., Slablab, A., Zhou, C., Chauvat, D., De Wilde, Y., Perruchas, S., Tard, C., Gacoin, T., Villeval, P., Roch, J. F.  
Publication date: 2009

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers  
Publisher: Optical Society of America  
ISBN (Print): 9781424440801  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
URLs:

<http://www.scopus.com/inward/record.url?scp=84898050536&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84898050536

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Routing light with nematicons: Light localization and steering in liquid crystals**

Liquid crystals in the nematic phase support light self-confinement via reorientational nonlinearity and nonlocality, yielding robust spatial solitons which can trap, switch and route optical signals. We review the major achievements in the field.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Nonlinear Optics and OptoElectronics Lab, CNISM and University of Rome, INRS-EMT Université du Québec

Contributors: Assanto, G., Peccianti, M., Alberucci, A., Piccardi, A.

Number of pages: 2

Pages: 2281-2282

Publication date: 2009

#### **Host publication information**

Title of host publication: Optics InfoBase Conference Papers

Publisher: Optical Society of America

ISBN (Print): 9781557528698

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/IQEC.2009.ITuG1

URLs:

<http://www.scopus.com/inward/record.url?scp=84897963487&partnerID=8YFLogxK> (Link to publication in Scopus)

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Observation of defect formation in metamaterials**

We report subwavelength localization of electromagnetic fields within cavities based on metamaterials. Cavity resonances are observed in the transmission spectrum of a split ring resonator and composite metamaterials cavity structures. These cavity resonances are shown to exhibit high quality factors. Since the unit cells of metamaterials are much smaller than the operation wavelength, subwavelength localization is possible within these metamaterial cavity structures. In the present paper, we show that the electromagnetic field is localized into a region of  $\lambda/8$ , where  $\lambda$  is the cavity resonance wavelength.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Nanotechnology Research Center-NANOTAM, Bilkent University, Harvard University

Contributors: Caglayan, H., Bulu, I., Loncar, M., Ozbay, E.

Number of pages: 2

Publication date: 2008

#### **Host publication information**

Title of host publication: Plasmonics and Metamaterials 2008

Publisher: Optical Society of America

Article number: MMC7

ISBN (Print): 9781557528612

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/META\_PLAS.2008.MMC7

URLs:

<http://www.scopus.com/inward/record.url?scp=84898623312&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **High power fiber lasers**

Over 1 kW of output power has now been reached with nearly diffraction-limited ytterbium-doped fiber lasers. Amplifiers can reach comparable powers, even with single-frequency beams. We review these and other recent results and discuss the possibilities for further progress.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication



Organisations: Optoelectronics Research Centre, Southampton Photonics, Inc., University of Southampton  
Contributors: Nilsson, J., Sahu, J. K., Jeong, Y., Filippov, V. N., Soh, D. B. S., Codemard, C. A., Dupriez, P., Kim, J., Richardson, D. J., Malinowski, A., Piper, A. N., Price, J. H. V., Furusawa, K., Clarkson, W. A., Payne, D. N.  
Publication date: 2006

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers  
Publisher: Optical Society of America  
ISBN (Print): 1557528020, 9781557528025  
ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84899075367&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84899075367  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Walking anisotropic spatial solitons and their steering in nematic liquid crystals

A novel nematic liquid crystal cell allows the excitation of anisotropic spatial solitons and their angular steering, acting on walk-off thru the applied bias. The input interface enables polarization-healing soliton generation and spatial routing.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, University of Calabria  
Contributors: Peccianti, M., Alberucci, A., Assanto, G., De Luca, A., Coschignano, G., Umetsu, C.  
Publication date: 1 Jan 2005

#### Host publication information

Title of host publication: Nonlinear Guided Waves and Their Applications, NLGW 2005  
Publisher: Optical Society of America OSA  
ISBN (Print): 1557527911  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Electrical and Electronic Engineering  
DOIs:  
10.1364/NLGW.2005.FA1  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Supercontinuum generation: Introduction

The article collection in this feature issue presents the most recent experimental and numerical studies of supercontinuum generation in bulk nonlinear media, photonic crystal fibers, and waveguides. It also introduces new results of design and fabrication of these structures with engineered dispersion, development of new diagnostic tools, as well as applications of spectral broadening and supercontinuum generation for pulse compression, imaging, and sensing.

