The effect of phosphorous and arsenic on the fracture behaviour of a 2,25% Cr-1% Mo Steel

Creep and Charpy impact tests have been performed on specially melted casts of 2.25%Cr - 1%Mo steel, containing trace additions of P, As and (P + As), and on a high purity melt of this steel. Creep testing at 580°C and 160 MPa revealed that casts containing either P or (P + As) had improved ductility compared to that of the high purity alloy. The creep behaviour of material containing only the addition of As was similar to the high purity data. Conversely, the presence of P was associated with brittle intergranular fracture in Charpy impact tests at ambient temperature, while the high purity and As bearing alloys were indistinguishable and ductile. Furthermore, intergranular fracture of the P-containing material was obtained at both lower and upper energy positions. Auger Electron Spectroscopy (AES) analysis of post creep test and Charpy test samples showed that segregation of P to grain boundaries had occurred. No evidence was detected for the segregation of As to these boundaries.

General information

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Contributors: Lorimer, G. W., Dicken, R., Peura, P., Pilkington, R., Younes, C. M., Allen, G. C., Holt, M. J.
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Source ID: 5344222759
Research output: Contribution to journal › Article › Scientific › peer-review

Measurement theory and dimensional analysis: Methodological impact on the comparison and evaluation process

Comparison and ranking of solutions are central tasks of the design process. Designers have to deal with decisions simultaneously involving multiple criteria. Those criteria are often inconsistent in the sense that they are expressed according to different types of metrics. This means that usual engineering performance indicators are expressed according to physical quantities (i.e. SI system) and indicators such as preference functions can be "measured" by using other type of qualitative metrics. This aspect limits the scientific consistency of design because a coherent scientific framework will at first require the creation of a unified list of fundamental properties. A combined analysis of the measurement theory, the General Design Theory (GDT) and the dimensional analysis theory give an interesting insight in order to create guidelines for establishing a coherent measurement system. This article establishes a list of fundamental requirements. We expect that these guidelines can help engineers and designers to be more aware of the drawbacks linked with the use of wrong comparison procedures and limitations associated with the use of weak measurement scales. This article makes an analysis of the fundamental aspects available in major scientific publications related to comparison, provides a synthesis of these basic concepts and unifies those concepts together from a designing perspective. A practical design methodology using the fundamental results of this article as prerequisites has been implemented by the authors.

General information

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Organisations: LGI, LGI Laboratory, Helsinki University of Technology, Aalto University
Contributors: Coatanéa, E., Yannou, B., Honkala, S., Lajunen, A., Saarelainen, T., Makkonen, P.
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ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Mechanical Engineering, Modelling and Simulation
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Statistical modeling of water vapor transmission rates for extrusion-coated papers

The testing of water vapor transmission rates (WVTR) for extrusion-coated papers can be a time-consuming task for laboratories. This study introduces a prediction model that provides an effective and helpful option to laboratory measurements. In practice, the WVTR of an extrusion-coated paper is affected by three main factors: coating weight (or squared mass) of the polymer concerned, the temperature and moisture content of the immediate surroundings. The prediction model determines mathematical connections between the WVTR and these variables covering the detected region of experimental WVTR results with a continuous estimation. By using mixing ratio as a variable of humidity, the model was found to provide accurate estimation across the field of experiments. As a result of this study, a practical computer program, which predicts the WVTR of a multilayer extrusion-coated paper as a function of user-defined temperature and relative humidity values and the layer structure of the coating, was developed. APPLICATION STATEMENT: This work shows how WVTR of a multilayer extrusion-coated paper can be estimated with the help of a statistical prediction model.

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Organisations: Department of Energy and Process Engineering, Department of Materials Science
Contributors: Lahtinen, K., Kuusipalo, J.
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The effects of corona and flame treatment: Part 2. PE-HD and PP coated papers

The most important function of a packaging material is to shield the product inside the package. Extrusion coated papers and paperboards are generally used in various consumer packages like food, medical and cosmetic packages. Extrusion coatings give a barrier against water, water vapour, aroma, grease, oxygen, etc. In addition to barrier properties, heat sealability and printability are important properties in packaging applications. From the point of view of printing, the dense and impervious structure of extrusion coatings is challenging: printing inks and toners do not penetrate into the coatings. The durability of the printed image is significant, because the image must withstand various converting operations when the package is constructed. The most common method for obtaining good ink or toner adhesion is to oxidise the surface. Surface treatments are used to change the chemical composition, increase surface energy, modify surface morphology and topography, or remove contaminants and weak boundary layers. Two widely used methods are corona discharge treatment and flame treatment. These processes generally cause physical and chemical changes in a thin surface layer without affecting the bulk properties. Treatments will increase surface energy and also provide polar molecular groups necessary for good bonds between ink/toner and polymer molecules. In addition to printability, surface treatments also affect the sealing properties, i.e. initial heat sealing temperature, initial hot tack temperature, sealing window and seal strength of extrusion coatings. Both the sealability of packaging material and the tightness of the seal are critical points in the manufacturing process of packages and of the final package. The printability must be obtained without losing the sealability properties. In the first part of this research (TAPPI European PLACE 2007), surface energy, printability and sealability of low density polyethylene (PE-LD) coated paperboard after flame and corona treatments were studied. In this second part of the study, the research is extended to other polyolefins, i.e. high-density polyethylene (PE-HD) and polypropylene (PP). The surface chemistry is evaluated with contact angle measurements and X-ray photoelectron spectroscopy (XPS) measurements. Scanning electron microscopy (SEM) and optical profilometry are used to study the topographical and morphological changes on the surfaces. Furthermore, the heat sealing and hot tack properties, and water vapour barrier properties of the extrusion coatings are evaluated. The aim of this study is also to evaluate the

printability of the extrusion coatings and to map out the role of surface modification in print quality formation. This study has concentrated on digital printing, particularly on the dry toner-based electrophotographic printing process. Flame treatment decreases the contact angle of water on PE-LD, PE-HD and PP coated papers more than corona treatment, but the lowest contact angle is obtained when the treatments are used simultaneously (i.e. co-effect of the treatments). Flame treatment deteriorates the sealability properties of PE-LD coated paper, whereas corona treatment improves sealability for example by decreasing the minimum heat sealing temperature. The sealability properties of PE-HD and PP coated papers are improved not only by corona treatment, but also by flame treatment. Flame treatment significantly improves the water vapour barrier of PEs. Where printability is concerned, it can be noticed that all the treatments improve rub-off resistance with PEs. With PE-LD flame is the most effective, and with PE-HD corona. With PP, the co-treatment gives the best result. Morphological changes in micro- and nano- scale were most observed on the flame treated PE-LD surface, whereas the electret phenomenon was observed on PE-LD, PE-HD and PP surfaces only after corona treatment.

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Contributors: Lahti, J., Tuominen, M., Penttinen, T., Räsänen, J. P., Kuusipalo, J.
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A framework for building behavioral models for design-stage failure identification using dimensional analysis
In this paper, a design-stage failure identification framework is proposed using a modeling and simulation approach based on Dimensional Analysis and qualitative physics. The proposed framework is intended to provide a new approach to model the behavior in the Functional-Failure Identification and Propagation (FFIP) framework, which estimates potential faults and their propagation paths under critical event scenarios. The initial FFIP framework is based on combining hierarchical system models of functionality and configuration, with behavioral simulation and qualitative reasoning. This paper proposes to develop a behavioral model derived from information available at the configuration level. Specifically, the new behavioral model uses design variables, which are associated with units and quantities (i.e., Mass, Length, Time, etc...). The proposed framework continues the work to allow the analysis of functional failures and fault propagation at a highly abstract system concept level before any potentially high-cost design commitments are made. The main contribution in this paper consists of developing component behavioral models based on the combination of fundamental design variables used to describe components and their units or quantities, more precisely describing components' behavior.

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Contributors: Coatanéa, E., Ritola, T., Tumer, I. Y., Jensen, D.
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Effect of pre-treatments on barrier properties of layers applied by atomic layer deposition onto polymer-coated substrates

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Organisations: Department of Materials Science, Department of Materials Science, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland
Contributors: Vähä-Nissi, M., Hirvikorpi, T., Sievänen, J., Salo, E., Harlin, A., Johansson, P., Kuusipalo, J.
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Evaluation of parts of a boat cabin based on exergy - Focusing on environmental and economic assessments
Product and process engineering design is a complex problem which relies on multiple fields, and while many design aid tools exist they rarely take into account more than a single field or aspect at a time. This implies that a few tools have to used for a single project, making the engineer, or designer, juggle among them or favouring a single aspect. Many existing environmental assessment tools on the market only focus on environmental aspects, which are extremely important in today's impact conscious context but are not enough to make viable products and processes. Moreover the tools often require precise data which is only known during the late stages of design when it is too late to make any significant changes. The aim of the current work is to further develop and test a multi-domain modelling framework, for the early stages of product and process design, which primarily focuses on environmental assessment but also takes into account economic aspects and can be expanded to further fields, such as risk. The two bases for the proposed framework are exergy, a measure of useful work that can be, unlike energy, both created and destroyed, and dimensional analysis, a widely used tool in engineering to model problems through dimensional homogeneity. The environmental and economic assessments proposed by the tool are illustrated on the case of insulation of the cabin on a passenger ferry and the environmental results are compared to those from two existing methodologies, Eco-Indicator and Cumulative Exergy Demand.

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Organisations: EOP Reseach Group, Aalto University
Contributors: Medyna, G., Coatanea, E., Millet, D.
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Nanoparticle deposition on packaging materials by the liquid flame spray

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Contributors: Teisala, H., Tuominen, M., Aromaa, M., Mäkelä, J. M., Stepien, M., Saarinen, J. J., Toivakka, M., Kuusipalo, J.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Semantic analysis of function-solution duality
Methodologies of the literature tend to separate clearly the design problem definition from the solutions to this problem. Nevertheless, this paper argues that conceptual design solutions are deeply rooted in the definition of the design problem. Hence, it is shown that conceptual solutions can emerge from the semantic analysis of the functional definition of a problem. This paper addresses the recursive aspect of conceptual design and the iterative loops between each step of design methodologies which are usually presented as a sequential flow. This paper presents that, in fact, in the early design phases, the functional representation of the design problem may often emerge from ideas of potential solutions. Afterward, this functional representation can be refined into concept of solutions, which can then give emergence to another functional representation. We hence argue here that the conceptual design process involves a constant duality between the functional representation of a problem and the potential solutions to this problem. Furthermore, we argue that the concepts of solution to a design problem can already be embedded semantically in the description of the problem as well as the description of these potential solutions enables the discovery of new design problem. This article presents these developments through the study of the sub-system of a robot used for harvesting fruits in a robot competition.

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Contributors: Christophe, F., Ritola, T., Coatanéa, E., Bernard, A.
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Self-alignment in the stacking of microchips with mist-induced water droplets

This paper reports a novel and versatile water droplet self-alignment technique where the water is delivered in mist form onto the assembly site. The droplet forming process has been carefully investigated using machine vision, where each individual droplet on the microchip surface can be identified and the volume per surface area can be calibrated at a specific time. The result reveals that the volume of water droplets on the assembly surface grows linearly as a function of time. Self-alignment based on the mist-induced droplets has been studied, where a robotic microgripper is used to deliver the microchips on the assembly site. The paper also investigates the maximum tolerance of the initial placement error in stacking SU-8 chips 200 × 200 × 70 μm in size, and the possibility of stacking two SU-8 chips of different dimensions using the proposed self-alignment technique. Moreover, self-alignment of chips on hydrophilic/hydrophobic patterns covered by mist-induced water droplets has been studied. The experimental results indicate that this novel self-alignment technique is very promising. Furthermore, a statistical model has been used to validate the experimental results.

General information

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Contributors: Chang, B., Sariola, V., Jääskeläinen, M., Zhou, Q.
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Hexaferrite/polyethylene Composite coatings prepared with flame spraying

Composite coatings from different volume ratios of hexaferrite ($BaFe_{12}O_{19}$ or $SrFe_{12}O_{19}$) and polyethylene were prepared, for the first time, with flame spraying. The hexaferrite phase retained its crystal structure and microstructure during the process, while the polyethylene melted and resolidified. The coatings showed magnetic hysteresis loops with high coercivities. The measured electromagnetic behaviour proved that the studied composite coatings would be suitable for electromagnetic wave absorbers in the U-band.

General information

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Contributors: Lisjak, D., Lintunen, P., Hujanen, A., Varis, T., Bolelli, G., Lusvarghi, L., Jagodič, M., Drofenik, M.
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Optimised selection of new protective coatings for biofuel boiler applications

Using biofuels in power and CHP boilers can pose a challenge for materials performance. Formation of deposits containing e.g. potassium, sulphur, calcium, sodium, and chlorine can result in severe corrosion of conventional steels and alloys at relatively modest temperatures. Given suitable component design and fabrication facilities, coatings may be considered to protect the fireside surfaces. This paper aims to present a systematic approach to the design and selection criteria for protective coatings of boilers. The approach includes modelling of the process and surface conditions, optimisation of the coating process and structure, and performance validation in the laboratory and plant scales. The applied examples have included iron and nickel based HVOF and arc sprayed coatings subjected to verification field testing in boiler testing under aggressive biofuel conditions. The coatings have shown good corrosion resistance in both laboratory tests and long-term harsh field tests. The paper discusses the used approach for finding a suitable and cost effective coating for biofuel boiler applications. The paper gives test results from microstructural, corrosion resistance and field testing experience for the selected coatings.

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Contributors: Tuurna, S., Varis, T., Penttilä, K., Ruusuvuori, K., Holmström, S., Yli-Olli, S.
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Defined-size DNA triple crossover construct for molecular electronics: Modification, positioning and conductance properties

We present a novel, defined-size, small and rigid DNA template, a so-called B-A-B complex, based on DNA triple crossover motifs (TX tiles), which can be utilized in molecular scale patterning for nanoelectronics, plasmonics and sensing applications. The feasibility of the designed construct is demonstrated by functionalizing the TX tiles with one

biotin-triethylene glycol (TEG) and efficiently decorating them with streptavidin, and furthermore by positioning and anchoring single thiol-modified B-A-B complexes to certain locations on a chip via dielectrophoretic trapping. Finally, we characterize the conductance properties of the non-functionalized construct, first by measuring DC conductivity and second by utilizing AC impedance spectroscopy in order to describe the conductivity mechanism of a single B-A-B complex using a detailed equivalent circuit model. This analysis also reveals further information about the conductivity of DNA structures in general.

General information

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Contributors: Linko, V., Leppiniemi, J., Paasonen, S. T., Hytönen, V. P., Jussi Toppari, J.
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Self-alignment of RFID dies on four-pad patterns with water droplet for sparse self-assembly

This paper reports an in-depth study of a water-droplet-assisted self-alignment technique that self-aligns radio frequency identification (RFID) dies on four-pad patterns. The segmented structure of four hydrophilic pads on a hydrophobic substrate brings freedom to the design of the electrical functionality and the surface functionality. The paper investigates the influence of the key parameters that may affect the self-alignment in theory and experiment. The theoretical model justifies that RFID dies can be reliably aligned on the segmented four-pad pattern even when the initial placement error is as large as 50% of the size of the die and the gap between the four pads is about 10% of the size of the die. A method has been introduced to estimate the sufficient droplet volume for self-alignment. A series of experiments have been carried out to verify the results of the model. The experiments indicate that the self-alignment between the 730 × 730 vm RFID dies and the pattern occurs reliably when the releasing bias between the RFID die and antenna is less than 400 vm for patterns with 50 and 100 vm gaps, and successful self-alignment is possible even with greater bias of 500 vm.

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Optical interference lithography using azobenzene-functionalized polymers for micro-and nanopatterning of silicon
Light-induced mass transport in azobenzene-functionalized polymers is exploited in optical interference lithography to fabricate large-area, periodic 1D and 2D silicon nanostructures. The demonstrated technique is a fast, reliable, and cost-effective alternative to conventional photoresist-based methods of nano-and microfabrication. Potential applications of the technique range from optics and photonics to functional materials and coatings.

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

Cost optimal and nearly zero (nZEB) energy performance calculations for residential buildings with REHVA definition for nZEB national implementation
This study determined cost optimal and nearly zero energy building (nZEB) energy performance levels following the REHVA definition and energy calculation methodology for nZEB national implementation. Cost optimal performance levels - meaning the energy performance leading to minimum life cycle cost - were calculated with net present value method according to the cost optimal draft regulation. The seven-step procedure was developed to conduct cost optimal and nZEB energy performance levels calculations in systematic and robust scientific fashion. It was shown that cost optimal primary energy use can be calculated with limited number of energy simulations as only four construction concepts were simulated and cost calculated. The procedure includes the specification of building envelope components based on specific heat loss coefficient and systems calculation with post processing of energy simulation results, without the need to use iterative approach or optimization algorithm. Model calculations were conducted for Estonian reference detached house to analyse the difference between the cost optimal and nZEB energy performance levels. Cost optimal energy performance level of Estonian reference detached house was 110 kW h/(m^2 a) primary energy including all energy use with domestic appliances and it was significantly lower than the current minimum requirement of 180 kW h/(m^2 a).

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MoE publication type: A1 Journal article-refereed
Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Sitra, the Finnish Innovation Fund, Aalto University, Tallinn University of Technology, Equa Simulation Finland Oy, Hevac O

Contributors: Kurnitski, J., Saari, A., Kalamees, T., Vuolle, M., Niemelä, J., Tark, T.
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Keywords: Cost optimal, Energy performance, EPBD recast, Global cost, Nearly zero energy buildings, nZEB, REHVA nZEB technical definition
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Source: Scopus
Source ID: 80053300759
Research output: Contribution to journal › Article › Scientific › peer-review

A system for real-time detection and tracking of vehicles from a single car-mounted camera
A novel system for detection and tracking of vehicles from a single car-mounted camera is presented. The core of the system are high-performance vision algorithms: the WaldBoost detector [1] and the TLD tracker [2] that are scheduled so that a real-time performance is achieved. The vehicle monitoring system is evaluated on a new dataset collected on Italian motorways which is provided with approximate ground truth (GT0) obtained from laser scans. For a wide range of distances, the recall and precision of detection for cars are excellent. Statistics for trucks are also reported. The dataset with the ground truth is made public.

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Organisations: Research Community on Data-to-Decision (D2D), Advanced Technology Division, Czech Technical University in Prague
Contributors: Caraffi, C., Vojir, T., Trefný, J., Šochman, J., Matas, J.
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ASJC Scopus subject areas: Automotive Engineering, Mechanical Engineering, Computer Science Applications
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Source: Scopus
Source ID: 84871239330
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Biomimetic hemo-compatible surfaces of polyurethane by grafting copolymer brushes of poly(ethylene glycol) and poly(phosphorylcholine methacrylate)
Polyurethanes (PU) have been widely used as biomaterial in recent years, while thrombus may still occur when contacting with blood especially for extended period of time. Poly(ethylene glycol) (PEG) and phosphorylcholine (PC)-based polymers are commonly employed for surface modification to create protein repellent surfaces. PC-based polymers have been investigated as biomimetic materials because PC is the major component in the outer layer of cell membranes. In this study, the biomimetic copolymer brush of PEG-b-poly(2-methacryloyloxyethyl phosphorylcholine) on PU surfaces was synthesized via atom transfer radical polymerization (ATRP) with a surface initiator. The flexible PEG chain was 200 g·mol

$^{-1}$, while the poly(2-methacryloyloxyethyl phosphorylcholine) (poly(MPC)) chain length was controlled by the ratio of monomer to sacrificial initiator in solution. The topology of the modified surfaces was characterized by the phase image of atomic force microscopy (AFM) to study the synergy effect between PEG chains and poly(MPC) chains. The unmodified and modified surfaces were characterized by Fourier transform infrared (FTIR), X-ray photoelectron spectroscopy (XPS), water contact angle and platelet adhesion. The results demonstrated that efficient grafting of PEG-b-poly(MPC) brushes on the surfaces was achieved. The PU surfaces modified with PEG and phosphorylcholine zwitterionic brushes showed effective resistance to platelet adhesion and high hemocompatibility in vitro. These PEG and PC-grafted PU materials might be potentially applied in blood-contacting materials or devices due to their good mechanical and hemocompatible properties.

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MoE publication type: A4 Article in a conference publication
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Tianjin University, Tianjin University-Helmholtz-Zentrum Geesthacht, Helmholtz-Zentrum Geesthacht - Zentrum für Material- und Küstenforschung GmbH, School of Chemical Engineering and Technology
Contributors: Yang, D., Feng, Y., Behl, M., Lendlein, A., Zhao, H., Khan, M., Guo, J.
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ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials
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Source: Scopus
Source ID: 84865010271
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Block copolymer self-assembly on ethylene glycol (EG) self-assembled monolayer (SAM) for nanofabrication
Nanostructure templates fabrication from P(S-b-MMA) thin films requires precise control of interfacial energies to achieve perpendicular orientation of microdomains to the substrate surface and can be obtained by modifying the oxide layer on silicon with a covalently anchored hydroxyl-terminated random copolymer P(S-r-MMA) termed a "neutral brush". This commonly employed method enables precise fine-tuning of interfacial energies, but involves a lengthy process, requires starting materials that are commercially available but expensive, and results in a relatively thick under layer that can interfere with subsequent surface processing. We report here the microphase separation behaviour of an asymmetric P(S-b-MMA) diblock copolymer on electronic substrates modified with ethylene glycol (EG) self-assembled monolayer (SAM) as alternative to standard random copolymer brush. The diblock copolymer films deposited on EG SAMs upon thermal annealing spontaneously generates features with sub-lithographic resolution and pitch with perpendicular orientation. Selective etching provides a rapid route for the generation of PS template structures as the PMMA domains are etched at a faster rate. These templates can subsequently be used as etch masks to generate nanoscale features. We use state of the art lithography to generate sub-μm features and within these generate nm sized copolymer templates. Graphoepitaxy method proved a successful approach for the alignment of the microphase separated structures. This method of EG SAM driven self-0assembly provides a simple, rapid, yet tuneable approach for surface neutralization and nanofabrication technique for creating high density nanoscale features for the nanoelectronic industry.