#### General information

Publication status: Published  
MoE publication type: B1 Article in a scientific magazine  
Organisations: Physics, Research group: Ultrafast Optics, Vilnius University, Université Paris-Saclay  
Contributors: Dubietis, A., Couairon, A., Genty, G.  
Pages: SG1-SG3  
Publication date: 1 Feb 2019  
Peer-reviewed: No

#### Publication information

Journal: Journal of the Optical Society of America B: Optical Physics  
Volume: 36  
Issue number: 2  
ISSN (Print): 0740-3224  
Ratings:  
Scopus rating (2019): CiteScore 3.9 SJR 0.851 SNIP 0.964  
Original language: English  
ASJC Scopus subject areas: Statistical and Nonlinear Physics, Atomic and Molecular Physics, and Optics  
DOIs:  
10.1364/JOSAB.36.000SG1  
Source: Scopus

Source ID: 85060854199

Research output: Contribution to journal › Editorial › Scientific

### **Nonlinear guided waves: Preface**

This special issue presents a collection of experimental and theoretical research in nonlinear waves, with emphasis on nonlinear optics, which were presented at the conference Nonlinear Guided Waves VIII held at the Hotel Victoria, Oaxaca, Mexico in April 2016. This preface provides a short history of the conference series Nonlinear Guided Waves and short introductions to the contributed papers which puts them in context.

### **General information**

Publication status: Published

MoE publication type: B1 Article in a scientific magazine

Organisations: Photonics, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre", Optics Laboratory, Department of Physics, Tampere University of Technology, CNR-ISC, Institute for Complex Systems, University of Edinburgh

Contributors: Assanto, G., Smyth, N. F.

Publication date: 1 Dec 2016

Peer-reviewed: No

### **Publication information**

Journal: Journal of Nonlinear Optical Physics and Materials

Volume: 25

Issue number: 4

Article number: 1650041

ISSN (Print): 0218-8635

Ratings:

Scopus rating (2016): CiteScore 1.3 SJR 0.301 SNIP 0.493

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Physics and Astronomy (miscellaneous)

Keywords: discrete systems, Nonlinear optics, solitary waves, solitons

DOIs:

10.1142/S0218863516500417

Source: Scopus

Source ID: 85011382866

Research output: Contribution to journal › Article › Scientific

### **Dynamics of rogue wave and soliton emergence in spontaneous modulation instability**

Numerical simulations of spontaneous modulation instability show that localized structures in the chaotic instability field are well-described by analytic elementary and higher order soliton on finite background solutions of the nonlinear Schrödinger equation.

### **General information**

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Physics, Frontier Photonics, The University of Auckland, University College Dublin, Ireland, Christina Thorpe, Université de Franche-Comté, Institut FEMTO-ST, School of Mathematical Sciences, University College Dublin

Contributors: Toenger, S., Godin, T., Billet, C., Dias, F., Erkintalo, M., Genty, G., Dudley, J. M.

Number of pages: 2

Publication date: 4 May 2015

### **Host publication information**

Title of host publication: CLEO: QELS - Fundamental Science, CLEO\_QELS 2015

Publisher: Optical Society of America (OSA)

ISBN (Print): 9781557529688

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electrical and Electronic Engineering

DOIs:

10.1364/CLEO\_QELS.2015.FW4D.2

Source: Scopus

Source ID: 84935059381

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

### Vedyn Stark-ilmion ja polarisoituvuuksien mallintaminen polkuintegraali-Monte Carlo-menetelmällä

Ulkoisen sähkökentän vaikutusta kvanttimekaaniseen kuvaukseen mallinnetaan käyttämällä polarisoituvuutta, jonka eri komponentit kuvaavat myös aineen optisia ominaisuuksia. Näistä staattinen dipolipolarisoituvuus  $\alpha$  sekä hyperpolarisoituvuudet  $\beta$ ,  $\gamma$ ... liittyvät keskeisesti Stark-ilmioon eli ominaistilojen energiaspektrin silpoutumiseen sähkökentässä. Tässä tutkimuksessa tarkastellaan äärellisen sähkökentän simuloimiseen ja staattisten polarisoituvuuksien laskemiseen liittyvää problematiikkaa, jota lähestytään ensimmäistä kertaa suoraan äärellisessä lämpötilassa käyttämällä polkuintegraali-Monte Carlo -menetelmää (PIMC). Sähkökentän kuvaaminen käsitellään yksityiskohtaisesti ja sitä sovelletaan Finite field-periaatteella neljään eri vetysysteemiin:  $H$ ,  $H^-$ ,  $H_2^+$  ja  $H_2$ . Menetelmä toimii luotettavasti, ja saadut tulokset vastaavat tunnettuja staattisten polarisoituvuuksien arvoja erinomaisesti sekä adiabaattisissa että ei-adiabaattisissa tapauksissa. Lisäksi merkittävä äärellisen lämpötilan vaikutus havaitaan vetymolekyyleillä, joilla rotaatio- ja vibraatiotilojen osuudet ovat suuret. Laskentakapasiteetin riittäessä PIMC-menetelmä voidaan todeta suoraviivaiseksi keinoksi staattisten polarisoituvuuksien kuvaamiseen ja laskemiseen äärellisissä lämpötiloissa myös niissä tapauksissa, joissa perinteiset menetelmät osoittautuvat työläiksi.

#### General information

Publication status: Published

MoE publication type: G2 Master's thesis, polytechnic Master's thesis

Organisations: Department of Physics

Contributors: Tiihonen, J.

Number of pages: 50

Publication date: 3 Sep 2014

#### Publication information

Publisher: Tampere University of Technology

Original language: Finnish

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: path integral Monte Carlo, finite temperature, quantum statistics, polarizability, hyperpolarizability, hydrogen

Electronic versions:

Juha Tiihonen - Diplomityö

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201410301532>

Research output: Book/Report > Master's Thesis > Scientific

### Diffusion processes and growth on aluminum cluster surfaces

Diffusion processes of adatoms on icosahedral and Wulff polyhedral aluminum cluster surfaces have been studied by molecular dynamics simulations using the effective medium theory. Activation energies of diffusion mechanisms along  $\{111\}$  and  $\{100\}$  facets and from one facet to another, including different hopping and exchange processes as well as more exotic events, have been calculated. Exchange diffusion of an adatom by a chain mechanism through a  $\{100\}$  facet between two  $\{111\}$  facets and hopping diffusion across the edge between two  $\{111\}$  facets via a pull of another adatom on the neighbour facet are shown to play an important role. Adatoms on  $\{111\}$  facets are mobile already at very low temperatures, but on  $\{100\}$  facets diffusion starts above the room temperature as well as diffusion from  $\{111\}$  facets to  $\{100\}$  facets. Diffusion from  $\{100\}$  facet to other facets was not observed until at temperatures close to the melting temperatures of clusters. Dynamical simulations at different temperatures confirmed the appearance of diffusion mechanisms predicted by the activation energies.

#### General information

Publication status: Published

MoE publication type: Not Eligible

Organisations: Jyväskylän yliopisto

Contributors: Valkealahti, S., Manninen, M.