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MoE publication type: A4 Article in a conference publication
Organisations: Frontier Photonics, Trinity College Dublin, University College Cork, Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Tyndall National Institute at National University of Ireland, Cork
Contributors: Borah, D., Rasappa, S., Kosmala, B., Holmes, J. D., Morris, M. A.
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ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials
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Source ID: 84879275849
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Development of expanded graphite filled natural rubber vulcanizates in presence and absence of carbon black: Mechanical, thermal and morphological properties

As nanosized expanded graphite (EG) reveals a similar layered structure like organoclay and also it has a high expansion ratio so rubber chains can easily be intercalated into the gallery space. To improve the dispersion of EG in the rubber matrices, primarily the surface modification of the expanded graphite have been done and then the modified expanded graphite (MEG)/polar compatibilizer [epoxidized natural rubber (ENR)] master batch have been prepared by solution mixing method in the laboratory. After that the MEG/ENR master batch have been mixed with bulk natural rubber (NR) in presence and absence of carbon black (CB) in a laboratory scale open two roll mixing mill. Wide angle X-ray diffraction (WAXD) and high resolution transmission electron microscopic (HR-TEM) analysis of the nanocomposites revealed that MEG was intercalated and as well as delaminated in the NR matrix. Scanning electron microscope (SEM) images of the nanocomposites showed very rough surface than the pure NR matrix. In presence of expanded graphite the crack paths are channelized and coincide in one point suggesting the effect of plate like expanded graphite to acts as a barrier. We have got improved mechanical, thermal and dynamic mechanical properties for the MEG and MEG/CB loaded NR compounds compared to EG and EG/CB loaded NR compounds.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Rubber Technology Centre, Indian Institute of Technology Kharagpur, Leibniz Institute of Polymer Research Dresden (IPF)
Contributors: Malas, A., Das, C. K., Das, A., Heinrich, G.
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Source: Scopus
Source ID: 84860009426
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of rotor pole-shoe construction on losses of inverter-fed synchronous motors

The effect of rotor pole-shoe construction on the electromagnetic losses of frequency-converter fed wound-field synchronous motors is studied by numerical simulations. In the machine under examination, a reduction of 6.8 % in the rated-load total electromagnetic losses was achieved merely by modifying the rotor pole-shoe shape and the damper winding slots. Furthermore, a 15.4 % reduction was achieved by removing the damper winding and changing the rotor lamination material to a 0.5-mm Fe-Si sheet instead of the original 2-mm steel sheet.

General information

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Organisations: Smart Energy Systems (SES), Aalto University

Contributors: Rasilo, P., Belahcen, A., Arkkio, A.
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ASJC Scopus subject areas: Electrical and Electronic Engineering, Mechanical Engineering
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Redox-active, organometallic surface-relief gratings from azobenzene-containing polyferrocenylsilane block copolymers
Organometallic Gratings: The ionic self-assembly of metal-containing block-copolymer polyelectrolytes and azobenzene chromophores is exploited for the efficient production of stable photo-induced surface-relief gratings. We show that feature sizes can be tuned using simple redox chemistry, and that the chromophores can be removed during plasma treatment to yield ceramic-based optical materials.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, University of Bristol, Tokyo Institute of Technology
Contributors: Ahmed, R., Priimagi, A., Faul, C. F. J., Manners, I.
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Ratings:

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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: azobenzene, ionic self-assembly, polyferrocenylsilane block-copolymer, redox activity, surface-relief grating
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Research output: Contribution to journal › Article › Scientific › peer-review

Highly conducting polychloroprene composites based on multi-walled carbon nanotubes and 1-butyl 3-methyl imidazolium bis(trifluoromethylsulphonyl)imide
Highly conducting flexible polychloroprene composites are prepared based on a novel mixing technique using ionic liquid (IL) modified multi-walled carbon nanotubes (MWCNTs). A conductivity of 0.1 S/cm is achieved for composites even at a low concentration of the tubes (5 phr). Extremely fine dispersion and a strong tube-tube networking of modified carbon nanotubes (M-CNTs), which are responsible for such high conductivity of the composites, are understood from transmission electron microscopy and amplitude sweep measurements. Several interesting applications can be visualised using these conducting composites: as a substrate for electronic circuits, and as an excellent construction material.

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Organisations: Engineering materials science and solutions (EMASS), Leibniz-Institut für Polymerforschung Dresden E.V.
Contributors: Subramaniam, K., Das, A., Heinrich, G.

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ASJC Scopus subject areas: Mechanical Engineering, Polymers and Plastics, Industrial and Manufacturing Engineering, Materials Chemistry
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Source ID: 84865498333
Research output: Contribution to journal › Article › Scientific › peer-review

Implementation of a direct procedure for critical point computations using preconditioned iterative solvers
Computation of critical points on an equilibrium path requires the solution of a non-linear eigenvalue problem. These critical points could be either bifurcation or limit points. When the external load is parametrized by a single parameter, the non-linear stability eigenvalue problem consists of solving the equilibrium equations along the criticality condition. Several techniques exist for solution of such a system. Their algorithmic treatment is usually focused for direct linear solvers and thus use the block elimination strategy. In this paper special emphasis is given for a strategy which can be used also with iterative linear solvers. Comparison to the block elimination strategy with direct linear solvers is given. Due to the non-uniqueness of the critical eigenmode a normalizing condition is required. In addition, for bifurcation points, the Jacobian matrix of the augmented system is singular at the critical point and additional stabilization is required in order to maintain the quadratic convergence of the Newton's method. Depending on the normalizing condition, convergence to a critical point with negative load parameter value can happen. The form of the normalizing equation is critically discussed. Due to the slenderness of the buckling sensitive structures the resulting matrices are ill-conditioned and a good preconditioner is mandatory for efficient solution.

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Organisations: Department of Mechanics and Design, Department of Civil Engineering, Life Cycle Effectiveness of the Built Environment (LCE@BE), Academy of Sciences of the Czech Republic, Institute of Computer Science of the Academy of Sciences of the Czech Republic, Department of Civil and Structural Engineering, Aalto University
Contributors: Kouhia, R., Tůma, M., Mäkinen, J., Fedoroff, A., Marjamäki, H.
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Co-electrospun blends of PU and PEG as potential biocompatible scaffolds for small-diameter vascular tissue engineering

A small-diameter vascular graft (inner diameter 4 mm) was fabricated from polyurethane (PU) and poly(ethylene glycol) (PEG) solutions by blend electrospinning technology. The fiber diameter decreased from 1023 ± 185 nm to 394 ± 106 nm with the increasing content of PEG in electrospinning solutions. The hybrid PU/PEG scaffolds showed randomly nanofibrous morphology, high porosity and well-interconnected porous structure. The hydrophilicity of these scaffolds had been improved significantly with the increasing contents of PEG. The mechanical properties of electrospun hybrid PU/PEG scaffolds were obviously different from that of PU scaffold, which was caused by plasticizing or hardening effect imparted by PEG composition. Under hydrated state, the hybrid PU/PEG scaffolds demonstrated low mechanical performance due to the hydrophilic property of materials. Compared with dry PU/PEG scaffolds with the same content of PEG, the tensile strength and elastic modulus of hydrated PU/PEG scaffolds decreased significantly, while the elongation at break increased. The hybrid PU/PEG scaffolds demonstrated a lower possibility of thrombi formation than blank PU scaffold in platelet adhesion test. The hemolysis assay illustrated that all scaffolds could act as blood contacting materials. To investigate further in vitro cytocompatibility, HUVECs were seeded on the scaffolds and cultured over 14 days. The cells could attach and proliferate well on the hybrid scaffolds than blank PU scaffold, and form a cell monolayer fully covering on the PU/PEG (80/20) hybrid scaffold surface. The results demonstrated that the electrospun hybrid PU/PEG tubular scaffolds possessed the special capacity with excellent hemocompatibility while simultaneously supporting extensive endothelialization with the 20 and 30% content of PEG in hybrid scaffolds.

General information

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Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Shihezi University, Tianjin University, School of Chemical Engineering and Technology, Key Laboratory of Systems Bioengineering
Contributors: Wang, H., Feng, Y., Fang, Z., Yuan, W., Khan, M.
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Peer-reviewed: Yes

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

Improving the effect of a nanoscale barrier coating on BOPP film properties by surface pretreatments

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), Lappeenranta University of Technology, Paper Converting and Packaging Technology
Contributors: Lahtinen, K., Lahti, J., Johansson, P., Seppänen, T., Cameron, D. C.
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Source: Scopus
Source ID: 84962833172
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Materials for electronics by thermal spraying

In this paper, dielectric and conductive properties of thermally sprayed Al_2O_3- and Cubased coatings on steel and alumina substrates were studied. Alumina powders with nano- and micro-sized additions of Ni, NiO, TiO_2, silica, and commercial glass were used in High Velocity Oxygen Fuel (HVOF) deposition. The conventional commercial copper powder and three Ag, WC and H_2 -modified powders were used in Direct Write Thermal Spray (DWTS) deposition. Mixed phases of α-Al_2O_3 and γ-Al_2O_3 were found to be present in the as-deposited coatings. Sprayed alumina-based composites exhibited dielectric permittivity of 5.3-13.9 and losses of 0.002-0.178 at 1 MHz and 1 GHz while the additions tend to increase the values. Sprayed compositions with glasstype additions were found to retain α-Al_2O_3 crystalline phase after the deposition. Cu depositions, especially modified ones, realised by Direct Write Thermal Spray (DWTS) showed conductivity values as high as 42-56% of IACS values. The results demonstrate that ceramic and conductive coatings fabricated by thermal spray techniques show feasible properties for electrical applications, such as low-frequency components and insulation layers to be utilised in embedded 3D circuitry, in a way that is not possible through traditional manufacturing methods.

General information

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MoE publication type: A4 Article in a conference publication
Organisations: Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland, Univ of Oulu
Contributors: Ronkainen, H., Kanerva, U., Varis, T., Ruusuvuori, K., Turunen, E., Peräntie, J., Putaala, J., Juuti, J., Jantunen, H.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Modeling of steels and steel surfaces using quantum mechanical first principles methods

We describe recent progress in first principles materials modelling applied to iron alloys. First principles methods in general have proven to be an effective way of describing atomic level phenomena in solids. When applied to alloys with chemical disorder, however, the widely used supercell methods turn out to be impractical due to the vast variety of different possible configurations. This problem can be overcome using the coherent potential approximation (CPA), which enables the description of a multicomponent alloy in terms of an effective medium constructed in such a way that it represents, on the average, the scattering properties of the alloy. A bulk alloy, in the case of substitutional random alloys, can thus be described with a single atom while a slab is needed to describe surfaces. The exact muffin-tin orbitals (EMTO) method provides a first principles method that can be combined with the CPA in order to describe steels and other

multicomponent alloys. We describe the EMTO-CPA method and provide examples of both bulk and surface properties that can be modelled with this method.

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Organisations: Computational Science X (CompX), Lappeenranta University of Technology, Department of Physics and Astronomy, University of Turku, Turun Yliopisto/Turun Biomateriaalikeskus, Surface and Corrosion Science
Contributors: Alatalo, M., Pitkänen, H., Ropo, M., Kokko, K., Vitos, L.
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Source: Scopus
Source ID: 84880844724
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Towards an approach for evaluating the quality of requirements
In engineering design, the needs of stakeholders are often captured and expressed in natural language (NL). While this facilitates such tasks as sharing information with nonspecialists, there are several associated problems including ambiguity, incompleteness, understandability, and testability. Traditionally, these issues were managed through tedious procedures such as reading requirements documents and looking for errors, but new approaches are being developed to assist designers in collecting, analysing, and clarifying requirements. The quality of the end-product is strongly related to the clarity of requirements and, thus, requirements should be managed carefully. This paper proposes to combine diverse requirements quality measures found from literature. These metrics are coherently integrated in a single software tool. This paper also proposes a new metric for clustering requirements based on their similarity to increase the quality of requirement model. The proposed methodology is tested on a case study and results show that this tool provides designers with insight on the quality of individual requirements as well as with a holistic assessment of the entire set of requirements.

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Organisations: Intelligent dexterity for secure networked infrastructure and applications (IDSNIA), Aalto University
Contributors: Mokammel, F., Coatanea, E., Christophe, F., Ba Khouya, M., Medyna, G.
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ASJC Scopus subject areas: Mechanical Engineering, Computer Graphics and Computer-Aided Design, Computer Science Applications, Modelling and Simulation
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Naturally occurring amino acids: A suitable substitute of N-N/-di-phenyl guanidine (DPG) in silica tyre formulation?

N-N/-di-phenyl guanidine (DPG) in combination with cyclohexyl benzothiazole sulfenamide (CBS) is widely used as an accelerator for the vulcanization of silica filled solution styrene butadiene rubber (S-SBR). The vulcanizates thus obtained exhibit excellent mechanical properties, good dynamic properties and also good aging resistance property. However, the use of DPG is a bit restricted of late being reported to be a potent carcinogenic compound and, hence, the effective substitution for DPG by safe alternative has been extensively explored. In this study, we systematically study the effects of naturally occurring amino acid L-cystine (L-cys) and its derivative L-cystine dimethyl ester dihydrochloride (ELCH) as environmental friendly co-accelerators for the vulcanization of silicafilled S-SBR.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Leibniz-Institut für Polymerforschung Dresden E.V.
Contributors: Debnath, S. C., Das, A., Basu, D., Heinrich, G.
Number of pages: 7
Pages: 25-31
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Peer-reviewed: Yes

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Journal: KGK: KAUTSCHUK GUMMI KUNSTSTOFFE
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Industrial and Manufacturing Engineering, Materials Chemistry, Polymers and Plastics
Keywords: L-cystine, N-N/-di-phenyl guanidine, Silica, Solution styrene butadiene rubber, Vulcanization
URLs:

http://www.scopus.com/inward/record.url?scp=84874674495&partnerID=8YFLogxK (Link to publication in Scopus)
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Source ID: 84874674495
Research output: Contribution to journal › Article › Scientific › peer-review

Chemically tailored dielectric-to-metal transition for the design of metamaterials from nanoimprinted colloidal nanocrystals

We demonstrate optical metamaterial design using colloidal gold nanocrystal building blocks. In the solid state, chemically exchanging the nanocrystals' surface-capping molecules provides a tailorable dielectric-to-metal transition exhibiting a 10^{10} range in DC conductivity and dielectric permittivity ranging from everywhere positive to everywhere negative throughout the visible-to-near-IR. Direct, wide-area nanoimprinting of subwavelength superstructures at room temperature, on plastic and glass substrates, affords plasmonic resonances ranging from 660 to 1070 nm, in agreement with numerical simulations.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Pennsylvania, Department of Electrical and Systems Engineering
Contributors: Fafarman, A. T., Hong, S. H., Caglayan, H., Ye, X., Diroll, B. T., Paik, T., Engheta, N., Murray, C. B., Kagan, C. R.
Number of pages: 8
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Peer-reviewed: Yes

Publication information

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Ratings:

Scopus rating (2013): CiteScore 22.6 SJR 9.081 SNIP 3.355
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: ammonium thiocyanate, dielectric function, gold nanoparticles, ligand exchange, Plasmonics, soft lithography
DOIs:

10.1021/nl303161d
URLs:

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Bibliographical note
EXT="Caglayan, Humeyra"
Source: Scopus
Source ID: 84873680258
Research output: Contribution to journal › Article › Scientific › peer-review

Fabrication of a sub-10 nm silicon nanowire based ethanol sensor using block copolymer lithography
This paper details the fabrication of ultrathin silicon nanowires (SiNWs) on a silicon-on-insulator (SOI) substrate as an electrode for the electro-oxidation and sensing of ethanol. The nanowire surfaces were prepared by a block copolymer (BCP) nanolithographic technique using low molecular weight symmetric poly(styrene)-block-poly(methyl methacrylate) (PS-b-PMMA) to create a nanopattern which was transferred to the substrate using plasma etching. The BCP orientation was controlled using a hydroxyl-terminated random polymer brush of poly(styrene)-random-poly(methyl methacrylate) (HO-PS-r-PMMA). TEM cross-sections of the resultant SiNWs indicate an anisotropic etch process with nanowires of sub-10 nm feature size. The SiNWs obtained by etching show high crystallinity and there is no evidence of defect inclusion or amorphous region production as a result of the pattern transfer process. The high density of SiNWs at the substrate surface allowed the fabrication of a sensor for cyclic voltammetric detection of ethanol. The sensor shows better sensitivity to ethanol and a faster response time compared to widely used polymer nanocomposite based sensors.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Materials Chemistry and Analysis Group, University College Cork, Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Trinity College Dublin, Tyndall National Institute at National University of Ireland, Cork, Collinstown Industrial Estate
Contributors: Rasappa, S., Borah, D., Faulkner, C. C., Lutz, T., Shaw, M. T., Holmes, J. D., Morris, M. A.
Publication date: 15 Feb 2013
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Publication information
Journal: Nanotechnology
Volume: 24
Issue number: 6
Article number: 065503
ISSN (Print): 0957-4484
Ratings:

Scopus rating (2013): CiteScore 6.9 SJR 1.602 SNIP 1.27
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Electrical and Electronic Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all)
DOIs:

10.1088/0957-4484/24/6/065503
URLs:

http://www.scopus.com/inward/record.url?scp=84872971946&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84872971946
Research output: Contribution to journal › Article › Scientific › peer-review

New design of textile light diffusers for photodynamic therapy
A homogeneous and reproducible fluence delivery rate during clinical photodynamic therapy (PDT) plays a determinant role in preventing under- or overtreatment. PDT applied in dermatology has been carried out with a wide variety of light sources delivering a broad range of more or less adapted light doses. Due to the complexities of the human anatomy, these light sources do not in fact deliver a uniform light distribution to the skin. Therefore, the development of flexible light sources would considerably improve the homogeneity of light delivery. The integration of plastic optical fiber (POF) into

textile structures could offer an interesting alternative. In this article, a textile light diffuser (TLD) has been developed using POF and Polyester yarns. Predetermined POF macrobending leads to side emission of light when the critical angle is exceeded. Therefore, a specific pattern based on different satin weaves has been developed in order to improve light emission homogeneity and to correct the decrease of side emitted radiation intensity along POF. The prototyped fabrics (approximately 100 cm^2: 5 × 20 cm) were woven using a hand loom, then both ends of the POF were coupled to a laser diode (5 W, 635 nm). The fluence rate (mW/cm^2) and the homogeneity of light delivery by the TLD were evaluated. Temperature evolution, as a function of time, was controlled with an infrared thermographic camera. When using a power source of 5 W, the fluence rate of the TLD was 18 ± 2.5 mw/cm^2. Due to the high efficiency of the TLD, the optical losses were very low. The TLD temperature elevation was 0.6 C after 10 min of illumination. Our TLD meets the basic requirements for PDT: homogeneous light distribution and flexibility. It also proves that large (500 cm^2) textile light diffusers adapted to skin, but also to peritoneal or pleural cavity, PDTs can be easily produced by textile manufacturing processes.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, ENSAIT Ecole Nationale Superieure des Arts et Industries Textiles, Univ Lille Nord de France, Lille University Hospital - CHRU
Contributors: Cochrane, C., Mordon, S. R., Lesage, J. C., Koncar, V.
Number of pages: 6
Pages: 1170-1175
Publication date: 1 Apr 2013
Peer-reviewed: Yes

Publication information
Journal: Materials Science and Engineering C: Materials for Biological Applications
Volume: 33
Issue number: 3
ISSN (Print): 0928-4931
Ratings:

Scopus rating (2013): CiteScore 3.6 SJR 0.779 SNIP 1.354
Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials, Medicine(all)
Keywords: Laser, Optical fiber, Photodynamic therapy, Textile light diffuser, Weaving
DOIs:

10.1016/j.msec.2012.12.007
URLs:

http://www.scopus.com/inward/record.url?scp=84873414524&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84873414524
Research output: Contribution to journal › Article › Scientific › peer-review

Electrolyte-gated organic field-effect transistor sensors based on supported biotinylated phospholipid bilayer
Anchored, biotinylated phospholipids forming the capturing layers in an electrolyte-gated organic field-effect transistor (EGOFET) allow label-free electronic specific detection at a concentration level of 10 nM in a high ionic strength solution. The sensing mechanism is based on a clear capacitive effect across the PL layers involving the charges of the target molecules.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Universita degli Studi di Bari, Centro S3, VTT Technical Research Centre of Finland
Contributors: Magliulo, M., Mallardi, A., Mulla, M. Y., Cotrone, S., Pistillo, B. R., Favia, P., Vikholm-Lundin, I., Palazzo, G., Torsi, L.
Number of pages: 5
Pages: 2090-2094
Publication date: 11 Apr 2013
Peer-reviewed: Yes

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Journal: Advanced Materials
Volume: 25
Issue number: 14

ISSN (Print): 0935-9648
Ratings:

Scopus rating (2013): CiteScore 25.1 SJR 7.564 SNIP 3.685
Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: electrolyte-gated organic field-effect transistors, electronic sensing, organic field-effect transistors
DOIs:

10.1002/adma.201203587
URLs:

http://www.scopus.com/inward/record.url?scp=84876023704&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84876023704
Research output: Contribution to journal › Article › Scientific › peer-review

Controlling liquid spreading using microfabricated undercut edges

A purely topographical method for controlling liquid spreading by using easy-to-fabricate undercut edges is reported. By periodic repetition of such edges, it is shown that multiple droplets can be patterned in well-controlled shapes, and highly anisotropic wetting can also be achieved at a large scale. Apparent contact angles close to 180° at the edge are shown, even for low surface tension liquids.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Aalto University, Department of Automation and Systems Technology
Contributors: Liimatainen, V., Sariola, V., Zhou, Q.
Number of pages: 4
Pages: 2275-2278
Publication date: 24 Apr 2013
Peer-reviewed: Yes

Publication information

Journal: Advanced Materials
Volume: 25
Issue number: 16
ISSN (Print): 0935-9648
Ratings:

Scopus rating (2013): CiteScore 25.1 SJR 7.564 SNIP 3.685
Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: anisotropic wetting, contact-line pinning, surface microfluidics
DOIs:

10.1002/adma.201204696
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http://www.scopus.com/inward/record.url?scp=84876473793&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84876473793
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
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Publication information
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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:

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Source: Scopus
Source ID: 84874118385
Research output: Contribution to journal › Article › Scientific › peer-review

Shape-dependent plasmonic response and directed self-assembly in a new semiconductor building block, indium-doped cadmium oxide (ICO)
The influence of particle shape on plasmonic response and local electric field strength is well-documented in metallic nanoparticles. Morphologies such as rods, plates, and octahedra are readily synthesized and exhibit drastically different extinction spectra than spherical particles. Despite this fact, the influence of composition and shape on the optical properties of plasmonic semiconductor nanocrystals, in which free electrons result from heavy doping, has not been well-studied. Here, we report the first observation of plasmonic resonance in indium-doped cadmium oxide (ICO) nanocrystals, which exhibit the highest quality factors reported for semiconductor nanocrystals. Furthermore, we are able to independently control the shape and free electron concentration in ICO nanocrystals, allowing for the influence of shape on the optical response of a plasmonic semiconductor to be conclusively demonstrated. The highly uniform particles may be self-assembled into ordered single component and binary nanocrystal superlattices, and in thin films, exhibit negative permittivity in the near infrared (NIR) region, validating their use as a new class of tunable low-loss plasmonic building blocks for 3-D optical metamaterials.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Pennsylvania, Purdue University, Department of Electrical and Systems Engineering
Contributors: Gordon, T. R., Paik, T., Klein, D. R., Naik, G. V., Caglayan, H., Boltasseva, A., Murray, C. B.
Number of pages: 7
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Peer-reviewed: Yes

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Volume: 13
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ISSN (Print): 1530-6984
Ratings:

Scopus rating (2013): CiteScore 22.6 SJR 9.081 SNIP 3.355
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: indium-doped cadmium oxide, metamaterials, nanocrystal superlattices, Plasmonics, shape effects, transparent conducting oxide
DOIs:

10.1021/nl4012003
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Bibliographical note

EXT="Caglayan, Humeyra"
Source: Scopus
Source ID: 84879097164
Research output: Contribution to journal › Article › Scientific › peer-review

An origami inspired reconfigurable spiral antenna

Modern day systems often require reconfigurability in the operating parameters of the transmit and receive antennas, such as the resonant frequency, radiation pattern, impedance, or polarization. In this work a novel approach to antenna reconfigurability is presented by integrating antennas with the ancient art of origami. The proposed antenna consists of an inkjet printed center-fed spiral antenna, which is designed to resonate at 1.0GHz and have a reconfigurable radiation pattern while maintaining the 1.0GHz resonance with little variation in input impedance. When flat, the antenna is a planar spiral exhibiting a bidirectional radiation pattern. By a telescoping action, the antenna can be reconfigured into a conical spiral with a directional pattern and higher gain, which gives the antenna a large front-to-back ratio. Construction of the antenna in this manner allows for a simple, lightweight, transportable antenna that can expand to specifications in the field.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology
Contributors: Saintsing, C. D., Cook, B. S., Tentzeris, M. M.
Publication date: 2014

Host publication information

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Publisher: The American Society of Mechanical Engineers ASME
ISBN (Electronic): 9780791846377
ASJC Scopus subject areas: Modelling and Simulation, Mechanical Engineering, Computer Science Applications, Computer Graphics and Computer-Aided Design
DOIs:

10.1115/DETC201435353
URLs:

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Source: Scopus
Source ID: 84926029890
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Graph based representation and analyses for conceptual stages

What is the fundamental similarity between investing in stock of a company, because you like the products of this company, and selecting a design concept, because you have been impressed by the esthetic quality of the presentation made by the team developing the concept? Except that both decisions are based on a surface analysis of the situations, they both reflect a fundamental human's cognitive feature. Human brain is profoundly trying to minimize the efforts required to solve a cognitive task and is using when possible an automatic mode relying on recognition, memory, and causality. This mode is even used in some occasion without the engineer being conscious of it. Such type of tendencies are naturally pushing engineers to rush into known solutions, to avoid analyzing the context of a design problem, to avoid modelling design problems and to take decision based on isolated evidences. Those behaviors are familiar to experience teachers and engineers. This tendency is magnified by the time pressure imposed to the engineering design process. Early phases in particular have to be kept short despite the large impact of decisions taken at this stage. Few support tools are capable of supporting a deep analysis of the early design conditions and problems regarding the fuzziness and complexity of the early stage. The present article is hypothesizing that the natural ability of humans to deal with cause-effects relations push toward the massive usage of causal graphs analysis during the design process and specifically during the early phases. A global framework based on graphs is presented in this paper to efficiently support the early stages. The approach used to generate graphs, to analyze them and to support creativity based on the analysis is forming the central contribution of this paper.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Intelligent dexterity for secure networked infrastructure and applications (IDSNIA), Aalto University
Contributors: Coatanéa, E., Nonsiri, S., Christophe, F., Mokammel, F.
Publication date: 2014

Host publication information

Title of host publication: 34th Computers and Information in Engineering Conference

Volume: 1A
Publisher: The American Society of Mechanical Engineers ASME
ISBN (Electronic): 9780791846285
ASJC Scopus subject areas: Mechanical Engineering, Computer Graphics and Computer-Aided Design, Computer Science Applications, Modelling and Simulation
DOIs:

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URLs:

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Source: Scopus
Source ID: 84961306932
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

High performance natural rubber composites with a hierarchical reinforcement structure of carbon nanotube modified natural fibers

A simple and facile method for depositing multiwall carbon nanotubes (MWCNTs) onto the surface of naturally occurring short jute fibers (JFs) is reported. Hierarchical multi-scale structures were formed with CNT-networks uniformly distributed and fully covering the JFs (JF-CNT), as depicted by the scanning electron microscopy (SEM) micrographs. The impact of these hybrid fillers on the mechanical properties of a natural rubber (NR) matrix was systematically investigated. Pristine JFs were cut initially to an average length of 2.0 mm and exposed to an alkali treatment (a-JFs) to remove impurities existing in the raw jute. MWCNTs were treated under mild acidic conditions to generate carboxylic acid moieties. Afterward, MWCNTs were dispersed in an aqueous media and short a-JFs were allowed to react with them. Raman spectroscopy confirmed the chemical interaction between CNTs and JFs. The JF-CNT exposed quite hydrophobic behavior as revealed by the water contact angle measurements, improving the wettability of the non-polar NR. Consequently, the composite interfacial adhesion strength was significantly enhanced while a micro-scale "mechanical interlocking" mechanism was observed from the interphase-section transmission electron microscopy (TEM) images. SEM analysis of the composite fracture surfaces demonstrated the interfacial strength of NR/a-JF and NR/JF-CNT composites, at different fiber loadings. It can be presumed that the CNT-coating effectively compatibillized the composite structure acting as a macromolecular coupling agent. A detailed analysis of stress-strain and dynamic mechanical spectra confirmed the high mechanical performance of the hierarchical composites, consisting mainly of materials arising from natural resources.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Vodafone Department of Mobile Communications Systems, University of Kalyani, Leibniz-Institut für Polymerforschung Dresden E.V.
Contributors: Tzounis, L., Debnath, S., Rooj, S., Fischer, D., Mäder, E., Das, A., Stamm, M., Heinrich, G.
Number of pages: 11
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Publication date: 2014
Peer-reviewed: Yes

Publication information

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Volume: 58
ISSN (Print): 0264-1275
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: Carbon nanotubes, Elastomers, Hierarchical composites, Interface, Multi-scale reinforcement, Natural fibers
DOIs:

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Source: Scopus
Source ID: 84893518872
Research output: Contribution to journal › Article › Scientific › peer-review

Improving the effect of nanoscale barrier coating on BOPP film properties: Influence of substrate contamination, web handling and pretreatments

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Paper Converting and Packaging, Engineering materials science and solutions (EMASS), Lappeenranta University of Technology, ASTRaL, Miktech Oy, Masaryk Univ, Masaryk University Brno, R&D Ctr Low Cost Plasma & Nanotechnol Surface Mod
Contributors: Lahti, J., Johansson, P., Lahtinen, K., Cameron, D. C., Seppänen, T.
Number of pages: 23
Pages: 1039-1061
Publication date: 2014

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Title of host publication: TAPPI PLACE Conference 2014
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Publisher: TAPPI Press
ISBN (Print): 9781510801271
ASJC Scopus subject areas: Materials Science(all), Chemistry(all), Mechanical Engineering, Media Technology, Chemical Engineering(all)
URLs:

http://www.tappi.org/Bookstore/Technical-Papers/Conference-Papers/2014/14PLACE/14pla34.aspx
Source: Scopus
Source ID: 84939521131
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Superhydrophobic Coatings on Cellulose-Based Materials: Fabrication, Properties, and Applications
Wettability of a solid surface by a liquid plays an important role in several phenomena and applications, for example in adhesion, printing, and self-cleaning. In particular, wetting of rough surfaces has attracted great scientific interest in recent decades. Superhydrophobic surfaces, which possess extraordinary water repelling properties due to their low surface energy and specific nanometer- and micrometer-scale roughness, are of particular interest due to the great variety of potential applications ranging from self-cleaning surfaces to microfluidic devices. In recent years, the potential of superhydrophobic cellulose-based materials in the function of smart devices and functional clothing has been recognized, and in the past few years cellulose-based materials have established themselves among the most frequently used substrates for superhydrophobic coatings. In this Review, over 40 different approaches to fabricate superhydrophobic coatings on cellulose-based materials are discussed in detail. In addition to the anti-wetting properties of the coatings, particular attention is paid to coating durability and other incorporated functionalities such as gas permeability, transparency, UV-shielding, photoactivity, and self-healing properties. Potential applications for the superhydrophobic cellulose-based materials range from water- and stain-repellent, self-cleaning and breathable clothing to cheap and disposable lab-on-a-chip devices made from renewable sources with reduced material consumption.

General information
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MoE publication type: A2 Review article in a scientific journal
Organisations: Tampere University of Technology, Department of Materials Science, Research group: Paper Converting and Packaging, Engineering materials science and solutions (EMASS)
Contributors: Teisala, H., Tuominen, M., Kuusipalo, J.
Number of pages: 20
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Journal: Advanced Materials Interfaces
Volume: 1
Issue number: 1
Article number: 1300026
ISSN (Print): 2196-7350
Ratings:

Scopus rating (2014): CiteScore 1.5
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials
Keywords: cellulose, cotton, paper, superhydrophobic, water-repellent
DOIs:

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URLs:

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Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2013-12-29
Publisher name: Wiley
Source: researchoutputwizard
Source ID: 3525
Research output: Contribution to journal › Review Article › Scientific › peer-review

Graphoepitaxial Directed Self-Assembly of Polystyrene-Block-Polydimethylsiloxane Block Copolymer on Substrates Functionalized with Hexamethyldisilazane to Fabricate Nanoscale Silicon Patterns
In block copolymer (BCP) nanolithography, microphase separated polystyrene-block-polydimethylsiloxane (PS-b-PDMS) thin films are particularly attractive as they can form small features and the two blocks can be readily differentiated during pattern transfer. However, PS-b-PDMS is challenging because the chemical differences in the blocks can result in poor surface-wetting, poor pattern orientation control and structural instabilities. Usually the interfacial energies at substrate surface are engineered with the use of a hydroxyl-terminated polydimethylsiloxane (PDMS-OH) homopolymer brush. Herein, we report a facile, rapid and tuneable molecular functionalization approach using hexamethyldisilazane (HMDS). The work is applied to both planar and topographically patterned substrates and investigation of graphoepitaxial methods for directed self-assembly and long-range translational alignment of BCP domains is reported. The hexagonally arranged in-plane and out-of-plane PDMS cylinders structures formed by microphase separation were successfully used as on-chip etch masks for pattern transfer to the underlying silicon substrate. The molecular approach developed here affords significant advantages when compared to the more usual PDMS-OH brushes used.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Tyndall National Institute at National University of Ireland, Cork, Materials Chemistry and Analysis Group, University College Cork, Trinity College Dublin
Contributors: Borah, D., Rasappa, S., Senthamaraikannan, R., Holmes, J. D., Morris, M. A.
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Volume: 1
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Article number: 1300102
ISSN (Print): 2196-7350
Ratings:

Scopus rating (2014): CiteScore 1.5
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering
Keywords: directed self-assembly, etching, molecular functionalization, pattern transfer, polystyrene-block-polydimethylsiloxane, solvent anneal
DOIs:

10.1002/admi.201300102
URLs:

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Source: Scopus
Source ID: 84927789563
Research output: Contribution to journal › Article › Scientific › peer-review

Mechanically Switchable Elastomeric Microfibrillar Adhesive Surfaces for Transfer Printing
A new mechanically switchable topographical adhesive surface for transfer printing is reported. The surface consists of a thin non-adhesive mesh and pillars, coated with a dry microfibrillar adhesive, extending through the holes in the mesh. The switching is achieved by retracting the pillars. 2000-to-1 switching ratios and examples of part transfer applications are shown.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Carnegie Mellon University, Aalto University
Contributors: Sariola, V., Sitti, M.
Publication date: 1 Jul 2014
Peer-reviewed: Yes

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Volume: 1
Issue number: 4
Article number: 1300159
ISSN (Print): 2196-7350
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Scopus rating (2014): CiteScore 1.5
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials
Keywords: adhesive interfaces, biomimetics, elastomers, hierarchical structures, microstructures
DOIs:

10.1002/admi.201300159
URLs:

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Source ID: 84910131877
Research output: Contribution to journal › Article › Scientific › peer-review

Branched thiophene oligomer/polymer bulk heterojunction organic solar cell
Thiophene small novel branched structures have been proposed as candidates for dopant agents transporting holes-electron in organic solar cell (OSC). Low-band gap of these branched oligotiophene have been obtained to be used in organic solar cells. Two branched thiophene oligomers, a sexithienylene vinylene (E)-Bis-l,2-(5,5″-Dimethyl-(2,2′:3′,2″-terthiophene) vinylene ,(BSTV) and octathienylene vinylene (BOTV) (E)-Bis-l,2-(5,5"'-Dimethyl- (2,2′:5′,2″:3′,2˅-tetrathiophene) vinylene oligomers, have been synthesized and used as electron donor or dopant in a bulk heterojunction poly(3-hexylthiophene) (P3HT), /[6,6]-phenyl C61-butyric acid methylester (PCBM), Organic Photovoltaic cell.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics, Universidad de Chile
Contributors: Martinez, F., Neculqueo, G., Vasquez, S. O., Lemmetyinen, H., Efimov, A., Vivo, P.
Number of pages: 7
Pages: 19-25
Publication date: 2015

Host publication information
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Volume: 1737
Publisher: MATERIALS RESEARCH SOCIETY
ISBN (Print): 9781510806177
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials
DOIs:

10.1557/opl.2015.529
URLs:

http://www.scopus.com/inward/record.url?scp=84938866855&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84938866855
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Detection beyond Debye's length with an electrolyte-gated organic field-effect transistor
A systematic study of the sensor response as a function of the Debye's length, the receptor charge, and the distance at which the binding event occurred addressed the basic functional mechanisms of a bio-electrolyte-gated organic field-effect transistors (EGOFET). A bio-EGOFET sensing platform comprising a biological layer at the interface between the OSC and the electrolyte was used to conduct the investigations. The biological layer was composed of a phospholipid (PL) bilayer covalently anchored to the OSC surface through a plasma-deposited (?COOH)-functionalized thin coating. It was observed that some of the anchored PLs were endowed with a biotin moiety, having an incomparably high binding affinity for streptavidin (SA) or avidin (AV) proteins.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed

Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Universita degli Studi di Bari, Centro S3, Fimlab Laboratories Ltd
Contributors: Palazzo, G., De Tullio, D., Magliulo, M., Mallardi, A., Intranuovo, F., Mulla, M. Y., Favia, P., Vikholm-Lundin, I., Torsi, L.
Number of pages: 6
Pages: 911-916
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Advanced Materials
Volume: 27
Issue number: 5
ISSN (Print): 0935-9648
Ratings:

Scopus rating (2015): CiteScore 30.6 SJR 8.625 SNIP 3.649
Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
DOIs:

10.1002/adma.201403541
URLs:

http://www.scopus.com/inward/record.url?scp=84949324410&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84949324410
Research output: Contribution to journal › Article › Scientific › peer-review

Experimental study on the behavior of wear resistant steels under high velocity single particle impacts
High velocity solid particle erosion may cause severe damage and high wear rates in materials used for wear protection. An experimental work on the behavior of wear resistant steels, including three high-strength martensitic alloys and a carbide-reinforced metal matrix composite, was performed in high rate single impact conditions. Characterization of the mechanical behavior of the materials at high strain rates was conducted using the Hopkinson Split Bar technique to identify the effects of strain rate on strain hardening and the prevailing failure mechanisms. The high velocity impact experiments using spherical projectiles were carried out at various impact angles and projectile velocities. The effects of impact energy and impact angle were studied and discussed.Wear was analyzed as volume loss from the surface, but it was also presented in a more precise way by taking into account the actual energy spent on the plastic deformation and wear. In-situ high speed photography and post impact characterization of the impact craters were used to reveal the prevailing failure and wear mechanisms. Depending on the impact angle and impact energy, different wear mechanisms of plastic deformation, cutting, shear banding and fracture were identified. The martensitic steels exhibited adiabatic shear banding in the microstructure at high strain rates and impact velocities, which may accelerate the wear. The carbide reinforced steel was found susceptible to catastrophic fracturing especially at high impact angles.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Computational Science X (CompX), Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland, Ruukki Metals Inc.
Contributors: Lindroos, M., Apostol, M., Kuokkala, V. T., Laukkanen, A., Valtonen, K., Holmberg, K., Oja, O.
Number of pages: 14
Pages: 114-127
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: International Journal of Impact Engineering
Volume: 78
ISSN (Print): 0734-743X
Ratings:

Scopus rating (2015): CiteScore 4.9 SJR 1.697 SNIP 2.926
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Civil and Structural Engineering, Aerospace Engineering, Automotive Engineering, Ocean Engineering, Safety, Risk, Reliability and Quality
Keywords: Adiabatic shear band, High strain rate, High strength steel, Impact wear
Electronic versions:

Experimental study on the behavior of wear resistant steels under high velocity single particle impacts. Embargo ended:

26/12/16
DOIs:
10.1016/j.ijimpeng.2014.12.002
URLs:
http://urn.fi/URN:NBN:fi:tty-201606134241 . Embargo ended: 26/12/16

Bibliographical note
EXT="Oja, Olli"
Source: Scopus
Source ID: 84920738236
Research output: Contribution to journal › Article › Scientific › peer-review

Fe_2O_3-TiO_2 Nano-heterostructure Photoanodes for Highly Efficient Solar Water Oxidation

Harnessing solar energy for the production of clean hydrogen by photo-electrochemical water splitting represents a very attractive, but challenging approach for sustainable energy generation. In this regard, the fabrication of Fe_2O_3-TiO_2 photoanodes is reported, showing attractive performances [≈2.0 mA cm^{-2} at 1.23 V vs. the reversible hydrogen electrode in 1 M NaOH] under simulated one-sun illumination. This goal, corresponding to a tenfold photoactivity enhancement with respect to bare Fe_2O_3, is achieved by atomic layer deposition of TiO_2 over hematite (α-Fe_2O_3) nanostructures fabricated by plasma enhanced-chemical vapor deposition and final annealing at 650 °C. The adopted approach enables an intimate Fe_2O_3-TiO_2 coupling, resulting in an electronic interplay at the Fe_2O_3/TiO_2 interface. The reasons for the photocurrent enhancement determined by TiO_2 overlayers with increasing thickness are unraveled by a detailed chemico-physical investigation, as well as by the study of photo-generated charge carrier dynamics. Transient absorption spectroscopy shows that the increased photoelectrochemical response of heterostructured photoanodes compared to bare hematite is due to an enhanced separation of photogenerated charge carriers and more favorable hole dynamics for water oxidation. The stable responses obtained even in simulated seawater provides a feasible route in view of the eventual large-scale generation of renewable energy.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Tampere University of Technology, Research group: Supramolecular photochemistry, Universita degli Studi di Padova, Italy, Universiteit Antwerpen, Universitat zu Koln, Universita degli Studi di Brescia
Contributors: Barreca, D., Carraro, G., Gasparotto, A., Maccato, C., Warwick, M. E. A., Kaunisto, K., Sada, C., Turner, S., Gönüllü, Y., Ruoko, T., Borgese, L., Bontempi, E., Van Tendeloo, G., Lemmetyinen, H., Mathur, S.
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Advanced Materials Interfaces
Volume: 2
Issue number: 17
ISSN (Print): 2196-7350
Ratings:
Scopus rating (2015): CiteScore 2.2 SJR 1.193 SNIP 0.738
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials
Keywords: FeO, Nano-heterostructures, Photoelectrochemistry, TiO, Water splitting
Electronic versions:
Fe2O3-TiO2_post-print
DOIs:
10.1002/admi.201500313
URLs:
http://urn.fi/URN:NBN:fi:tty-201612024841
Source: Scopus
Source ID: 84955180397
Research output: Contribution to journal › Article › Scientific › peer-review