Number of pages: 7

Pages: 496-502

Publication date: 1 Jan 1997

Peer-reviewed: Yes

#### Publication information

Journal: Zeitschrift fur Physik D-Atoms Molecules and Clusters

Volume: 40

Issue number: 1-4

ISSN (Print): 0178-7683

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

DOIs:

10.1007/s004600050262

Research output: Contribution to journal > Article > Scientific > peer-review

### **Structural transitions and melting of copper clusters**

Molecular dynamics is used to study the melting and structural transitions of small copper clusters. The melting temperature is found to be proportional to the average coordination number. Small icosahedral clusters melt at slightly higher temperatures than the cubic structures. Small cuboctahedral clusters are not stable but transform via a nondiffusive transition to icosahedral structure.

#### **General information**

Publication status: Published  
MoE publication type: Not Eligible  
Organisations: Jyväskylän yliopisto  
Contributors: Valkealahti, S., Manninen, M.  
Number of pages: 3  
Pages: 255-257  
Publication date: 1 Mar 1993  
Peer-reviewed: Yes

#### **Publication information**

Journal: Zeitschrift für Physik D Atoms, Molecules and Clusters  
Volume: 26  
Issue number: 1  
ISSN (Print): 0178-7683  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Keywords: 36.40  
DOIs:  
10.1007/BF01429161  
Source: Scopus  
Source ID: 27144438045  
Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Simulation of cluster impact fusion**

We report molecular dynamics simulations of the impact of TiD clusters on TiD targets. In each cluster collision the total fusion probability seems to be due to a single deuterium deuterium collision. The kinetic energies of incident deuterium atoms gradually level off around the initial cluster energy, but do not reach the high energy tail of a corresponding Maxwell-Boltzmann distribution. Neither any other support for a thermonuclear fusion mechanism was observed. On the contrary, our simulations imply that the enhanced fusion rate is rather due to channeled many atom collision cascade type mechanism.

#### **General information**

Publication status: Published  
MoE publication type: Not Eligible  
Organisations: Jyväskylän yliopisto  
Contributors: Valkealahti, S., Manninen, M., Hammarén, E.  
Number of pages: 5  
Pages: 547-551  
Publication date: 1 Jun 1992  
Peer-reviewed: Yes

#### **Publication information**

Journal: Zeitschrift für Physik D Atoms, Molecules and Clusters  
Volume: 22  
Issue number: 2  
ISSN (Print): 0178-7683  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Keywords: 36.40.+d, 79.20.Rf  
DOIs:  
10.1007/BF01426097  
Source: Scopus  
Source ID: 34249834202  
Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Molecular dynamics investigation of the premelting effects of lennard-jones (111) surfaces**

Molecular dynamics simulations have been performed to study the premelting effects of noble-gas surfaces (argon) close to but below the bulk melting temperature. In particular, the increase of disorder as a function of temperature at (111) surface has been considered. The truncated Lennard-Jones (6-12) potential is used to describe the interactions between particles. Surface premelting has been analyzed by means of total energies, trajectory plots, mean square displacement functions, diffusion coefficients, vacancy concentrations and two-dimensional order parameters. The (111) surface starts to disorder by vacancy formation, which leads to the premelting of the surface layer far below the bulk melting temperature. Melting proceeds via a layer-by-layer mechanism, when temperature is further increased. This study supports the earlier observations of a melting that proceeds in the direction of high packing density.

#### **General information**

Publication status: Published  
MoE publication type: Not Eligible  
Organisations: Jyväskylän yliopisto  
Contributors: Valkealahti, S., Nieminen, R. M.  
Number of pages: 5  
Pages: 646-650  
Publication date: 1 Oct 1987  
Peer-reviewed: Yes

#### **Publication information**

Journal: Physica Scripta  
Volume: 36  
Issue number: 4  
ISSN (Print): 0031-8949  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Mathematical Physics, Condensed Matter Physics  
DOIs:  
10.1088/0031-8949/36/4/007  
Source: Scopus  
Source ID: 0043182611  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Tunable narrow-linewidth VECSELS for atomic and molecular physics**