High Temperature Tension HSB Device Based on Direct Electrical Heating

The effects of strain rate and temperature on the mechanical properties of various engineering materials have been extensively studied within the past few decades. However, the high temperature high strain rate tension Hopkinson Split Bar (HSB) testing is still quite challenging to perform due to the need to fix the sample to the stress bars. Mechanical fixing of a sheet material sample is not very convenient and can produce low quality results. Therefore, the sheet samples are typically glued directly to the stress bars. This glue joint, however, loses strength rapidly if the temperature of the glue joint

increases above room temperature, which makes the high temperature testing more difficult. In this paper, we present a tension Hopkinson Split Bar device with a high temperature system that allows the sample to be heated while keeping the glue joint at or close to room temperature. The sample is rapidly heated by a powerful low voltage high amperage DC pulse. When testing stainless steels, test temperatures between 400 and 800 °C are reached in less than one second, and even the melting temperature of the material is reached in less than 2 s. The system is fully computer controlled allowing accurate timing and control of the different actions during the test including heating of the sample, pneumatic manipulation of the heating electrodes, releasing of the striker bar, and recording of the test results. The results obtained with the current high temperature system are high quality and the obtained high temperature stress strain curves are essentially oscillation free.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Materials Characterization, Engineering materials science and solutions (EMASS)
Contributors: Hokka, M., Östman, K., Rämö, J., Kuokkala, V. T.
Number of pages: 7
Pages: 227-233
Publication date: 2015

Host publication information
Title of host publication: Dynamic Behavior of Materials, Volume 1 : Proceedings of the 2014 Annual Conference on Experimental and Applied Mechanics
Volume: 65
Publisher: Springer
Editors: Song, B., Casem, D., Kimberley, J.
ISBN (Print): 978-3-319-06994-4
ISBN (Electronic): 978-3-319-06995-1

Publication series
Name: Conference Proceedings of the Society for Experimental Mechanics Series
Publisher: Springer
ISSN (Print): 2191-5644
ASJC Scopus subject areas: Engineering(all), Computational Mechanics, Mechanical Engineering
Keywords: High strain rate, High temperature, Hopkinson split bar, Stainless steels, Tension testing
DOIs:

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Bibliographical note
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Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2015-01-13</br>publication_forum:72540
Source: researchoutputwizard
Source ID: 8
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Measurements and Modeling of Frost Depth in Railway Tracks
In Finland, increases in the maximum allowable operating speed on railways have led to stricter smoothness requirements for rails. Despite continuous rehabilitation of the track structures, decreased speed limits have been required due to seasonal frost action. To improve the understanding of frost action phenomena in railway structures, a real-time in-situ monitoring system was installed at 14 sites within the Finnish railway track network for the purpose of measuring temperatures in the track structures and vertical displacements of selected railway sleepers. Based on 5 years of data collected from 2009 to 2013, during which time the maximum frost depth was observed to range from 0.9 m to 2.4 m, multivariable regression models for predicting the maximum frost depth at the instrumented sites were developed. Several factors were shown to influence the maximum frost depth, including latitude, longitude, air-freezing index, rainfall, elevation, and ditch depth. With comparatively high R² values of 0.73 and 0.87, the resulting regression models may provide satisfactory utility for predicting maximum frost depth at sites similar to those that were instrumented for this research. When considered with other information such as track structure thickness, predictions of maximum frost depth can be useful for development of site-specific reasons for observed frost problems in railways.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Civil Engineering, Research group: Earth Constructions, Research group: Track Structures, Life Cycle Effectiveness of the Built Environment (LCE@BE), Brigham Young University, BrightEdge

Contributors: Pylkkänen, K., Nurmikolu, A., Guthrie, W. S., Argyle, H. M.
Number of pages: 12
Pages: 123-134
Publication date: 2015

Host publication information
Title of host publication: Proceedings of the International Conference on Cold Regions Engineering : 16th International Conference on Cold Regions Engineering 2015
Publisher: American Society of Civil Engineers ASCE
ISBN (Electronic): 978-0-7844-7931-5
ASJC Scopus subject areas: Mechanical Engineering
Keywords: Air-freezing index, Frost depth, Railway track structures, Seasonal frost action, Train speed
DOIs:

10.1061/9780784479315.012
Source: Scopus
Source ID: 84938530985
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Roll-to-roll coating by liquid flame spray nanoparticle deposition
Nanostructured coatings have been prepared on a flexible, moving paperboard using deposition of ca. 10-50-nm-sized titanium dioxide and silicon dioxide nanoparticles generated by a liquid flame spray process, directly above the paperboard, to achieve improved functional properties for the material. With moderately high production rate (~ g/min), the method is applicable for thin aerosol coating of large area surfaces. LFS-made nanocoating can be synthesized e.g. on paper, board or polymer film in roll-to-roll process. The degree of particle agglomeration is governed by both physicochemical properties of the particle material and residence time in aerosol phase prior to deposition. By adjusting the speed of the substrate, even heat sensitive materials can be coated. In this study, nanoparticles were deposited directly on a moving paperboard with line speeds 50-300 m/min. Functional properties of the nanocoating can be varied by changing nanoparticle material; e.g. Ti02 and Si02 are used for changing the surface wetting properties. If the liquid precursors are dissolved in one solution, synthesis of multi component nanoparticle coatings is possible in a one phase process. Here, we present analysis of the properties of LFS-fabricated nanocoatings on paperboard. The thermophoretic flux of nanoparticles is estimated to be very high from the hot flame onto the cold substrate. A highly hydrophobic coating was obtained by a mass loading in the order of 50-100 mg/m² of titanium dioxide on the paperboard.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, Department of Materials Science, Research group: Paper Converting and Packaging, Engineering materials science and solutions (EMASS), Abo Akad Univ, Abo Akademi University, Dept Phys
Contributors: Mäkelä, J. M., Haapanen, J., Aromaa, M., Teisala, H., Tuominen, M., Stepien, M., Saarinen, J. J., Toivakka, M., Kuusipalo, J.
Number of pages: 6
Pages: 37-42
Publication date: 2015

Host publication information
Title of host publication: Materials Research Society Symposium Proceedings
Volume: 1747
Publisher: MATERIALS RESEARCH SOCIETY
ISBN (Print): 9781510806245
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials
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10.1557/opl.2015.530
URLs:

http://www.scopus.com/inward/record.url?scp=84938922555&partnerID=8YFLogxK (Link to publication in Scopus)

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ORG=fys,0.5
ORG=mol,0.5
Source: Scopus
Source ID: 84938922555
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

The correlation between gear contact friction and ball on disc friction measurements

Running experiments with full-size gearboxes from the actual application has the advantage of giving realistic results in terms of power losses. The drawback is extensive costs, lengthy testing, and the difficulty in differentiating between load dependent and load independent losses, and which losses are coming from the gears, seals, bearings or synchronizers. In this work, the correlation between friction measurements conducted in a ball-on-disc machine and friction measurements conducted in a back-to-back gear rig is investigated. The correlation between the gear tests and the ball-on-disc tests was reasonably good in terms of absolute values, and the shape of the friction curves was similar, indicating that the ball-on-disc measurements to a large extent are capturing the behavior of the gear contact.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), Luleå University of Technology, Department of Engineering Sciences and Mathematics, Division of Energy Science, Luleå University of Technology, Division of Machine Elements
Contributors: Björling, M., Miettinen, J., Marklund, P., Lehtovaara, A., Larsson, R.
Number of pages: 6
Pages: 114-119
Publication date: 2015
Peer-reviewed: Yes

Publication information

Journal: Tribology International
Volume: 83
ISSN (Print): 0301-679X
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Ball-on-disc, EHL, Friction, Gears
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Bibliographical note

Available online 24 November 2014; (vol 83 (2015), s. 114-119
Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2015-01-13
Publisher name: Pergamon
Source: researchoutputwizard
Source ID: 171
Research output: Contribution to journal › Article › Scientific › peer-review

The deformation, strain hardening, and wear behavior of chromium-alloyed hadfield steel in abrasive and impact conditions

The alloying of Hadfield steels aims at enhanced mechanical properties and improvements in the wear resistance. In this work, the impact and abrasive properties of a chromium-alloyed high-manganese Hadfield steel were experimentally studied using a wide variety of testing techniques and characterization methods. In addition, an in-service sample was characterized to identify the wear and hardening mechanisms in a real application (jaw crusher). The dynamic mechanical behavior of the steel was determined using the Hopkinson split bar technique. The abrasion properties were studied with three-body abrasion tests using several different natural abrasives. The effects of existing plastic strain and normal loading on the surface hardening and wear rate were further investigated with scratch testing. High-velocity impact testing was performed to evaluate the effect of pre-strain on the impact wear behavior of the material. It was shown that the dynamic loading affects both the yield behavior and the strain hardening rate of the studied steel. The connection between pre-strain, hardness, and wear rate in abrasion was established. In impact conditions, plastic straining of the surface layer first has a positive effect on the wear resistance, but when strain hardening reached the observed ductility limit, it showed an adverse effect on the material's performance. The addition of chromium and an increase in the manganese content from the nominal ASTM Hadfield composition provided some improvements in the strength, ductility, and surface hardening of the studied steel.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Computational Science X (CompX), Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland

Contributors: Lindroos, M., Apostol, M., Heino, V., Valtonen, K., Laukkanen, A., Holmberg, K., Kuokkala, V. T.
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Tribology Letters
Volume: 57
Issue number: 3
Article number: 24
ISSN (Print): 1023-8883
Ratings:

Scopus rating (2015): CiteScore 3.7 SJR 1.013 SNIP 1.237
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Abrasive wear, Hadfield manganese steel, High strain rate, Impact wear, Plasticity, Work hardening
Electronic versions:

The deformation, strain hardening and wear behavior of chromium alloyed Hadfield steel in abrasive and impact conditions
DOIs:

10.1007/s11249-015-0477-6
URLs:

http://urn.fi/URN:NBN:fi:tty-201603223737
Source: Scopus
Source ID: 84921751364
Research output: Contribution to journal › Article › Scientific › peer-review

Towards dependable automation
Automation runs the modern society and it’s critical systems. It is anetworked software product depending on the co-operation of old and new technologies.Information security for automation systems should be regarded in light ofthe most important quality required from automation—dependability. This chapterfocuses on process of developing dependable solutions for the entire lifecycle ofautomation systems. The approach includes a guideline for securing automation anda dependability model that is a data flow model extended with security and automationrequirements. Results of this analysis should be used in final requirementspecification for implementation. Dependability model is the key tool in securedevelopment lifecycle. It can be used in new product development, improving anold automation system and also during the active lifecycle of automation to manage inevitable changes occurring during the entire lifespan of automation system.

General information
Publication status: Published
MoE publication type: A3 Part of a book or another research book
Organisations: Tampere University of Technology, Department of Automation Science and Engineering, Research area: Information Systems in Automation
Contributors: Seppälä, J., Salmenperä, M.
Number of pages: 21
Pages: 229-249
Publication date: 2015

Host publication information
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Publisher: Springer International Publishing
ISBN (Print): 978-3-319-18301-5
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Publication series
Name: Intelligent Systems, Control and Automation: Science and Engineering
Volume: 78
ISSN (Print): 2213-8986
ASJC Scopus subject areas: Computer Science Applications, Control and Systems Engineering, Mechanical Engineering, Control and Optimization
DOIs:

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Source: Scopus

Source ID: 84934873164
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

A comparison of five optical surface topography measurement methods

The results of optical surface topography measurement techniques have been questioned in the past because of possible measurement artifacts due to light penetration into the paper. We compared the topography measurement results from five optical techniques: laser profilometry, shape-from-focus, stripe projection, chromatic sensing, and photometric stereo. These techniques were tested on coated and uncoated papers with a PPS roughness range from 0.7 μm to 7.7 μm. We made the measurement results directly comparable by measuring exactly the same regions on the paper samples and registering the resulting topography maps. We then calculated the point-wise Pearson correlation between the maps at different wavelength bands to obtain quantitative values for the similarity of the measurement results at different structure sizes. The correspondences between the measured topography maps were also examined through multivariate linear regression and roughness indices evaluated at two different structure sizes. For rougher grades like office paper or sack paper, the topography measurements from the five measurement techniques showed corresponding results. For a moderately smooth lightweight coated (LWC) paper, the measured topographies agreed to some degree, and for smooth supercalendered (SC) and woodfree coated (WFC) papers, the agreement was poor. From the available data, it is impossible to tell which of the measurement techniques delivers the true surface topography of smooth papers.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Automation Science and Engineering, Field robotics for efficient work sites (FIRE), Graz University of Technology
Contributors: Mettänen, M., Hirn, U.
Number of pages: 12
Pages: 27-38
Publication date: 1 Jan 2015
Peer-reviewed: Yes

Publication information

Journal: TAPPI Journal
Volume: 14
Issue number: 1
ISSN (Print): 0734-1415
Ratings:

Scopus rating (2015): SJR 0.44 SNIP 0.718
Original language: English
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
Electronic versions:

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URLs:

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URLs:

http://www.scopus.com/inward/record.url?scp=84923164333&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84923164333
Research output: Contribution to journal › Article › Scientific › peer-review

Measured energy consumption of educational buildings in a Finnish city

This study measures energy consumption in existing educational buildings. The study provides an overall picture of energy consumption and assesses the factors that are used in evaluating measured energy. The studied buildings are day care centres, schools and university buildings located in southern Finland. The energy efficiency requirements in Finnish building regulations have become significantly stricter in recent years. This study shows that in different educational building type, the newer buildings consume less heating. However, such a clear correlation not found for electricity consumption. In the day care centres and school buildings studied, the primary heating consumption as a function of the age of the buildings has a decreasing trend. In turn, the primary electricity consumption has a slightly rising trend. However, in different building types, the primary heating and electricity consumption varied significantly between the buildings e.g. in day care centres variation was 83%, in schools 84% and in university buildings 76%. This study shows that even though Finnish climate is cold the primary electricity consumption is higher than primary heating in educational buildings constructed in the 2000s. This means that in the design phase, there is a need to find ways to influence the electricity consumption in particular.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), VTT Technical Research Centre of Finland, Aalto University
Contributors: Sekki, T., Airaksinen, M., Saari, A.
Number of pages: 11
Pages: 105-115
Publication date: 1 Jan 2015
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 87
ISSN (Print): 0378-7788
Ratings:

Scopus rating (2015): CiteScore 6 SJR 2.04 SNIP 2.185
Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Educational buildings, Energy consumption, Measured energy, Primary energy consumption
DOIs:

10.1016/j.enbuild.2014.11.032
URLs:

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Source: Scopus
Source ID: 84911913165
Research output: Contribution to journal › Article › Scientific › peer-review

Second-Harmonic Generation from Metal Nanoparticles: Resonance Enhancement versus Particle Geometry
We demonstrate that optical second-harmonic generation (SHG) from arrays of noncentrosymmetric gold nanoparticles depends essentially on particle geometry. We prepare nanoparticles with different geometrical shapes (L and T) but similar wavelengths for the polarization-dependent plasmon resonances. In contrast to recent interpretations emphasizing resonances at the fundamental frequency, the T shape leads to stronger SHG when only one, instead of both, polarization component of the fundamental field is resonant. This is explained by the character of plasmon oscillations supported by the two shapes. Our numerical simulations for both linear and second-order responses display unprecedented agreement with measurements.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research area: Optics, Research group: Nonlinear Optics, Frontier Photonics, Institute of Photonics, Univ Eastern Finland, University of Eastern Finland, Sch Pharm
Contributors: Czaplicki, R., Mäkitalo, J., Siikanen, R., Husu, H., Lehtolahti, J., Kuittinen, M., Kauranen, M.
Number of pages: 5
Pages: 530-534
Publication date: 14 Jan 2015
Peer-reviewed: Yes
Early online date: 18 Dec 2014

Publication information
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Volume: 15
Issue number: 1
ISSN (Print): 1530-6984
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Scopus rating (2015): CiteScore 22.9 SJR 8.359 SNIP 3.071
Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Bioengineering, Chemistry(all), Materials Science(all), Mechanical Engineering
Keywords: Metal nanoparticles, nonlinear optics, plasmonic resonances, second-harmonic generation
DOIs:

10.1021/nl503901e
Additional files:

Supplementary_info_to_Nano_Lett._15_(2015)_530-534_R.Czaplicki_open

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Source: WOS
Source ID: 000348086100083
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of Multiple Impacts on the Deformation of Wear-Resistant Steels

More durable materials enable reducing the downtime and maintenance costs by decreasing the number of replaced core components in various industrial applications. In this study, the behavior of three wear-resistant quenched martensitic steel grades and the S355 structural steel was examined in controlled impact conditions. The materials' impact behavior was investigated by several methods including residual stress measurements and electron backscatter diffraction. For all studied materials, the size and depth of the impact marks correlate via a logarithmic function to the number of impacts mostly due to work hardening. The underlying deformation behavior of the material depends on the mechanical properties and microstructure of the material. At high impact counts, softer martensitic steel was found to behave differently when compared to the other tested materials as it underwent severe changes in its microstructure and exhibited marked hardening.

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), AC2T Research GmbH
Contributors: Ratia, V., Rojacz, H., Terva, J., Valtonen, K., Badisch, E., Kuokkala, V. T.
Publication date: 21 Jan 2015
Peer-reviewed: Yes

Publication information

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Article number: 15
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Ratings:

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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Deformation, EBSD, Impact, Martensite, Residual stresses, Steel
DOIs:

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Source: Scopus
Source ID: 84937924221
Research output: Contribution to journal › Article › Scientific › peer-review

Second-harmonic generation imaging of semiconductor nanowires with focused vector beams

We use second-harmonic generation (SHG) with focused vector beams to investigate individual vertically aligned GaAs nanowires. Our results provide direct evidence that SHG from oriented nanowires is mainly driven by the longitudinal field along the nanowire growth axis. Consequently, focused radial polarization provides a superior tool to characterize such nanowires compared to linear polarization, also allowing this possibility in the native growth environment. We model our experiments by describing the SHG process for zinc-blende structure and dipolar bulk nonlinearity.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research area: Optics, Research group: Nonlinear Optics, Tampere University of Technology, Frontier Photonics, Aalto University, Department of Micro- and Nanosciences, Aalto University, Department of Applied Physics and Nanomicroscopy Center
Contributors: Bautista, G., Mäkitalo, J., Chen, Y., Dhaka, V., Grasso, M., Karvonen, L., Jiang, H., Huttunen, M. J., Huhtio, T., Lipsanen, H., Kauranen, M.
Number of pages: 6
Pages: 1564-1569
Publication date: 6 Feb 2015

Peer-reviewed: Yes

Publication information
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Volume: 15
Issue number: 3
ISSN (Print): 1530-6984
Ratings:

Scopus rating (2015): CiteScore 22.9 SJR 8.359 SNIP 3.071
Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Bioengineering, Chemistry(all), Materials Science(all), Mechanical Engineering
Keywords: modeling, nonlinear imaging, radial polarization, Second-harmonic generation, semiconductor
DOIs:

10.1021/nl503984b
URLs:

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Bibliographical note
AUX=fys,"Grasso, Marco"
EXT="Dhaka, Veer"
EXT="Huttunen, Mikko J."
Source: Scopus
Source ID: 84924595561
Research output: Contribution to journal › Article › Scientific › peer-review

Corrosion mechanisms of sintered Nd-Fe-B magnets in the presence of water as vapour, pressurised vapour and liquid
Corrosion behaviour of three commercial sintered Nd-Fe-B magnets exposed to environments containing water as vapour, pressurised vapour, and liquid was investigated in order to understand their overall corrosion performance under a range of conditions. Two types of heat humidity exposure tests, namely the 85/85 and pressure cooker test, and the immersion test combined with electrochemical measurements were used as corrosion tests. It was observed that varying the temperature, pressure, and the prevailing state of water in the exposure tests, different corrosion mechanisms were detected on the surface of Nd-Fe-B magnets. The surface finish of the magnet had an effect on the initiation of corrosion in mild heat-humidity exposure. Immersion in liquid water resulted in a corrosion topography where the Nd-rich grain-boundary phase did not corrode selectively as in the other accelerated corrosion tests but was retained intact while the matrix phase underwent corrosion. These results and the dominant corrosion mechanisms of sintered Nd-Fe-B magnets in different environments are presented and discussed in this paper.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Ceramic materials, Research group: Materials Characterization, Engineering materials science and solutions (EMASS), Prizztech Magnet Technology Centre, VTT Technical Research Centre of Finland
Contributors: Isotahdon, E., Huttunen-Saarivirta, E., Heinonen, S., Kuokkala, V. T., Paju, M.
Number of pages: 11
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Publication date: 25 Mar 2015
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Journal: Journal of Alloys and Compounds
Volume: 626
ISSN (Print): 0925-8388
Ratings:

Scopus rating (2015): CiteScore 4.6 SJR 0.957 SNIP 1.408
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Materials Chemistry, Metals and Alloys
Keywords: Corrosion, Electrochemical impedance spectroscopy, Permanent magnets, Rare-earth alloys and compounds, Scanning electron microscopy, SEM
DOIs:

10.1016/j.jallcom.2014.12.048
URLs:

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Source ID: 84920283616
Research output: Contribution to journal › Article › Scientific › peer-review

Smart Skins: Could they be the ultimate sensing tool? Today\uFFFDs industry and personal medical care both strongly demand accurate, reliable, robust, lo

Today's industry and personal medical care both strongly demand accurate, reliable, robust, low-power, and low-cost methods to sense changes in the environment and the condition of the body. This is where the concept of smart skin comes in. Smart skins can monitor changes in environmental parameters, such as temperature, strain, and the presence of ambient gas, and communicate. The smart skin concept can also be extended to that of wearable electronic devices for continuous monitoring and reporting of critical biosignals. There are a lot of challenges for the state of the art of smart skin, such as expensive fabrication methods, a lack of flexibility and mobility, and the large area fabrication method.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology
Contributors: Le, T., Lin, Z., Wong, C. P., Tentzeris, M. M.
Number of pages: 7
Pages: 4-10
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Publication information

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Volume: 9
Issue number: 2
Article number: 7080864
ISSN (Print): 1932-4510
Ratings:

Scopus rating (2015): CiteScore 1.7 SJR 0.188 SNIP 0.313
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Electrical and Electronic Engineering
DOIs:

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

Transfer printing of metallic microstructures on adhesion-promoting hydrogel substrates

Fabrication schemes that integrate inorganic microstructures with hydrogel substrates are essential for advancing flexible electronics. A transfer printing process that is made possible through the design and synthesis of adhesion-promoting hydrogels as target substrates is reported. This fabrication technique may advance ultracompliant electronics by melding microfabricated structures with swollen hydrogel substrates.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Carnegie Mellon University, Department of Electrical Engineering and Automation, Aalto University, Max Planck Institute for Intelligent Systems, McGowan Institute of Regenerative Medicine
Contributors: Wu, H., Sariola, V., Zhu, C., Zhao, J., Sitti, M., Bettinger, C. J.
Number of pages: 7
Pages: 3398-3404
Publication date: 1 Jun 2015
Peer-reviewed: Yes

Publication information

Journal: Advanced Materials
Volume: 27
Issue number: 22
ISSN (Print): 0935-9648
Ratings:

Scopus rating (2015): CiteScore 30.6 SJR 8.625 SNIP 3.649

Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: adhesion, catechol, flexible electronics, hydrogels, transfer printing
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10.1002/adma.201500954
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http://www.scopus.com/inward/record.url?scp=84930679962&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84930679962
Research output: Contribution to journal › Article › Scientific › peer-review

Evaluating the electrode measurement sensitivity of subdermal electroencephalography electrodes

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Wireless Identification and Sensing Systems Research Group
Contributors: Mendes, M. R., Subramaniyam, N. P., Wendel-Mitoraj, K.
Number of pages: 4
Pages: 1092-1095
Publication date: 1 Jul 2015

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Title of host publication: International IEEE/EMBS Conference on Neural Engineering, NER
Volume: 2015-July
Publisher: IEEE COMPUTER SOCIETY PRESS
ISBN (Print): 9781467363891
ASJC Scopus subject areas: Artificial Intelligence, Mechanical Engineering
DOIs:
10.1109/NER.2015.7146818

Bibliographical note
AUX=elt,"Mendes, Miguel Rodrigues"
Source: Scopus
Source ID: 84940367793
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

On the threshold based neuronal spike detection, and an objective criterion for setting the threshold
In this paper, we investigate the workings of threshold (TH) based spike detection for neuronal extracellular field potential spikes. Thresholding is the most used spike detection method. In general, it is employed by setting the TH as per convention and without considering either the undetected or spurious spikes. In this paper, we provide insight in to the workings of thresholding, and proposed a new objective way to set the TH based on spike count histogram analysis. We illustrate the method with 2D and 3D simulations and analysis of measured data.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), BioMediTech
Contributors: Tanskanen, J. M. A., Kapucu, F. E., Hyttinen, J. A. K.
Number of pages: 4
Pages: 1016-1019
Publication date: 1 Jul 2015

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Title of host publication: International IEEE/EMBS Conference on Neural Engineering, NER
Publisher: IEEE COMPUTER SOCIETY PRESS
ISBN (Print): 9781467363891
ASJC Scopus subject areas: Artificial Intelligence, Mechanical Engineering
DOIs:
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Source: Scopus
Source ID: 84940384726
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Recurrence network analysis of wide band oscillations of local field potentials from the primary motor cortex reveals rich dynamics.

Aggregate signals that reflect activities of a large number of neurons in the cerebral cortex, local field potentials (LFPs) have been observed to mediate gross functional activities of a relatively small volume of the brain tissues. There are several bands of the oscillations frequencies in LFPs that have been observed across multiple brain areas. The signature oscillation band of the LFPs in the primary motor cortex (MI) is over β range and it has been consistently observed both in human and non-human primates around the time of visual cues and movement onsets. However, its dynamical behavior has not been well characterized. Furthermore, dynamics of β oscillations has been documented based on the phase locking of β oscillations, but not in terms of the inherent dynamics of the oscillations themselves. Here, we used the complexity measure derived from cluster coefficients of a recurrence network and analyzed a pair of wide-band signals, one including β band of the LFPs and the other ranging the low γ band in MI recorded from a non-human primate. We show rather unique temporal profiles of the evoked responses using complexity of the dynamical behavior in both bands of the oscillation, either of which is not simply resembling either the power of the oscillation or the phase locking of β oscillations. Therefore, the current method can reveal a new type of dynamics of the underlying network complexity during the task simply based on event evoked potentials of wide-band oscillatory signals.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), Department of Organismal Biology and Anatomy, University of Chicago
Contributors: Subramaniyam, N. P., Hyttinen, J., Hatsopoulos, N. G., Takahashi, K.
Number of pages: 4
Pages: 960-963
Publication date: 1 Jul 2015

Host publication information

Title of host publication: International IEEE/EMBS Conference on Neural Engineering, NER
Publisher: IEEE COMPUTER SOCIETY PRESS
ISBN (Print): 9781467363891
ASJC Scopus subject areas: Artificial Intelligence, Mechanical Engineering
Keywords: event evoked potentials, functional connectivity, Local field potentials, motor cortex, recurrence network, temporal dynamics
DOIs:

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Source ID: 84940371617
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Fretting-induced friction and wear in large flat-on-flat contact with quenched and tempered steel

Fretting may cause severe surface damage and lead to unexpected fatigue failure. Our test apparatus was designed based on reciprocating, large, annular flat-on-flat contact without any edge effects in the direction of the fretting movement. Fretting wear tests were run with quenched and tempered steel with different normal pressures and sliding amplitudes under gross sliding conditions. The development of the friction coefficient and total wear mass depended mostly on the accumulated sliding distance. Initially, friction and wear were highly adhesive but gradually changed to abrasive due to third body accumulation in the interface.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Tribology and Machine Elements, Engineering materials science and solutions (EMASS), Research and Development, Wärtsilä Finland
Contributors: Hintikka, J., Lehtovaara, A., Mäntylä, A.
Number of pages: 12
Pages: 191-202
Publication date: 2 Jul 2015
Peer-reviewed: Yes

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Scopus rating (2015): CiteScore 4.2 SJR 1.421 SNIP 2.104
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Fretting, Friction, Steel, Wear
DOIs:

10.1016/j.triboint.2015.06.008
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Source: Scopus
Source ID: 84933509998
Research output: Contribution to journal › Article › Scientific › peer-review

Divertor remote handling for DEMO: Concept design and preliminary FMECA studies

The paper describes a concept design of a remote handling (RH) system for replacing divertor cassettes and cooling pipes in future DEMO fusion power plant. In DEMO reactor design important considerations are the reactor availability and reliable maintenance operations. The proposed divertor mover is a hydraulic telescopic boom driven from the transportation cask through the maintenance tunnel of the reactor. The boom is divided in three sections and it is driving an end-effector in order to perform the scheduled operations of maintenance inside the vacuum vessel. Two alternative designs of the end effector to grip and manipulate the divertor cassette are presented in this work. Both concepts are hydraulically actuated, based on ITER previous studies. The divertor cassette end-effector consists of a lifting arm linked to the divertor mover, a tilting plate, a cantilever arm and a hook-plate. Taking advantage of the ITER RH background and experience, the proposed hydraulic RH system is compared with the rack and pinion system currently designed for ITER and is an object of simulations at Divertor Test Platform (DTP2) in VTT's Labs of Tampere, Finland. Pros and cons will be put in evidence.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, Field robotics for efficient work sites (FIRE), VTT Technical Research Centre of Finland, ENEA/CREATE/Università Degli Studi Napoli Federico II
Contributors: Carfora, D., Di Gironimo, G., Järvenpää, J., Huhtala, K., Määttä, T., Siuko, M.
Number of pages: 5
Pages: 1437-1441
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Publication information

Journal: Fusion Engineering and Design
Volume: 98-99
ISSN (Print): 0920-3796
Ratings:

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Original language: English
ASJC Scopus subject areas: Nuclear Energy and Engineering, Materials Science(all), Civil and Structural Engineering, Mechanical Engineering
Keywords: Concept design, DEMO, Divertor, Hydraulic telescopic boom, Remote handling
DOIs:

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Bibliographical note

EXT="Siuko, M."
Source: Scopus
Source ID: 84942553949
Research output: Contribution to journal › Article › Scientific › peer-review

Lithography-free oxide patterns as templates for self-catalyzed growth of highly uniform GaAs nanowires on Si(111)

We report self-catalyzed growth of GaAs nanowires (NWs) on Si/SiO<inf>x</inf> patterns fabricated by a lithography-free method. The patterns are defined using droplet epitaxy of GaAs nanocrystals, spontaneous oxidation, and thermal annealing. We investigate the influence of the size and density of the nucleation sites on the NW growth process and show that this approach enables the fabrication of highly uniform GaAs NWs with controllable density. The pattern fabrication and NW growth process are studied and discussed in relation to the surface morphology and chemical properties of the Si/SiO<inf>x</inf> patterns. Furthermore, the optical quality of the NWs is investigated by photoluminescence experiments performed for GaAs-AlGaAs core-shell NWs.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Augmented Human Activities (AHA), Frontier Photonics, Department of Physics and Astronomy, University of Turku, University of Turku
Contributors: Hakkarainen, T. V., Schramm, A., Mäkelä, J., Laukkanen, P., Guina, M.
Publication date: 18 Jul 2015
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Article number: 275301
ISSN (Print): 0957-4484
Ratings:

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Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Electrical and Electronic Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: droplet epitaxy, GaAs, nanowires, self-catalyzed
DOIs:

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URLs:

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Bibliographical note

EXT="Laukkanen, P."
Source: Scopus
Source ID: 84934916555
Research output: Contribution to journal › Article › Scientific › peer-review

Improved dimensional stability with bioactive glass fibre skeleton in poly(lactide-co-glycolide) porous scaffolds for tissue engineering

Abstract Bone tissue engineering requires highly porous three-dimensional (3D) scaffolds with preferable osteoconductive properties, controlled degradation, and good dimensional stability. In this study, highly porous 3D poly(d,l-lactide-co-glycolide) (PLGA) - bioactive glass (BG) composites (PLGA/BG) were manufactured by combining highly porous 3D fibrous BG mesh skeleton with porous PLGA in a freeze-drying process. The 3D structure of the scaffolds was investigated as well as in vitro hydrolytic degradation for 10 weeks. The effect of BG on the dimensional stability, scaffold composition, pore structure, and degradation behaviour of the scaffolds was evaluated. The composites showed superior pore structure as the BG fibres inhibited shrinkage of the scaffolds. The BG was also shown to buffer the acidic degradation products of PLGA. These results demonstrate the potential of these PLGA/BG composites for bone tissue engineering, but the ability of this kind of PLGA/BG composites to promote bone regeneration will be studied in forthcoming in vivo studies.

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, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), BioMediTech - Institute of Biosciences and Medical Technology, Abo Akademi University, BioMediTech, Laboratory of Polymer Technology, Centre of Excellence in Functional Materials at Biological Interfaces, Åbo Akademi University
Contributors: Haaparanta, A., Uppstu, P., Hannula, M., Ellä, V., Rosling, A., Kellomäki, M.
Number of pages: 10
Pages: 457-466

Publication date: 20 Jul 2015
Peer-reviewed: Yes

Publication information
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Volume: 56
Article number: 5584
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials
Keywords: Bioactive glass, Bone, Composite, Freeze-drying, Poly(d,l-lactide-co-glycolide), Tissue engineering
DOIs:

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Source: Scopus
Source ID: 84937212744
Research output: Contribution to journal › Article › Scientific › peer-review

Analysing traffic fluency from bus data
The use of stored public transportation data facilitates the identification of potential issues with urban traffic flow. Focusing on buses, the authors proceed from a city-level delay distribution analysis to a detailed understanding of the factors that cause the delays on an example bus line. First, a database of bus data in Tampere was mined to detect any regular patterns in the distribution of delays in time, location or according to bus line throughout the city. The results allow the authors to focus on those areas and lines which are most prone to delays. In a case study, they illustrate that the most important reasons for tardy journeys are the long waiting times at traffic signals and bus stops, rather than slow driving speeds. The results are then further deepened to show spatially on a map which bus stops and intersections tend to be the ones where the time variances are high. The same methods can be applied to any other city for which the same kind of data are available.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Signal Processing, Research group: MMDM, Research Community on Data-to-Decision (D2D), University of Tampere
Contributors: Syrjärinne, P., Nummenmaa, J., Thanisch, P., Kerminen, R., Hakulinen, E.
Number of pages: 7
Pages: 566-572
Publication date: 1 Aug 2015
Peer-reviewed: Yes

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Volume: 9
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ISSN (Print): 1751-956X
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Environmental Science(all), Law, Transportation
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Source ID: 84938602651
Research output: Contribution to journal › Article › Scientific › peer-review

Analysis of thermo-active pile structures and their performance under groundwater flow conditions
Geothermal heat pump systems (GHPSs) are economically efficient and renewable environmentally friendly energy production systems in which the ground acts as a heat source in winter and a heat sink in summer. New methods have been developed to increase the economic efficiency of GHPSs, including using pile foundations as dual-purpose structures in energy production and load transfer from building to ground. The performance of such energy pile foundations in cold climate regions was assessed numerically in this study by considering groundwater flow effects and short-term imbalanced seasonal thermal loadings. The structural behaviour of frictional pile foundations was also analysed using soil elasto-plastic behaviour and assuming non-linear sliding contact at the pile-soil interface. The results indicated

that using energy pile foundations under medium groundwater flow (around 1.65E - 8 m/s), the productivity of system is improved by around 20% compared with a saturated conditions with no groundwater flow. They also indicated that no sliding occurred between the frictional pile shaft and the surrounding soil. However, the stresses in the frictional pile shaft decreased significantly in comparison with the end-bearing conditions. Moreover, there was a significant increase in the mobilised shaft friction at the pile-soil interface, particularly in summer mode.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), University of Oulu
Contributors: Gashti, E. H. N., Malaska, M., Kujala, K.
Number of pages: 8
Pages: 1-8
Publication date: 11 Aug 2015
Peer-reviewed: Yes

Publication information
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Ratings:

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Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Energy pile foundations, Geothermal energy, Groundwater flow, Nordic countries, Structural behaviour, Thermo-active infrastructures
DOIs:

10.1016/j.enbuild.2015.07.026
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Source ID: 84938855851
Research output: Contribution to journal › Article › Scientific › peer-review

Impact of building usage and occupancy on energy consumption in Finnish daycare and school buildings
The facility strategy of the City of Espoo emphasises improvements in the energy efficiency and efficient use of buildings. The design phase of a building is crucial and when the building is in operation, it is crucial to use control systems correctly. Further, in order to encourage relevant efficiency efforts, it is essential to know how to measure energy efficiency in the building operation phase. This requires an understanding of the correlation between building occupancy, space efficiency and energy efficiency. Energy efficiency is typically measured as energy consumption per unit of area kWh/m^2 per annum. The specific energy consumption is an effective way to measure the technical properties of a building and to guide its design but it neglects issues related to building occupancy and space efficiency. This paper explores ways in which building usage and occupancy influences the measured energy consumption in Finnish daycare centres and school buildings. The study adopts existing energy efficiency indicators and introduces a new indicator for building energy efficiency which takes into account both space and occupancy efficiency.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), VTT Technical Research Centre of Finland, Aalto University, School of Engineering, Aalto University
Contributors: Sekki, T., Airaksinen, M., Saari, A.
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Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Building usage, Daycare centres, Energy efficiency indicators, Measured energy consumption, Schools
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Source: Scopus
Source ID: 84939449749
Research output: Contribution to journal › Article › Scientific › peer-review

Erbium-doped borosilicate glasses containing various amounts of P2O5 and Al2O3: Influence of the silica content on the structure and thermal, physical, optical and luminescence properties

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Biomaterials and Tissue Engineering Group, Department of Electronics and Communications Engineering, BioMediTech, Frontier Photonics, Integrated Technologies for Tissue Engineering Research (ITTE), Politecnico di Torino, DISAT, Istituto di Ingegneria e Fisica dei Materiali, Corso Duca degli Abruzzi 24, I-10129 Torino, Italy, BioMediTech, Åbo Akademi University, Process Chemistry Centre, nLIGHT Corporation, Sorronrinne 9, FI-08500 Lohja, Finland, CNRS, Université de Bordeaux, ISM, 351Cours de la Libération, F-33405 Talence, France, CNRS, Université de Bordeaux, ICMCB, 87 Avenue du Dr Schweitzer, F-33608 Pessac, France
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ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanical Engineering, Mechanics of Materials
Keywords: Glasses, Infrared spectroscopy, Luminescence, Luminescence and optical properties, Photoelectron spectroscopy
DOIs:
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Source: Scopus
Source ID: 84927652209
Research output: Contribution to journal › Article › Scientific › peer-review

Improving the thermal performance of concrete-sandwich envelopes in relation to the moisture behaviour of building structures in boreal conditions
The excellent thermal performance and low cost of concrete-sandwich walls have made them widely applied in residential buildings. However, their standard composition may require additional insulation in boreal and arctic climates, where improvements in thermal insulation are achieved mainly by applying additional insulation layers on the envelope surface. Although thick insulation will substantially improve the heat capacity of a structure, elevated temperatures and entrapped humidity can lead to favourable conditions for the initiation of mould growth. The present study simulates the thermal performance of a model house wall structure in relation to increased mould growth risk. The results indicate that added insulation may have a negative impact not only on the structure and material properties of structural elements, but also on the environmental health and comfort of residents. Furthermore, climate conditions are shown to be a significant factor in identifying an optimal insulation design based on thermal performance and structural health.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), University of Oulu, Structural Engineering and Construction Technology, Ita-Suomen yliopisto
Contributors: Fedorik, F., Malaska, M., Hannila, R., Haapala, A.

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Publication date: 15 Nov 2015
Peer-reviewed: Yes

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Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Concrete sandwich, Energy efficiency, Heat and mass transfer, Mould growth, Renovation building, Structural health
DOIs:

10.1016/j.enbuild.2015.08.020
Source: Scopus
Source ID: 84953403315
Research output: Contribution to journal › Article › Scientific › peer-review

Differential basal-to-apical accessibility of lamin A/C epitopes in the nuclear lamina regulated by changes in cytoskeletal tension
Nuclear lamins play central roles at the intersection between cytoplasmic signalling and nuclear events. Here, we show that at least two N- and C-terminal lamin epitopes are not accessible at the basal side of the nuclear envelope under environmental conditions known to upregulate cell contractility. The conformational epitope on the Ig-domain of A-type lamins is more buried in the basal than apical nuclear envelope of human mesenchymal stem cells undergoing osteogenesis (but not adipogenesis), and in fibroblasts adhering to rigid (but not soft) polyacrylamide hydrogels. This structural polarization of the lamina is promoted by compressive forces, emerges during cell spreading, and requires lamin A/C multimerization, intact nucleoskeleton-cytoskeleton linkages (LINC), and apical-actin stress-fibre assembly. Notably, the identified Ig-epitope overlaps with emerin, DNA and histone binding sites, and comprises various laminopathy mutation sites. Our findings should help decipher how the physical properties of cellular microenvironments regulate nuclear events.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Laboratory of Applied Mechanobiology, HCI e 486.1
Contributors: Ihalainen, T. O., Aires, L., Herzog, F. A., Schwartlander, R., Moeller, J., Vogel, V.
Number of pages: 10
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Scopus rating (2015): CiteScore 59.3 SJR 16.382 SNIP 8.97
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Condensed Matter Physics, Materials Science(all), Chemistry(all)
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10.1038/nmat4389
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Source: Scopus
Source ID: 84947870719
Research output: Contribution to journal › Article › Scientific › peer-review

Comparative environmental impacts of additive and subtractive manufacturing technologies

Additive manufacturing technologies are opening new opportunities in term of production paradigm and manufacturing possibilities. Nevertheless, in term of environmental impact analysis supplementary research works require to be made in order to compare and evaluate them with traditional manufacturing processes. In this article, we propose to use Life Cycle Assessment (LCA) method and to associate decision criteria to support the selection of manufacturing strategies for an aeronautic turbine. The dimensionless criteria allow to define environmental trade-offs between additive and subtractive methods. This study provides an approach generalizable to other parts and processes.

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
Contributors: Paris, H., Mokhtarian, H., Coatanéa, E., Museau, M., Ituarte, I. F.
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Publication information

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ISSN (Print): 0007-8506
Ratings:

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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Industrial and Manufacturing Engineering
Keywords: Electron beam machining, Energy efficiency, Environment
DOIs:

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Source: Scopus
Source ID: 84969528922
Research output: Contribution to journal › Article › Scientific › peer-review

Development and numerical implementation of an anisotropic continuum damage model for concrete

In this paper, a thermodynamic formulation for modelling anisotropic damage of elasticbrittle materials based on Ottosen's 4-parameter failure surface is proposed. The model is developed by using proper expressions for Gibb's free energy and the complementary form of the dissipation potential. The formulation predicts the basic characteristic behaviour of concrete well and results in a realistic shape for the damage surface.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems, VTT Technical Research Centre of Finland , Aalto University
Contributors: Hartikainen, J., Kolari, K., Kouhia, R.
Number of pages: 4
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
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Bibliographical note
EXT="Hartikainen, Juha"
JUFOID=62253
Source: Scopus
Source ID: 84990191389
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

DIC measurements of the human heart during cardiopulmonary bypass surgery
Image-based measurements of the deformation of the human heart can be very useful to the surgeon, when assessing the condition and functioning of the patient's heart. Digital image correlation can provide fast and accurate information about the deformation and motion of the surface of the heart. The deformation measurements can be visualized with colors allowing easy interpretation of the results, which makes this technique even more suitable for use in the operating room. Digital image correlation, however, requires either a natural or an artificial surface pattern with high contrast. The surface of the heart is wet, smooth, and has only a minimal contrast pattern, which cannot easily be improved with artificial markers. This preliminary feasibility study, however, shows that despite the practical and theoretical problems, DIC can provide useful data on the deformation of the human heart during cardiopulmonary bypass surgery. The results show that the natural patterns of the right atrium and ventricle are sufficient for DIC analysis, but significantly better results could be obtained with higher contrast artificial patterns.