#### **General information**

Publication status: Published  
Organisations: Photonics, National Institute of Standards and Technology, Time and Frequency Division, Boulder, Colorado  
Contributors: Penttinen, J., Leinonen, T., Burd, S., Guina, M.  
Publication date: 23 Aug 2017  
Peer-reviewed: Unknown  
Event: Paper presented at The 25th Colloquium on High-Resolution Molecular Spectroscopy, Helsinki, Finland.  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Keywords: VECSEL  
Electronic versions:  
HRMS\_2017\_Penttinen\_abstract  
URLs:  
[http://www.helsinki.fi/kemia/HRMS2017/documents/HRMS\\_2017\\_Book%20of%20Abstracts.pdf](http://www.helsinki.fi/kemia/HRMS2017/documents/HRMS_2017_Book%20of%20Abstracts.pdf)  
Research output: Other conference contribution › Paper, poster or abstract › Scientific

### **VECSEL: a versatile laser tool for ion trappers**

#### **General information**

Publication status: Published  
Organisations: Photonics, National Institute of Standards and Technology, Time and Frequency Division, Boulder, Colorado  
Contributors: Penttinen, J., Leinonen, T., Burd, S. C., Allcock, D. T., Leibfried, D., Guina, M.  
Publication date: 16 Aug 2017  
Peer-reviewed: Unknown  
Event: Paper presented at 1st North American Conference on Trapped Ions, Boulder, United States.  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics  
Keywords: VECSEL

Electronic versions:

nacti\_abstract\_penttinen

Research output: Other conference contribution › Paper, poster or abstract › Scientific

## Broadband Anti-reflective Coatings for Multi-junction Solar Cells

### General information

Publication status: Published

Organisations: Facilities and Infrastructure, Photonics, Research group: ORC

Contributors: Reuna, J., Polojärvi, V. (ed.), Aho, T. (ed.), Aho, A. (ed.), Isoaho, R. (ed.), Tukiainen, A. (ed.), Guina, M. (ed.)

Number of pages: 1

Pages: 1

Publication date: 29 May 2017

Peer-reviewed: Unknown

Event: Paper presented at Optics and Photonics days 2017, Oulu, Finland.

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics

Keywords: anti-reflective coating, thin films, multi-junction solar cell, material characterization

Electronic versions:

Abstract\_JarnoReuna\_OPD2017

Poster\_for\_OPD17

URLs:

<http://urn.fi/URN:NBN:fi:ty-201710312092>

### Bibliographical note

Poster and an abstract for Optics and Photonics days 2017.

Research output: Other conference contribution › Paper, poster or abstract › Scientific

## Thermal Modification of ALD Grown Titanium Oxide Ultra Thin Film for Photoanode Applications

### General information

Publication status: Published

Organisations: Optoelectronics Research Centre, Research group: Surface Science

Contributors: Hannula, M. K., Lahtonen, K. T., Isotalo, T. J., Saari, J. S., Valden, M. O.

Publication date: 15 Dec 2016

Peer-reviewed: Unknown

Event: Paper presented at Symposium on Future Prospects for Photonics, Tampere, Finland.

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Surfaces, Coatings and Films, Surfaces and Interfaces, Atomic and Molecular Physics, and Optics

Keywords: Titanium dioxide, titanium silicide, Atomic layer deposition (ALD), photoemission electron microscopy, PEEM, hydrogen energy

Research output: Other conference contribution › Paper, poster or abstract › Scientific

### 1.3 $\mu\text{m}$ InAs quantum dot semiconductor disk laser

Vertical-external-cavity surface-emitting lasers (VECSEL), or semiconductor disk lasers (SDL), are attractive laser source for a wide range of applications owing to unique possibility to combine high output power with an excellent beam quality [1]. The intrinsic features of InAs quantum dots (QD) can offer low threshold, broad wavelength tunability, fast carrier dynamics and low temperature sensitivity. Recently, continuous wave (CW) operation of QD-based VECSEL emitting at 1.25  $\mu\text{m}$  with output powers reaching multi-watt levels were achieved at room temperature [2]. However, extending the emission wavelength to 1.3  $\mu\text{m}$  and beyond becomes more challenging. To date, QD-based VECSEL with optical power greater than 0.5 mW at 1305 nm has been demonstrated [3]. Here, we present a record-high power InAs/InGaAs QD-based VECSEL operating at the wavelength of 1.3  $\mu\text{m}$ .