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Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Materials Characterization, Universitätsklinikum Gießen und Marburg GmbH, LaVision GmbH
Contributors: Hokka, M., Mirow, N., Nagel, H., Vogt, S., Kuokkala, V.
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Publication date: 2016

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ASJC Scopus subject areas: Engineering(all), Computational Mechanics, Mechanical Engineering
Keywords: Digital Image Correlation, Human heart, In-vivo measurements, Natural pattern
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JUFOID=72540
Source: Scopus
Source ID: 84952003607
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Effects of added glazing on Balcony indoor temperatures: Field measurements
In this study the temperatures on 22 balconies (17 glazed) and adjacent flats were monitored with an aim to determine the key factors affecting the ability of a glazed balcony to warm up and remain warm without a heater. Considered were glazed balconies in different locations, the amount of glazing and building heat loss, the tightness of balcony vertical structures, and balcony ability to capture solar radiation. Temperature monitoring showed that over a year the air temperature of both glazed and unglazed balconies remained almost without an exception above the outdoor air temperature. On average, the temperatures of unglazed balconies were 2.0 °C and those of glazed balconies 5.0 °C higher than the outdoor air temperature. The three key factors affecting the glazed balcony temperatures seemed to be the level of air leakage in the balcony vertical structures, the balcony's ability to capture solar radiation, and the heat gain from an adjacent flat, in that order. The air tightness of the glazing was the most crucial factor, since it affected the results all the year round. Solar radiation was important from spring to autumn and heat gain in midwinter.

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Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Research group: Building Physics
Contributors: Hilliaho, K., Köliö, A., Pakkala, T., Lahdensivu, J., Vinha, J.
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Source: Scopus
Source ID: 84978370516
Research output: Contribution to journal › Article › Scientific › peer-review

End-plate connections in Bi-axial bending - Measurements

In this paper we consider the measurements of bolted end-plate connections of tubular beams with cold-formed hollow rectangular aluminium sections. The motivation for these measurements originates from the fact that the aluminium standard (EN 1999-1-1) [1] does not cover the design of this very frequently used type of connection, where the bolts are located outside the edge-lines of the cross-section, i.e. corner bolts. Many tests and studies regarding this area have been conducted, but this paper brings value to the case where bi-axial bending is applied. The measurements have been carried out and the detailed results shall be shown. In this paper, we will focus on the six measurements where the tubular beams were bent uniaxially and biaxially to these limit points. The tests were stopped when the ultimate limit state was reached. In this case the connection never actually broke, but effectively the joint had lost its load bearing capacity. Some residual capacity still remained, but the displacements were too great resulting in a totally different behavior of the connection. The behavior of this connection is highly non-linear, since aluminium (AW 5754) as a material is strain hardening and the mechanism in the connection changes as the displacements increase.

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MoE publication type: A4 Article in a conference publication
Organisations: Department of Civil Engineering, Research group: Structural Mechanics
Contributors: Mäkinen, J., Fränti, K., Korhonen, M., Fillion, J., Heinisuo, M.
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Pages: 275-280
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
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Bibliographical note
INT=rak,"Fränti, Keijo"
INT=rak,"Korhonen, Matti"
JUFOID=62253
Source: Scopus
Source ID: 84989839177
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nanoscale barrier coating on BOPP packaging film by ALD

General information
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MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Paper Converting and Packaging
Contributors: Lahti, J.
Number of pages: 13
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ISBN (Electronic): 9781510823563
ASJC Scopus subject areas: Media Technology, Mechanical Engineering, Materials Science(all), Chemistry(all), Chemical Engineering(all)
Source: Scopus
Source ID: 84981736600
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Normal displacements in non-Coulomb friction conditions during fretting
Non-Coulomb friction may occur in gross sliding fretting conditions, in which the tangential force increases as the fretting movement approaches its extreme position and produces 'hooked' fretting loops. Uncertainties in frictional behaviour make the design of highly loaded contacts against fretting a challenging task. Experiments were made with quenched and tempered steel, and cyclic normal displacements were discovered during non-Coulomb friction conditions. Normal displacement and non-Coulomb friction were caused by tangential fretting scar interactions between protrusions and depressions formed by material transfer. Tangential interlocking leads to inclined sliding conditions, which produce loading components in both tangential and normal directions; this explains most non-Coulomb friction.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Tribology and Machine Elements, Research and Development, Wärtsilä Finland
Contributors: Hintikka, J., Lehtovaara, A., Mäntylä, A.
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ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
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DOIs:

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Source: Scopus
Source ID: 84946600355
Research output: Contribution to journal › Article › Scientific › peer-review

Wear and impact behaviour of High Velocity Air-Fuel sprayed Fe-Cr-Ni-B-C alloy coatings

The tribological properties of High Velocity Air-Fuel sprayed Fe-31Cr-12Ni-3.6B-0.6C (wt%) coatings are studied as a function of the deposition parameters. At room temperature, ball-on-disk sliding against Al_2O_3 is controlled by abrasive grooving and interlamellar cracking, with some tribo-oxidation. Interlamellar crack propagation also controls the coatings response to cavitation erosion and cyclic impact tests. Coatings deposited with higher powder feed rate exhibit poorer performance under all conditions, because of weaker interlamellar cohesion. At 700 °C, sliding wear rates are levelled out, and they are one order of magnitude higher than at room temperature, because of severe abrasive grooving.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, University of Modena and Reggio Emilia
Contributors: Bolelli, G., Milanti, A., Lusvarghi, L., Trombi, L., Koivuluoto, H., Vuoristo, P.
Pages: 372-390
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Early online date: 30 Nov 2015

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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Cavitation damage, Impact wear, Sliding contact, Thermally-sprayed coating
DOIs:

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Source: Scopus
Source ID: 84949804098
Research output: Contribution to journal › Article › Scientific › peer-review

Static friction measurements on steel against uncoated and coated cast iron

Static friction is a phenomenon we may mainly consider as related to frictional joints within static mechanics. The step from static friction to tribological phenomena is, however, rather short, since at the onset of sliding in a mechanical contact, the static friction determines the initial resistance against motion. Static friction furthermore plays a role in contacts subjected to traction and fretting. Although being a phenomenon of short duration, the tribological phenomena during the transition from static friction to sliding friction may be of great importance for the operational life of the contact surfaces, particularly if the procedure is repeated for a sufficient number of times. The present paper describes the principles of static friction measurements, details of the employed static friction tribometer and the results of measurements with unlubricated and lubricated sliding couples consisting of steel against uncoated and coated cast iron.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Tribology and Machine Elements, Department of Materials Science, VTT Technical Research Centre of Finland
Contributors: Andersson, P., Kilpi, L., Holmberg, K., Vaajoki, A., Oksanen, V.
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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Friction transitions, Sliding friction, Static friction, Tribometer
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URLs:

http://www.scopus.com/inward/record.url?scp=85046147878&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 85046147878
Research output: Contribution to journal › Article › Scientific › peer-review

Chemical synthesis of WC-Co from water-soluble precursors: The effect of carbon and cobalt additions to WC synthesis
The chemical synthesis of WC-Co from water-soluble precursors and the effect of carbon content and cobalt addition were studied. Ammonium metatungstate AMT as tungsten source, glycine as a carbon source and cobalt acetate $Co(C_2H_3O_2)_2$ as a cobalt source was dissolved in water and spray-dried, and thermal synthesis in Ar atmosphere was performed. In order to understand the effects of carbon content and cobalt addition on synthesis steps, and the chemical and phase structure, thermogravimetry (TGA) with Differential Scanning Calorimetry (DCS) and mass spectrometry was used together with X-ray diffractometry and chemical analysis. The results reveal that carbon content mainly affected reduction temperatures and cobalt addition to reaction route and solid state synthesis temperature. This presented manufacturing route with water-soluble raw materials was a potential way of preparing nanostructural WC-Co composition with the correct phase structure and chemical composition.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland
Contributors: Kanerva, U., Karhu, M., Lagerbom, J., Kronlöf, A., Honkanen, M., Turunen, E., Laitinen, T.
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Pages: 69-75
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Volume: 56
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Scopus rating (2016): CiteScore 4.3 SJR 1.065 SNIP 1.736
Original language: English
ASJC Scopus subject areas: Ceramics and Composites, Materials Chemistry, Metals and Alloys, Mechanical Engineering , Mechanics of Materials
Keywords: Nano-sized WC-Co synthesis, Spray drying, Water soluble precursors
DOIs:

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Bibliographical note
EXT="Kanerva, Ulla"
EXT="Lagerbom, Juha"
Source: Scopus
Source ID: 84952359921
Research output: Contribution to journal › Article › Scientific › peer-review

Influence of specimen type and reinforcement on measured tension-tension fatigue life of unidirectional GFRP laminates
It is well known that standardised tension-tension fatigue test specimens of unidirectional (UD) glass-fibre-reinforced plastics (GFRP) laminates tend to fail at end tabs. The true fatigue life is then underestimated. The first objective of this study was to find for UD GFRP laminates a test specimen that fails in the gauge section. The second objective was to compare fatigue performance of two laminates, one having a newly developed UD powder-bound fabric as a reinforcement and the other having a quasi-UD stitched non-crimp fabric as a reinforcement. In the first phase, a rectangular specimen in accordance with the ISO 527-5 standard and two slightly different dog-bone shaped specimens were evaluated by means of finite element modelling. Subsequent comparative fatigue tests were performed for the laminates with the three specimen types. The results showed that the test specimen type has a significant effect on the failure mode and measured fatigue life of the laminates. A significantly higher fatigue life was measured for the laminate with the powder-bound fabric reinforcement when compared to the laminate with the stitched reinforcement.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Aalto University, Risø Campus
Contributors: Korkiakoski, S., Brøndsted, P., Sarlin, E., Saarela, O.
Number of pages: 16
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ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all), Modelling and Simulation
Keywords: Fatigue test methods, Polymer matrix composites, S-N curves, Specimen design, Unidirectional laminate
DOIs:

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Source: Scopus
Source ID: 84954185653
Research output: Contribution to journal › Article › Scientific › peer-review

Effects of strain rate and confining pressure on the compressive behavior of Kuru granite
Understanding the influence of hydrostatic pressure and loading rate on the strength and fracture behavior of rocks is very important for the development of deep drilling technology. This paper presents a systematic study on the mechanical properties and behavior of Kuru Gray granite at confining pressures up to 225 MPa and at strain rates of 10^{-6} s^{-1} and 600 s^{-1}. The low strain rate compression tests were carried out with a servo-controlled hydraulic testing machine with a radial confining chamber, and the dynamic tests with a special split Hopkinson pressure bar device with axial and radial confining pressure chambers. The results show that the rock strength increases significantly with strain rate and confining pressure. At confinements below 20 MPa, the strength of the material increases faster at the higher strain rate, but at confinements higher than this, the effect of confining pressure is stronger at the lower strain rate. The strain rate sensitivity increases when even a small confining pressure is applied. However, the rate sensitivity remains rather constant when the confining pressure is increased above 10 MPa. The parameters of the Hoek-Brown model and an alternative power-law model were calibrated for low and high rate data. Also, the fracture behavior of the rock was found to be strongly dependent on strain rate and confining pressure. At the low strain rate, the samples fail by axial splitting in the unconfined tests, whereas the dynamic unconfined tests result in a complete pulverization of the samples. At high confining pressures the fracture behavior is shear fracture for both studied strain rates.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, School of Aeronautics and Astronautics and Materials Engineering, Purdue University, Department of Geology and Mineral Resources Engineering, Norwegian Univ. of Sci. and Technol., Materials and Chemistry, SINTEF
Contributors: Hokka, M., Black, J., Tkalich, D., Fourmeau, M., Kane, A., Hoang, N. H., Li, C. C., Chen, W. W., Kuokkala, V.
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Publication date: 1 May 2016
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Civil and Structural Engineering, Aerospace Engineering, Automotive Engineering, Ocean Engineering, Safety, Risk, Reliability and Quality

Keywords: Confining pressure, Granite rock, High strain rate, Split Hopkinson pressure bar, Triaxial loading
DOIs:
10.1016/j.ijimpeng.2016.01.010
Source: Scopus
Source ID: 84957603545
Research output: Contribution to journal › Article › Scientific › peer-review

Improving the toughness of thermally sprayed Cr_3C_2-NiCr hardmetal coatings by laser post-treatment

Thermally sprayed hardmetal coatings typically exhibit a pronounced embrittlement of the metallic binder matrix due to carbide dissolution during the deposition process. This characteristic renders the coatings prone to wear by brittle fracture, which lays at the core of many relevant wear phenomena. The present work introduces laser post-treatments as a suitable means of "curing" the microstructure of high-velocity oxygen-fuel sprayed Cr_3C_2-NiCr coatings from this spray-process induced deterioration. While operating well below the remelting threshold, the essential impact of the laser-generated heat flux is precipitation of secondary chromium-carbides from the supersaturated binder matrix. The concomitant transition from a solid-solution to a precipitation-hardened phase significantly increases the fracture toughness of the binder matrix and renders the coatings more resistant against mechanical wear. In the present work, the microstructural modifications of the coatings upon laser post-treatments were investigated by means of scanning electron microscopy and microhardness probing, and the corresponding impact on the abrasive wear resistance was tested under both high- and low-stress conditions. Major improvements of the high-stress abrasive wear resistance by up to a factor of three were determined and discussed in the context of the microstructure of the wear scars.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, AC2T Research GmbH
Contributors: Janka, L., Norpoth, J., Eicher, S., Rodríguez Ripoll, M., Vuoristo, P.
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Peer-reviewed: Yes

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ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: Abrasive wear, Cr C -NiCr, HVOF, Laser post-treatment
DOIs:
10.1016/j.matdes.2016.03.007
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Research output: Contribution to journal › Article › Scientific › peer-review

Toward the Atomically Abrupt Interfaces of SiO_x/Semiconductor Junctions

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Contributors: Kuzmin, M., Laukkanen, P., Mäkelä, J., Yasir, M., Tuominen, M., Dahl, J., Punkkinen, M. P. J., Kokko, K., Hedman, H. P., Moon, J., Punkkinen, R., Lastusaari, M., Polojärvi, V., Korpijärvi, V., Guina, M.
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Ratings:

Scopus rating (2016): CiteScore 3.7 SJR 1.545 SNIP 0.906
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials
Keywords: Interface reactions, Oxide films, Semiconductors, Spectroscopic methods, Transistors
DOIs:

10.1002/admi.201500510
Source: Scopus
Source ID: 84959559248
Research output: Contribution to journal › Article › Scientific › peer-review

High-order lattice-Boltzmann

Unlike conventional CFD methods, the lattice Boltzmann method (LBM) describes the dynamic behaviour of physical systems in a mesoscopic scale, based on discrete forms of kinetic equations. In addition to the classical collision-propagation scheme in which the physical and velocity spaces are coupled, finite-differences, finite volumes and finite-element schemes have been used for numerically solving the discrete kinetic equations. A major breakthrough in LB theory was the direct derivation of the LB equation from continuous kinetic equations, establishing a systematic link between the kinetic theory and the lattice Boltzmann method and determining the necessary conditions for the discretization of the velocity space. The lattices obtained by this method proved to be stable in flows over a wide range of parameters, by the use of high-order lattice Boltzmann schemes, leading to velocity sets which, when used in a discrete velocity kinetic scheme, ensures accurate recovery of the high-order hydrodynamic moments. This review presents the theoretical background of these kinetic methods. In particular, we focus on high-order discrete forms of the Boltzmann equation suitable for non-ideal fluids and on the lattice-Boltzmann collision-propagation method.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Physics, Federal University of Santa Catarina, State University of Santa Catarina
Contributors: Philippi, P. C., Siebert, D. N., Hegele, L. A., Mattila, K. K.
Number of pages: 19
Pages: 1401-1419
Publication date: 1 Jun 2016
Peer-reviewed: Yes

Publication information

Journal: Journal of the Brazilian Society of Mechanical Sciences and Engineering
Volume: 38
Issue number: 5
ISSN (Print): 1678-5878
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering
Keywords: Computational fluid dynamics, Kinetic methods, lattice-Boltzmann, Mesoscopic modelling
DOIs:

10.1007/s40430-015-0441-2

Bibliographical note

INT=fys,"Mattila, K. K."
Source: Scopus
Source ID: 84969570355
Research output: Contribution to journal › Article › Scientific › peer-review

The role of niobium in improving toughness and corrosion resistance of high speed steel laser hardfacings

Hardfacing by laser provides a cost-effective option for protecting components against mechanical wear and corrosion. In the present work, high speed steel hardfacings were deposited using a high-power direct diode laser with the aim of investigating the role of niobium content on their mechanical and corrosion properties. The content of niobium was varied between 0.1 and 3 wt%. The results show that niobium content has a high impact on the hardfacing microstructure and its resulting mechanical properties. In particular, niobium is able to significantly enhance the abrasive wear resistance of high speed steel laser hardfacings. This improvement is accompanied by a superior corrosion resistance. The impact of niobium content on slurry erosion resistance is less remarkable and a clear benefit can only be achieved by microalloying. These results are correlated with the microstructural changes induced by the varying niobium content. An increase in niobium content reduces the amount of carbides found along the grain boundaries, raises the amount of chromium dissolved in the iron matrix and increases the elastic strain to failure of the hardfacing. This results as a consequence in high speed steel laser hardfacings with superior toughness and enhanced corrosion resistance.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Paper Converting and Packaging Technology, TU Vienna, AC2T research GmBH (Australian Excellence Center for Tribology), Wiener Neustadt, Itävalta, Viktor-Kaplan-Straße 2/C
Contributors: Rodríguez Ripoll, M., Ojala, N., Katsich, C., Totolin, V., Tomastik, C., Hradil, K.
Number of pages: 12
Pages: 509-520
Publication date: 5 Jun 2016
Peer-reviewed: Yes

Publication information
Journal: Materials and Design
Volume: 99
ISSN (Print): 0264-1275
Ratings:

Scopus rating (2016): CiteScore 7.4 SJR 1.76 SNIP 2.547
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: Corrosion, High speed steel, Niobium, Toughness, Wear
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URLs:

http://urn.fi/URN:NBN:fi:tty-201605133983
Source: Scopus
Source ID: 84961627531
Research output: Contribution to journal › Article › Scientific › peer-review

Spontaneous formation of three-dimensionally ordered Bi-rich nanostructures within $GaAs_{1-x}Bi_x$/GaAs quantum wells

In this work, we report on the spontaneous formation of ordered arrays of nanometer-sized Bi-rich structures due to lateral composition modulations in Ga(As,Bi)/GaAs quantum wells grown by molecular beam epitaxy. The overall microstructure and chemical distribution is investigated using transmission electron microscopy. The information is complemented by synchrotron x-ray grazing incidence diffraction, which provides insight into the in-plane arrangement. Due to the vertical inheritance of the lateral modulation, the Bi-rich nanostructures eventually shape into a three-dimensional assembly. Whereas the Bi-rich nanostructures are created via two-dimensional phase separation at the growing surface, our results suggest that the process is assisted by Bi segregation which is demonstrated to be strong and more complex than expected, implying both lateral and vertical (surface segregation) mass transport. As demonstrated here, the inherent thermodynamic miscibility gap of Ga(As,Bi) alloys can be exploited to create highly uniform Bi-rich units embedded in a quantum confinement structure.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Hausvogteiplatz 5-7
Contributors: Luna, E., Wu, M., Hanke, M., Puustinen, J., Guina, M., Trampert, A.
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Peer-reviewed: Yes

Publication information
Journal: Nanotechnology
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Article number: 325603
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Scopus rating (2016): CiteScore 5.8 SJR 1.339 SNIP 0.982
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Electrical and Electronic Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: GaAsBi, phase separation and segregation, self organization, TEM

DOIs:
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Bibliographical note
EXT="Wu, M."
Source: Scopus
Source ID: 84978884196
Research output: Contribution to journal › Article › Scientific › peer-review

Framework and feasibility study for pairwise comparison tool
In design and engineering context, the use of tools, simulations and multi-realities is already an intrinsic part of design activities, methods and processes. To support participatory design during the ideation phase in a co-creative context, participative tools are needed. User-centered and co-creative design could benefit product creation and innovation process through data-collection (incl. product characteristics and user requirements) from individual data-mining activities. The traditional approach for customer requirements prioritization is pair-wise comparison. It is used both in the QFD method and in the Pugh matrix method. In practice, this means that a user compares two product characteristics at a time and decides which one of the two is more important or if they are equally important. Determining a suitable user interface for the comparison has proven to be the most demanding phase in the implementation of this method. This paper presents alternative ways to implement a customer property tool and discusses experiences with some of its implementations. In the first version, the interface is based on the use of numbers, whereas the last version is more visual, interactive and game-like. The feasibility of the tool was studied in user tests carried out in Finland and in the Netherlands.