### General information

Publication status: Published

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Ioffe Physico-Technical Institute, Peter the Great St. Petersburg Polytechnic University

Contributors: Blokhin, S. A., Bobrov, M. A., Blokhin, A. A., Kuzmenkov, A. G., Vasil'Ev, A. P., Maleev, N. A., Dudelev, V. V., Soboleva, K. K., Sokolovskii, G. S., Rantamäki, A., Okhotnikov, O., Ustinov, V. M.

Pages: R317

Publication date: 23 Aug 2016

Peer-reviewed: Unknown

Event: Paper presented at 2016 International Conference Laser Optics, LO 2016, St. Petersburg, Russian Federation.

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics  
Electronic versions:

Blokhin-LO2016-1.3  $\mu\text{m}$  InAs Quantum Dot Semiconductor Disk Laser

DOIs:

10.1109/LO.2016.7549727

URLs:

<http://urn.fi/URN:NBN:fi:tty-201612024842>

URLs:

<http://www.laseroptics.ru/publications.html> (Conference website)

Source: Scopus

Source ID: 84987923895

Research output: Other conference contribution > Paper, poster or abstract > Scientific

### **State of polarization in anisotropic tapered fiber with extremely large core diameter**

We produced numerical and experimental research of polarization maintaining properties of adiabatic anisotropic tapered optical fiber with extremely large output core diameter. Results show that polarization state of light coupling in the narrow end did not degrade dramatically through whole fiber length (while core diameter increasing adiabatically upto tens of wavelengths).

#### **General information**

Publication status: Published

Organisations: Optoelectronics Research Centre, Russian Quantum Center, Institute of Radio Engineering and Electronics of the Russian Academy of Sciences

Contributors: Ustimchik, V. E., Vyatkin, M. Y., Popov, S. M., Chamorovskii, Y. K., Filippov, V. N., Nikitov, S. A.

Pages: S123

Publication date: 23 Aug 2016

Peer-reviewed: Unknown

Event: Paper presented at 2016 International Conference Laser Optics, LO 2016, St. Petersburg, Russian Federation.

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: birefringence, large mode area fibers, polarization, taper fiber

DOIs:

10.1109/LO.2016.7549956

URLs:

<http://www.laseroptics.ru/publications.html> (Conference website)

Source: Scopus

Source ID: 84987880925

Research output: Other conference contribution > Paper, poster or abstract > Scientific

### **Advanced scheme of amplifier similariton laser**

We propose an advanced scheme of amplifier similariton laser providing an output pulse spectrum much wider than the gain bandwidth. The proposed scheme demonstrates a drastic increase of the output pulse spectrum width, reduction of the pulse duration, and increase of the output pulse peak power after compression.

#### **General information**

Publication status: Published

Organisations: Optoelectronics Research Centre, Ulyanovsk State University, A. M. Prokhorov General Physics Institute, Russian Academy of Sciences

Contributors: Korobko, D. A., Okhotnikov, O. G., Sysoliatin, A. A., Zolotovskii, I. O.

Pages: R858

Publication date: 23 Aug 2016

Peer-reviewed: Unknown

Event: Paper presented at 2016 International Conference Laser Optics, LO 2016, St. Petersburg, Russian Federation.

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics

Keywords: amplifier similariton laser, generation of extra broad spectrum, parabolic pulses

DOIs:

10.1109/LO.2016.7549889

URLs:

<http://www.laseroptics.ru/publications.html> (Conference website)

Source: Scopus

Source ID: 84987901019

Research output: Other conference contribution > Paper, poster or abstract > Scientific