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Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Design, Development and LCM, University of Twente, University of Tampere
Contributors: Ellman, A., Wendrich, R., Tiainen, T.
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Publication date: 21 Aug 2016

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Title of host publication: Proceedings of the ASME 2016 Computers and Information in Engineering Conference IDETC/CIE 2016
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Publisher: ASME
Article number: DETC2016-59886
ISBN (Print): 978-0-7918-5008-4
ASJC Scopus subject areas: Mechanical Engineering
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10.1115/DETC2016-59886
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Barkhausen noise response of three different welded duplex stainless steels
An investigation was made into the Barkhausen noise responses of three duplex grades: a lean alloy LDX 2101, a conventional duplex 2205 and a super duplex 2507, in welded conditions. The aim was to study the influence of alloy chemistry and microstructure on the Barkhausen noise response. In addition, the residual stresses of the grades were measured by X-ray diffraction and the microstructure and hardness of the base materials and welds were determined. It was observed that the Barkhausen noise responses in the rolling direction and in the transverse direction were governed by the phase morphology of the materials. Only the root mean square of the Barkhausen noise burst seemed to be additionally dependent on the alloy chemistry through the hardness of the materials. Furthermore, the relationships between various characteristics of the Barkhausen noise burst measured in the rolling direction and the transverse direction and microstructural features are discussed.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Outotec Research Center
Contributors: Lindgren, M., Santa-aho, S., Vippola, M.
Number of pages: 7
Pages: 480-486
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Peer-reviewed: Yes

Publication information
Journal: Insight
Volume: 58
Issue number: 9
ISSN (Print): 1354-2575
Ratings:

Scopus rating (2016): CiteScore 1.2 SJR 0.354 SNIP 0.624
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Metals and Alloys, Materials Chemistry
Keywords: Barkhausen, Stainless steel, Welds
DOIs:

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Source: Scopus
Source ID: 84985953068
Research output: Contribution to journal › Article › Scientific › peer-review

Solar Panel Breakage During Heavy Rain Caused by Thermal Stress
Solar panels and thermal collectors are increasingly popular. There is practical experience of large numbers of solar panel glasses being broken during heavy rain. The present paper studies the role of mean heat transfer between rain and the glass on the breaking. Thin tempered glass is preferred for its low weight, durability, and good optical quality. However, thin glass tempering is expensive and by understanding relevant stresses costs can be avoided. The heat transfer between a solid surface and rain is studied experimentally using a hot copper block and free falling drops. The thermal stresses are solved using a one-dimensional theory and the measured mean heat transfer coefficient.
The thermal stresses depend on rain rate, surface inclination, glass thickness and temperature difference. The results show that, expect for word record approaching rain rates, the thermal stresses are below 10 MPa. A non-heat treated soda-lime glass should withstand this stress without breaking. The
used rain rates were R = 1100, 340, 110 mm/h and the maximum mean heat transfer coefficients h = 600, 250, 140 W/m 2 K, respectively. All else being equal, the maximum mean heat transfer was observed for surfaces that were inclined 15° from horizontal. Based on the results in the present paper
the mean rain heat transfer causes no need to temper soda-lime glass to be use in solar panels. However, one should remember that thermal stresses must be added to all the other stresses.

General information
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MoE publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, Research area: Design, Development and LCM
Contributors: Mikkonen, A., Karvinen, R.
Publication date: Oct 2016

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Title of host publication: Engineered Transparency 2016 : Glass in Architechture and Structural Engineering
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ASJC Scopus subject areas: Civil and Structural Engineering, Mechanical Engineering
Keywords: Thermal stress, heat transfer, rain, experimental, one-dimensional
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A comparison of relative displacement fields between numerical predictions and experimental results in fretting contact
In this paper, a comparison is made between calculated and measured displacements from a complete contact fretting test device. An experimental technique based on digital image correlation was used to measure the local displacement field at the contact interface. The material of the fretting specimen and pads was quenched and tempered steel. The effect of test device compliances and rigid body movement was minimized by measuring displacements very close to the contact interface. The measured displacements were successfully compared to the computed displacements of a corresponding finite element model. The relative slip amplitude in partial slip conditions, slip distribution across the contact, length of the

slip region, and accumulated slip distribution, were compared. Relative slip decreases markedly with increasing normal load and friction coefficient. The friction coefficient was calibrated and determined as a function of loading cycles of fretting fatigue tests with two normal loads. The friction coefficient was found to increase at the beginning of tests and stabilize after about 1000 cycles, which is in agreement with general observations.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Tribology and Machine Elements, Wärtsilä Finland Oy
Contributors: Juoksukangas, J., Lehtovaara, A., Mäntylä, A.
Number of pages: 15
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Publication date: 1 Oct 2016
Peer-reviewed: Yes

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Volume: 230
Issue number: 10
ISSN (Print): 1350-6501
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Scopus rating (2016): CiteScore 2.2 SJR 0.691 SNIP 0.944
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Digital image correlation, finite element method, friction coefficient, relative displacement, slip
DOIs:

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Source: Scopus
Source ID: 84987650902
Research output: Contribution to journal › Article › Scientific › peer-review

Consideration of energy consumption, energy costs, and space occupancy in Finnish daycare centres and school buildings
The building sector contributes up to 30% of global annual greenhouse gas emissions and consumes up to 40% of all energy. Failure to encourage energy-efficiency and low-carbon in new builds or retrofitting will lock countries into the disadvantages of poor performing buildings for decades. The journey towards low-carbon and energy efficient buildings starts with good design, commissioning and measuring. The share of energy costs can be up to 50% of all maintenance costs [7] in Finland. In the studied buildings the average costs were 39% for daycare centres and 45% for schools. Since the share of energy costs is remarkable in maintenance, it is important to find out the most concrete indicators to measure energy efficiency in practice. This study explores ways in which building usage and occupancy influences the energy cost in Finnish daycare centres and school buildings. This study shows that energy costs vary a lot between different energy efficiency indicators, i.e. there is great variation in energy costs regardless of the building age and when child or student density varies. Results indicated that actual use of space is profiled in the operational phase where the energy costs variation is remarkable.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Civil Engineering, Aalto University, VTT Technical Research Centre of Finland
Contributors: Sekki, T., Andelin, M., Airaksinen, M., Saari, A.
Number of pages: 8
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Publication date: 1 Oct 2016
Peer-reviewed: Yes

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Journal: Energy and Buildings
Volume: 129
ISSN (Print): 0378-7788
Ratings:

Scopus rating (2016): CiteScore 6.6 SJR 2.055 SNIP 1.969
Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Daycare centres, Energy consumption, Energy costs, Occupation, Schools

DOIs:
10.1016/j.enbuild.2016.08.015
Source: Scopus
Source ID: 84982834048
Research output: Contribution to journal › Article › Scientific › peer-review

The effect of initial microstructure on the final properties of press hardened 22MnB5 steels

This paper addresses the relationship between initial microstructure and final properties of press hardened 22MnB5 steels. Four commercial 22MnB5 steels having different initial microstructures were investigated. An experimental press hardening equipment with a flat-die was used to investigate material behavior in the direct press hardening process. Two austenitizing treatments, 450 s and 180 s at 900 °C, were examined. Microstructural characterization with optical and scanning electron microscopes revealed a mixture of martensite and auto-tempered martensite after press hardening. Electron backscatter diffraction data of the transformed martensite was used to reconstruct grain boundary maps of parent austenite. Grain sizes of parent austenite (mean linear intercept) were measured for each material. In addition to microstructural evaluation, quasistatic and high strain rate tensile tests at strain rates of 5×10^{-4} s^{-1} and 400 s^{-1}, respectively, were performed for press hardened samples. The results show that strength and uniform elongation depend on the initial microstructure of the 22MnB5 steel, when parameters typical to the direct press hardening process are used. Parent austenite grain size was shown to influence the morphology of the transformed martensite, which in turn affects the strength and uniform elongation after press hardening. The tensile properties of the press hardened materials are almost strain rate independent in the studied strain rate range. The obtained results can be used to optimize the properties of 22MnB5 steels in the direct press hardening process. In addition, the here revealed connection between the parent austenite grain size and final steel properties should be taken into account in the development of new press hardening steel grades for automotive industry.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Metals Technology, SSAB
Contributors: Järvinen, H., Isakov, M., Nyyssönen, T., Järvenpää, M., Peura, P.
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Publication date: 31 Oct 2016
Peer-reviewed: Yes

Publication information
Journal: Materials Science and Engineering A: Structural Materials Properties Microstructure and Processing
Volume: 676
ISSN (Print): 0921-5093
Ratings:
Scopus rating (2016): CiteScore 5.5 SJR 1.669 SNIP 1.913
Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering
Keywords: EBSD, Grain boundaries, Grain growth, Hardening, Mechanical characterization, Steel
DOIs:
10.1016/j.msea.2016.08.096
Source: Scopus
Source ID: 84984819717
Research output: Contribution to journal › Article › Scientific › peer-review

Experimental and numerical investigation of fretting fatigue behavior in bolted joints

Bolted joints may suffer from fretting damage which can significantly decrease fatigue life. A testing arrangement was developed to study the effect of different operating and design parameters of a single bolted joint on fretting fatigue life. Fretting fatigue stress-life (S-N) tests were conducted to investigate in particular the effect of bolt preload and cyclic bulk loading on fatigue life. Fretting fatigue life decreased when increasing the preload and also when increasing the bulk stress. The Digital Image Correlation method was applied to measure tangential displacements close to the contact. A corresponding finite element model of the test setup was used to analyze contact variables in greater detail. The numerical results corresponded well to the experimental results.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Tribology and Machine Elements, Department of Materials Science, Wärtsilä Finland Oy
Contributors: Juoksukangas, J., Lehtovaara, A., Mäntylä, A.

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Volume: 103
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Ratings:

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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Contact, Fatigue, Finite-element method, Fretting
DOIs:

10.1016/j.triboint.2016.07.021

Bibliographical note
INT=MOL, "Juoksukangas, Janne"
Source: Scopus
Source ID: 84981164556
Research output: Contribution to journal › Article › Scientific › peer-review

Multicriteria selection in concept design of a divertor remote maintenance port in the EU DEMO reactor using an AHP participative approach
The work behind this paper took place in the Eurofusion remote maintenance system project (WPRM) for the EU Demonstration Fusion Power Reactor (DEMO). Following ITER, the aim of DEMO is to demonstrate the capability of generating several hundreds of MW of net electricity by 2050. The main objective of this paper was the study of the most efficient design of the maintenance port for replacing the divertor cassettes in a Remote Handling (RH) point of view. In DEMO overall design, one important consideration is the availability and short down time operations. The inclination of the divertor port has a very important impact on all the RH tasks such as the design of the divertor mover, the divertor locking systems and the end effectors. The current reference scenario of the EU DEMO foresees a 45° inclined port for the remote maintenance (RM) of the divertor in the lower part of the reactor. Nevertheless, in the optic of the systems engineering (SE) approach, in early concept design phase, all possible configurations shall be taken into account. Even the solutions which seem not feasible at all need to be investigated, because they could lead to new and innovative engineering proposals. The different solutions were compared using an approach based on the Analytic Hierarchy Process (AHP). The technique is a multi-criteria decision making approach in which the factors that are important in making a decision are arranged in a hierarchic structure. The results of these studies show how the application of the AHP improved and focused the selection on the concept which is closer to the requirements arose from technical meetings with the experts of the RH field.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, ENEA/CREATE/Università Degli Studi Napoli Federico II, VTT Technical Research Centre of Finland, ENEA Brasimone
Contributors: Carfora, D., Gironimo, G. D., Esposito, G., Huhtala, K., Määttä, T., Mäkinen, H., Miccichè, G., Mozzillo, R.
Number of pages: 8
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Peer-reviewed: Yes

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ISSN (Print): 0920-3796
Ratings:

Scopus rating (2016): CiteScore 2.3 SJR 0.579 SNIP 1.022
Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Materials Science(all), Nuclear Energy and Engineering, Mechanical Engineering
Keywords: AHP, Concept design, DEMO, Remote handling, Systems engineering
DOIs:

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Source ID: 84994060921
Research output: Contribution to journal › Article › Scientific › peer-review

Digital hydraulic multi-pressure actuator – the concept, simulation study and first experimental results

The decentralisation of hydraulic systems is a recent trend in industrial hydraulics. Speed variable drive is one concept where an actuator is driven by an integrated pump, thus removing the need for control valves or complex centralised variable displacement hydraulic units and long pipelines. The motivation for the development is the need to improve the energy efficiency and flexibility of drives. A similar solution to mobile hydraulics is not currently available. This paper studies a digital hydraulic approach, which includes a local hydraulic energy storage located together with the actuator, the means to convert efficiently energy from the storage to mechanical work and a small start-/stop-type pump unit sized according to mean power. The simulation results and first experimental results show that the approach has remarkable energy saving potential compared to traditional valve controlled systems, but further research is needed to improve the controllability.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, Aalto University
Contributors: Huova, M., Aalto, A., Linjama, M., Huhtala, K., Lantela, T., Pietola, M.
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Physics and Astronomy(all)
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Electronic versions:

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DOIs:

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URLs:

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Bibliographical note

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Source: Scopus
Source ID: 85016332698
Research output: Contribution to journal › Article › Scientific › peer-review

Dimension reduction and decomposition using causal graph and qualitative analysis for aircraft concept design optimization

With the increasing design dimensionality, it is more difficult to solve Multidisciplinary design optimization (MDO) problems. To reduce the dimensionality of MDO problems, many MDO decomposition strategies have been developed. However, those strategies consider the design problem as a black-box function. In practice, the designers usually have certain knowledge of their problem. In this paper, a method leveraging causal graph and qualitative analysis is developed to reduce the dimensionality of the MDO problem by systematically modeling and incorporating knowledge of the design problem. Causal graph is employed to show the input-output relationships between variables. Qualitative analysis using design structure matrix (DSM) is carried out to automatically find the variables that can be determined without optimization. According to the weight of variables, the MDO problem is divided into two sub-problems, the optimization problem with respect to important variables, and the one with less important variables. The novel method is performed to solve an aircraft concept design problem and the results show that the new dimension reduction and decomposition

method can significantly improve optimization efficiency.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Mechanical Engineering and Industrial Systems, Simon Fraser University
Contributors: Wu, D., Coatanea, E., Wang, G. G.
Publication date: 2017

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Publisher: The American Society of Mechanical Engineers ASME
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ASJC Scopus subject areas: Mechanical Engineering, Computer Graphics and Computer-Aided Design, Computer Science Applications, Modelling and Simulation
Keywords: Aircraft concept design, Causal graph, Dimension reduction, Dimensional analysis, Multidisciplinary design optimization
DOIs:

10.1115/DETC201767601
Source: Scopus
Source ID: 85034658662
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Do properties of bioactive glasses exhibit mixed alkali behavior?
The effect of substituting K_2O for Na_2O on the physical and chemical properties of 15 glasses in the system Na_2O–K_2O–CaO–P_2O_5–SiO_2 was studied for three series: low (52 mol% SiO_2), medium (60 mol% SiO_2) and high (66 mol% SiO_2) silica. The SiO_2 content expressed as weight-% varied from 46 to 64 wt%, thus suggesting that the compositions were either bioactive or biocompatible. The crystallization tendency and sintering behavior were studied using differential thermal analysis and hot stage microscopy. Formation of silica- and hydroxy-apatite-rich layers were studied for glass plates immersed in static simulated body fluid. The release of inorganic ions into Tris buffer solution was analyzed using inductively coupled plasma optical emission spectrometer in dynamic and static conditions. Substitution of K_2O for Na_2O suggested mixed alkali effect (MAE) for the thermal properties with a minimum value around 25% substitution. With increased share of K_2O in total alkali oxides, the hot working window markedly expanded in each series. Silica and hydroxyapatite layers were seen only on the low silica glasses, while a thin silica-rich layer formed on the other glasses. In each series, greater dissolution of alkali and alkali earth ions was seen from K-rich glasses. Clear MAE and preferential ion dissolution were recorded for medium and high silica series, while for low silica glasses, the initial MAE dissolution trends become rapidly covered by other simultaneous surface reactions. MAE enables designing especially low silica bioactive glasses for improved hot working properties and medium and high silica glasses for controlled dissolution.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Johan Gadolin Process Chemistry Centre, Abo Akademi University, Paroc Group Oy
Contributors: Wang, X., Fagerlund, S., Massera, J., Södergård, B., Hupa, L.
Number of pages: 12
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Peer-reviewed: Yes
Early online date: 22 Feb 2017

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Issue number: 15
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
DOIs:

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Source: Scopus
Source ID: 85013499798
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of finish rolling and quench stop temperatures on impact-abrasive wear resistance of 0.35 % carbon direct-quenched steel

Novel high-hardness medium-carbon martensitic laboratory steel has been produced and tested for abrasive wear resistance. Different finish rolling temperatures (FRT) combined with either direct quenching (DQ) or interrupted quenching to 250 °C was applied to vary the content of retained austenite and hardness. The steel carbon content was set to 0.35 % to obtain a surface hardness of approximately 600 HB. Lowering the finish rolling temperature in the range 920-780 °C, i.e. into the non-recrystallization regime resulted in a more elongated prior austenite grain structure, which increased the hardness of the DQ variants without any significant loss of Charpy-V impact toughness. Although increasing the degree of autotempering by raising the quench stop temperature reduces the hardness of the martensitic microstructure, it was found that proper quenching stop temperature could be utilized to achieve balanced toughness and hardness properties. Impact-abrasive wear resistance as measured in impeller-tumbler tests with natural granite as the abrasive demonstrated that wear resistance increased with increasing surface hardness.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Univ of Oulu, SSAB
Contributors: Haiko, O., Miettunen, I., Porter, D., Ojala, N., Ratia, V., Heino, V., Kemppainen, A.
Number of pages: 17
Pages: 5-21
Publication date: 2017
Peer-reviewed: Yes

Publication information

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ISSN (Print): 0780-2285
Ratings:

Scopus rating (2017): SJR 0.367 SNIP 2.184
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Hardness, Impact abrasion, Steel, Wear
URLs:

https://journal.fi/tribologia/article/view/59344
Source: Scopus
Source ID: 85039708969
Research output: Contribution to journal › Article › Scientific › peer-review

Heat Transfer of Impinging Jet: Effect of Compressibility and Turbulent Kinetic Energy Production

The effects of air compressibility, viscosity, and turbulent kinetic energy production modeling are studied in the case of round high-speed subsonic
wall impinging jet heat transfer. A vorticity based turbulence kinetic energy production term is implemented in the k-ω-SST model and the implementation is validated with experimental data. Compressible flow model results are compared with incompressible flow model results for more than 80 cases with pressure ratios up to 1.65 (Ma ≈ 0.85). The practical application considered in the present paper is the cooling section of a glass tempering machine. The vorticity based model performs better near stagnation point and second peak. The peak values affect visual quality of tempered glass through residual stresses. Glass initial temperature in the cooling section is about 600 oC and high-speed jets are produced with 1-3 mm nozzles. Validation is done with larger nozzles and slower jets as no suitable experimental data is available. The mean and maximum heat transfer rate resulting from choosing a constant viscosity at glass temperature and using an incompressible flow model differs less than 20 % from the compressible model results with locally modelled viscosity in all the studied cases. All the modeling is done with OpenFOAM and the modified code is published in GitHub.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Chemistry and Bioengineering, Research area: Design, Development and LCM, Mechanical Engineering and Industrial Systems
Contributors: Mikkonen, A., Karvinen, R.
Publication date: 2017

Host publication information

Title of host publication: IX International Conference on Computational Heat and Mass Transfer (ICCHMT 2016)
ISBN (Print): 9781510829237
ASJC Scopus subject areas: Computational Mechanics, Industrial and Manufacturing Engineering, Mechanical Engineering
Keywords: impinging jet, heat transfer, vorticity, turbulence, OpenFOAM, compressibility
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

On the effect of deformation twinning and microstructure to strain hardening of high manganese austenitic steel 3D microstructure aggregates at large strains

The hardening and deformation characteristics of Hadfield microstructure are studied to investigate the effect of microstucture to the material behavior. A crystal plasticity model including dislocation slip and deformation twinning is employed. The role of deformation twinning to the overall strain hardening of the material is evaluated for two different grain structures. Large compressive strains are applied on 3D microstructural aggregates representing the uniform and non-uniform grain structures of Hadfield steels. The grain structure has an effect on the strain hardening rate as well as on the overall hardening capability of the microstructure. A major reason causing the difference in strain hardening arises from the different twin volume fraction evolution influenced by intra-grain and inter-grain interactions. A mixture of large and small grains was found to be more favorable for twinning and thus resulting in a greater hardening capability than uniform grain size.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, VTT Lifecycle Solutions
Contributors: Lindroos, M., Laukkanen, A., Cailletaud, G., Kuokkala, V.
Pages: 68-76
Publication date: 2017
Peer-reviewed: Yes

Publication information

Journal: International Journal of Solids and Structures
Volume: 125
ISSN (Print): 0020-7683
Ratings:

Scopus rating (2017): CiteScore 4.8 SJR 1.295 SNIP 1.574
Original language: English
ASJC Scopus subject areas: Modelling and Simulation, Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering, Applied Mathematics
Keywords: Austenitic manganese steel, Crystal plasticity, Deformation twinning, Microstructure based modeling
DOIs:

10.1016/j.ijsolstr.2017.07.015

Bibliographical note

EXT="Lindroos, Matti"
Source: Scopus
Source ID: 85025152227
Research output: Contribution to journal › Article › Scientific › peer-review

Optimizing ammonium adsorption on natural zeolite for wastewaters with high loads of ammonium and solids

Ion exchange (IE) has been so far limited to treating waters and wastewaters low in solids (TS) and ammonium (NH_4^+). This study provides a new insight into the application of IE for NH_4^+ removal from wastewaters with high NH_4^+ and TS, using natural zeolite as adsorbent medium. Assays were carried out in continuously stirred batch reactors to study the effect of initial NH_4^+, pH, TS, contact time, and zeolite pore size (0.2–0.5 and 0.6–2.0 mm). Results confirmed the suitability of this zeolite to remove NH_4^+ from wastewater with high amounts of solids (up to 2%TS) and NH_4^+ (up to 2500 mgNH_4^+-N/L). Ammonium adsorption capacity (q_t) was faster with 0.2–0.5 mm size because of the greater specific surface area and shorter diffusion path than 0.6–2.0 mm zeolite. Both zeolites showed increasing q_t with increasing initial NH_4^+ due to the higher driving force produced by higher concentrations. The process followed a pseudo-second order kinetic and was best described by the Freundlich isotherm. Varying the pH (6–8.5) of the wastewater had no effect on NH_4^+ removal capacity. In conclusion, this natural zeolite showed high affinity for NH_4^+ in wastewater with high loads of NH_4^+ and solids, returning a viable treatment method when other techniques are not applicable.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering

Contributors: Taddeo, R., Prajapati, S., Lepistö, R.
Number of pages: 10
Pages: 1545–1554
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Peer-reviewed: Yes
Early online date: 3 Mar 2017

Publication information
Journal: Journal of Porous Materials
Volume: 24
Issue number: 6
ISSN (Print): 1380-2224
Ratings:

Scopus rating (2017): CiteScore 2.8 SJR 0.5 SNIP 0.697
Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: Ammonium, Ion exchange, Kinetics, Solids, Zeolite
DOIs:

10.1007/s10934-017-0394-1

Bibliographical note
INT=keb,"Prajapati, Sumitra"
Source: Scopus
Source ID: 85014222281
Research output: Contribution to journal › Article › Scientific › peer-review

Structures and properties of laser-assisted cold-sprayed aluminum coatings
In the cold spray process, solid particles impact on a surface with high kinetic energy, deform plastically and form a coating. This enables the formation of pure and dense coating structures. Even more, coating performance and deposition efficiency can be improved by assisting the process with a laser. Laser-assisted cold spraying (LACS) has shown its potential to improve coating properties compared with traditional cold spraying. In this study, coating quality improvement was obtained by using a co-axial laser spray (COLA) process which offers a new, cost-effective laser-assisted cold spray technique, for high-quality deposition and repair. In the COLA process, the sprayed surface is laser heated while particles hit the surface. This assists thebetter bonding between particles and substrate and leads to the formation of tight coating structures. This study focuses on the evaluation of the microstructural characteristics and mechanical properties (e.g., hardness and bond strength) of LACS metallic coatings.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Surface Engineering, Department of Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Universita degli Studi di Modena e Reggio Emilia, Sapienza University
Contributors: Koivuluoto, H., Milanti, A., Bolelli, G., Latokartano, J., Marra, F., Pulci, G., Vihinen, J., Lusvarghi, L., Vuoristo, P.
Number of pages: 6
Pages: 984-989
Publication date: 2017

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Publication series
Name: Materials Science Forum
Volume: 879
ISSN (Print): 0255-5476
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering
Keywords: Aluminum coatings, Coating properties, Laser-assisted cold spraying, Microstructure
DOIs:

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URLs:

http://www.scopus.com/inward/record.url?scp=85000762817&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
JUFOID=62997
Source: Scopus
Source ID: 85000762817
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Thermal, structural and in vitro dissolution of antimicrobial copper-doped and slow resorbable iron-doped phosphate glasses

This paper focuses on investigating and comparing the effects of CuO and Fe_2O_3 addition on the bioactive response of glass having composition [xCuO or Fe_2O_3 + (100 − x) (0.2CaO + 0.2SrO + 0.1Na_2O + 0.5P_2O_5)] (in mol%), where x is ranging from 0 up to 5. The addition of CuO was found to increase the hot processing window and the dissolution rate leading to a fast surface layer precipitation. Using IR and Raman spectroscopies, we related this change in the bioactive response of this glass to the progressive depolymerization of the glass network induced by the addition of CuO. On the other hand, the addition of Fe_2O_3 was found to reduce the hot processing window and the dissolution rate as no depolymerization of the network occurs due to the formation of P–O–Fe bonds at the expense of P–O–P bonds. All the glasses were found to dissolve congruently and in a controlled manner. Finally, the antimicrobial properties of the copper-doped glasses were examined and compared to bioactive glasses which are known to exhibit good antimicrobial properties. The CuO addition leads to higher antimicrobial properties than the commercial bioactive glass S53P4 and total bacterial elimination could be obtained.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Biomaterials and Tissue Engineering Group, Photonics, BioMediTech, Laboratory of Photonics, Chalmers University of Technology, Universite de Rennes
Contributors: Mishra, A., Petit, L., Pihl, M., Andersson, M., Salminen, T., Rocherullé, J., Massera, J.
Number of pages: 16
Pages: 8957–8972
Publication date: 2017
Peer-reviewed: Yes
Early online date: 24 Jan 2017

Publication information
Journal: Journal of Materials Science
Volume: 52
Issue number: 15
ISSN (Print): 0022-2461
Ratings:

Scopus rating (2017): CiteScore 4.6 SJR 0.807 SNIP 1.092
Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
DOIs:

10.1007/s10853-017-0805-3
Source: Scopus
Source ID: 85010756964
Research output: Contribution to journal › Article › Scientific › peer-review

Third Particle Ejection Effects on Wear with Quenched and Tempered Steel Fretting Contact

The design and life prediction of fretting wear-sensitive mechanical components remain a challenge. In the present work, the role of wear particle movements under conditions of axisymmetric loading of an annular flat-on-flat contact were investigated using self-mated quenched and tempered steel specimens. Total fretting wear significantly increased when loose wear particles were periodically removed from the interface, and this effect increased as a function of the sliding amplitude. Additionally, increased wear was measured when grooves perpendicular to the sliding direction were added to the interface. Increasing the rate of wear debris ejection leads to increased wear rate because naturally occurring entrapped third-body particles significantly reduce the wear. The shape of fretting loops and values of the average and maximum coefficient of friction remained unaffected by the removal of entrapped wear debris and by the introduction of the grooves.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Tribology and Machine Elements, Research and Development

Contributors: Hintikka, J., Lehtovaara, A., Mäntylä, A.
Number of pages: 9
Pages: 70-78
Publication date: 2017
Peer-reviewed: Yes

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Journal: TRIBOLOGY TRANSACTIONS
Volume: 60
Issue number: 1
ISSN (Print): 1040-2004
Ratings:

Scopus rating (2017): CiteScore 2.7 SJR 0.836 SNIP 1.242
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Fretting, third body, unlubricated friction, unlubricated wear, wear debris
Electronic versions:

Third Particle Ejection Effects on Wear with Quenched and Tempered Steel Fretting Contact - Latest own version
DOIs:

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URLs:

http://urn.fi/URN:NBN:fi:tty-201709281973
Source: Scopus
Source ID: 84978160752
Research output: Contribution to journal › Article › Scientific › peer-review

Vapor Phase Fabrication of Nanoheterostructures Based on ZnO for Photoelectrochemical Water Splitting
Nanoheterostructures based on metal oxide semiconductors have emerged as promising materials for the conversion of sunlight into chemical energy. In the present study, ZnO-based nanocomposites have been developed by a hybrid vapor phase route, consisting in the chemical vapor deposition of ZnO systems on fluorine-doped tin oxide substrates, followed by the functionalization with Fe_2O_3 or WO_3via radio frequency-sputtering. The target systems are subjected to thermal treatment in air both prior and after sputtering, and their properties, including structure, chemical composition, morphology, and optical absorption, are investigated by a variety of characterization methods. The obtained results evidence the formation of highly porous ZnO nanocrystal arrays, conformally covered by an ultrathin Fe_2O_3 or WO_3 overlayer. Photocurrent density measurements for solar-triggered water splitting reveal in both cases a performance improvement with respect to bare zinc oxide, that is mainly traced back to an enhanced separation of photogenerated charge carriers thanks to the intimate contact between the two oxides. This achievement can be regarded as a valuable result in view of future optimization of similar nanoheterostructured photoanodes.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Universita degli Studi di Padova, Italy, Universiteit Antwerpen
Contributors: Barreca, D., Carraro, G., Gasparotto, A., Maccato, C., Altantzis, T., Sada, C., Kaunisto, K., Ruoko, T., Bals, S.
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Journal: Advanced Materials Interfaces
Volume: 4
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Article number: 1700161
ISSN (Print): 2196-7350
Ratings:

Scopus rating (2017): CiteScore 5.9 SJR 1.796 SNIP 0.839
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering
Keywords: FeO, Nanoheterostructures, Water splitting, WO, ZnO
DOIs:

10.1002/admi.201700161
Source: Scopus
Source ID: 85019578018

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

Characterization of the microstructure and corrosion performance of Ce-alloyed Nd-Fe-B magnets

Expensive rare-earth elements used in neodymium-iron-boron permanent magnets can be partly replaced by a more abundant cerium without significantly compromising the magnetic properties. In this study, we investigated the effects that cerium addition has on the corrosion resistance of Nd-Fe-B magnets. The cerium-alloyed magnet grade was compared to two Ce-free magnet materials, a standard-grade Nd-Fe-B and a Co-alloyed magnet grade, with respect to microstructure and corrosion behaviour. The microstructure of the magnets was characterized by scanning electron microscopy, with the location of Ce being of primary interest. The magnets were exposed to electrochemical measurements and accelerated corrosion tests. Although the amount of the corrosion-sensitive grain-boundary phase was higher in the Ce-alloyed magnets than in the other two magnet grades, the overall corrosion behaviour was in many ways comparable to that of the Co-alloyed grade magnet, e.g., showing a slight increase in open circuit potential as compared to the standard grade magnet. In accelerated tests, corrosion of the Fe-rich phase was equal to the other magnet grades. Pulverization of the Ce-alloyed magnet was not detected during the accelerated tests, similarly to the Co-alloyed grade.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland
Contributors: Isotahdon, E., Huttunen-Saarivirta, E., Kuokkala, V.
Pages: 190-197
Publication date: Jan 2017
Peer-reviewed: Yes
Early online date: 7 Sep 2016

Publication information

Journal: Journal of Alloys and Compounds
Volume: 692
ISSN (Print): 0925-8388
Ratings:

Scopus rating (2017): CiteScore 5.7 SJR 1.02 SNIP 1.403
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Metals and Alloys, Materials Chemistry
Keywords: Corrosion, Electrochemical impedance spectroscopy, Rare earth alloys and compounds, Scanning electron microscopy, SEM
DOIs:

10.1016/j.jallcom.2016.09.058
Source: Scopus
Source ID: 84988024326
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of air gap on the adhesion of PET layer on cardboard substrate in extrusion coating

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science
Contributors: Suokas, E.
Number of pages: 16
Pages: 529-544
Publication date: 1 Jan 2017

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ISBN (Electronic): 9781510850880
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
Source: Scopus
Source ID: 85044480842
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Novel bio-based materials for active and intelligent packaging

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science
Contributors: Lahti, J., Kamppuri, T., Kuusipalo, J.
Number of pages: 1
Publication date: 1 Jan 2017

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Title of host publication: 16th TAPPI European PLACE Conference 2017
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ISBN (Electronic): 9781510850880
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
Source: Scopus
Source ID: 85044445672
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Novel equipment to simulate hot air heat sealability of packaging materials

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science, Research group: Paper Converting and Packaging
Contributors: Lahti, J., Kuusipalo, J., Auvinen, S.
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Pages: 237-248
Publication date: 1 Jan 2017

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Publisher: TAPPI Press
ISBN (Electronic): 9781510850880
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
Source: Scopus
Source ID: 85044468996
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Tampere University of Technology, laboratory of materials science, paper converting and packaging technology Tampere, Finland

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science, Research group: Paper Converting and Packaging
Contributors: Kuusipalo, J., Lahti, J.
Number of pages: 1
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Title of host publication: 16th TAPPI European PLACE Conference 2017 : Basel; Switzerland; 22 May 2017 through 24 May 2017
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Publisher: TAPPI Press
ISBN (Electronic): 9781510850880
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
URLs:

http://www.scopus.com/inward/record.url?scp=85044476202&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 85044476202
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Synchronous Full-Field Strain and Temperature Measurement in Tensile Tests at Low, Intermediate and High Strain Rates

Tensile tests with simultaneous full-field strain and temperature measurements at the nominal strain rates of 0.01, 0.1, 1, 200 and 3000 s^{-1} are presented. Three different testing methods with specimens of the same thin and flat gage-section geometry are utilized. The full-field deformation is measured on one side of the specimen, using the DIC technique with low and high speed visible cameras, and the full-field temperature is measured on the opposite side using an IR camera. Austenitic stainless steel is used as the test material. The results show that a similar deformation pattern evolves at all strain rates with an initial uniform deformation up to the strain of 0.25–0.35, followed by necking with localized deformation with a maximum strain of 0.7–0.95. The strain rate in the necking regions can exceed three times the nominal strain rate. The duration of the tests vary from 57 s at the lowest strain rate to 197 μs at the highest strain rate. The results show temperature rise at all strain rates. The temperature rise increases with strain rate as the test duration shortens and there is less time for the heat to dissipate. At a strain rate of 0.01 s^{-1} the temperature rise is small (up to 48 °C) but noticeable. At a strain rate of 0.1 the temperature rises up to 140 °C and at a strain rate of 1 s^{-1} up to 260 °C. The temperature increase in the tests at strain rates of 200 s^{-1} and 3000 s^{-1} is nearly the same with the maximum temperature reaching 375 °C.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Ohio State University
Contributors: Seidt, J. D., Kuokkala, V., Smith, J. L., Gilat, A.
Pages: 219–229
Publication date: Feb 2017
Peer-reviewed: Yes
Early online date: 1 Nov 2016

Publication information

Journal: Experimental Mechanics
Volume: 57
Issue number: 2
ISSN (Print): 0014-4851
Ratings:

Scopus rating (2017): CiteScore 4.3 SJR 0.947 SNIP 1.605
Original language: English
ASJC Scopus subject areas: Aerospace Engineering, Mechanics of Materials, Mechanical Engineering
Keywords: DIC, Full-field IR measurement, Plasticity, Strain rate, Temperature
DOIs:

10.1007/s11340-016-0237-z
URLs:

http://www.scopus.com/inward/record.url?scp=84994065670&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84994065670
Research output: Contribution to journal › Article › Scientific › peer-review

Chip-by-chip configurable interconnection using digital printing techniques

Printed electronics technologies add new fabrication concepts to the classical set of microelectronic processes. Among these, the use of digital printing techniques such as inkjet permits the deposition of materials on top of preexisting substrates without any mask. This allows individual personalization of electronic circuits. Different proposals have been made to make use of such a property: (1) wiring new metallic layers on top of circuits to build programmable logic array-like circuits, (2) programming OTP ROM like memories, and (3) building inkjet-configurable gate arrays. The capability of building an individual circuit with technological steps simpler than photolithographic ones opens a concept similar to the successful field programmable gate array. Although nowadays the process resolution is still low, it can quickly evolve to higher wiring densities and therefore permit a greater level of transistor integration. In this paper, we propose a new structure to realize the connections only by deposition of conductive dots oriented to optimize the area needed to implement the drop-on-demand (DoD) wiring at circuit level. One important feature of this structure is that it minimizes the amount of printed material required for the connection thereby reducing failures often seen with DoD printing techniques for conductive lines. These structures have been validated by two different DoD technologies: inkjet and superfine jet, and have been compared to mask-based photolithography technology with promising results.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Electronics and Communications Engineering, Research group: Laboratory for Future Electronics, Universitat Autònoma de Barcelona, Centre for Process Innovation (CPI), A UK Based OSC Materials Company, IMB-CNM (CSIC)

Contributors: Mashayekhi, M., Winchester, L., Laurila, M., Mäntysalo, M., Ogier, S., Terés, L., Carrabina, J.
Publication date: 6 Mar 2017
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Publication information
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Volume: 27
Issue number: 4
Article number: 045009
ISSN (Print): 0960-1317
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Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Mechanics of Materials, Mechanical Engineering , Electrical and Electronic Engineering
Keywords: digital circuits, digital printing, drop-on-demand, inkjet, inkjet configurable gate array, interconnection, printed electronics
Electronic versions:

Manuscript-20170127
DOIs:

10.1088/1361-6439/aa5ef3
URLs:

http://urn.fi/URN:NBN:fi:tty-201712202440
Source: Scopus
Source ID: 85016467042
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of energy measures on the values of energy efficiency indicators in Finnish daycare and school buildings

The potential for cost-effective energy efficiency improvements is very large. However, major impacts from energy efficiency improvements can take decades to be fully realised. In addition, today the building sector is requested to define strategies and decide which energy retrofit actions to undertake in their existing building stock. Since building users are very often encouraged to save energy based on measured energy consumption, it is essential to know that the indicator used to assess energy efficiency is really guiding the building use towards sustainability. This study examines how energy measures reflect energy efficiency indicators and how they can be combined so that the result is user-driven and reflects the reality of the building operational phase energy efficiency better. This study shows that energy efficiency can be measured by using alternative indicators and confirms that different indicators make a different impact on results showing efficiency. In the studied cases savings in energy consumption can be achieved by investing in technical measures or operating the building automation system based on actual occupancy. Results indicated that the size of the effect of energy measures is roughly similar in a case of alternative indicators of energy efficiency.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Civil Engineering, Aalto University, VTT Technical Research Centre of Finland
Contributors: Sekki, T., Airaksinen, M., Saari, A.
Number of pages: 9
Pages: 124-132
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Peer-reviewed: Yes

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Journal: Energy and Buildings
Volume: 139
ISSN (Print): 0378-7788
Ratings:

Scopus rating (2017): CiteScore 7.8 SJR 2.061 SNIP 2.131
Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Daycare centres, Energy efficient indicators, Energy savings, Schools
DOIs:

10.1016/j.enbuild.2017.01.005
Source: Scopus
Source ID: 85009126496

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

Concepts, methods and tools for individualized production

The main objective of the paper is to give an overview of prerequisites and enablers for individualized production from the perspective of flexible, agile and sustainable production of customized and personalized products. Increasing volatility in the global and local markets, shortening innovation and product life cycles, as well as a tremendously increasing number of variants, call for production facilities and networks and operations management which comply with these changing demands. The paper presents a set of developed concepts, methods and tools based on the recognized needs of manufacturing companies. The observed manufacturing domain is characterized with highly customized and personalized products produced in competitively in a high-cost country with short delivery times and high quality requirements. Micro and desktop factories can be seen as one type of solution to point-of-need manufacturing of customized and personalized products, such as hand-held consumer electronics or medical implants. The LeanMES concept and associated solution blocks aim for more efficient operation via digital tools. The Competitive Sustainable Manufacturing Hotel (CSM-Hotel) concept of a platform targeted for SMEs collaborating under same factory roof or in the same area. The A-NET vision offers a new holistic framework for industrial supply networks to manage development more agilely and for deeper strategic cooperation.

General information

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Organisations: Mechanical Engineering and Industrial Systems, DIMECC
Contributors: Lanz, M., Tuokko, R.
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Pages: 205-212
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Peer-reviewed: Yes

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ISSN (Print): 0944-6524
Ratings:

Scopus rating (2017): CiteScore 2.1 SJR 0.602 SNIP 1.085
Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Industrial and Manufacturing Engineering
Keywords: Agile supply networks, Desktop manufacturing, Digitalization, Individualized production, Lean, MES
DOIs:

10.1007/s11740-017-0728-5

Bibliographical note

EXT="Tuokko, R."
Source: Scopus
Source ID: 85016410595
Research output: Contribution to journal › Article › Scientific › peer-review

A fractional representation approach to the robust regulation problem for SISO systems

The purpose of this article is to develop a new approach to the robust regulation problem for plants which do not necessarily admit coprime factorizations. The approach is purely algebraic and allows us dealing with a very general class of systems in a unique simple framework. We formulate the famous internal model principle in a form suitable for plants defined by fractional representations which are not necessarily coprime factorizations. By using the internal model principle, we are able to give necessary and sufficient solvability conditions for the robust regulation problem and to parameterize all robustly regulating controllers.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Mathematics, Parc Scientifique de la Haute Borne
Contributors: Laakkonen, P., Quadrat, A.
Number of pages: 6
Pages: 32-37
Publication date: 1 May 2017
Peer-reviewed: Yes

Publication information

Journal: Systems and Control Letters
Volume: 103
ISSN (Print): 0167-6911
Ratings:

Scopus rating (2017): CiteScore 5.3 SJR 1.939 SNIP 1.722
Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Computer Science(all), Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Fractional representation approach, Linear systems, Robust regulation
DOIs:

10.1016/j.sysconle.2017.02.006
Source: Scopus
Source ID: 85016517305
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

Redundant robotic manipulator path planning for real-time obstacle and self-collision avoidance

This paper presents a method to generate joint trajectories for a redundant manipulator. The control system of the manipulator determines the joint references so that the goal pose can be reached without any collisions, in real-time. The control system checks weather any part of the manipulator is at risk of colliding with itself or with any obstacles. If there is a risk of collision, then the collision server computes the exact points where the collision is about to happen and calculates the shortest distance between the colliding objects. The joint trajectories of the manipulator are modified so that collisions will be avoided while at the same time, the trajectory of the end-effector maintains its initial trajectory if possible.

Experimental results are given for a 7 DOF redundant manipulator to demonstrate the capability of the collision avoidance control system.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering, Research group: Mobile manipulation, Sandvik Mining and Construction Oy
Contributors: Kivelä, T., Mattila, J., Puura, J., Launis, S.
Number of pages: 9
Pages: 208-216
Publication date: 21 Jun 2017

Host publication information
Title of host publication: Advances in Service and Industrial Robotics : Proceedings of the 26th International Conference on Robotics in Alpe-Adria-Danube Region, RAAD 2017
Publisher: Springer International Publishing
Editors: Ferraresi, C., Quaglia, G.
ISBN (Print): 978-3-319-61276-8

Publication series
Name: Mechanisms and Machine Science
Volume: 49
ISSN (Print): 2211-0984
ISSN (Electronic): 2211-0992
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering
Keywords: Collision avoidance, Real-time control, Redundant, Robotic manipulator
DOIs:

10.1007/978-3-319-61276-8_24

Bibliographical note
jufoid=77016
EXT="Launis, Sirpa"
Source: Scopus
Source ID: 85028340054
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Democratizing composites manufacturing -inexpensive tooling empowers new players
Additive manufacturing (AM) has become more common in the composites industri/ during the past decade. Tliere are several areas where the quick production of tooling and fixtures using additive manufacturing makes sense. Typical drawbacks of AM have recently been solved, such as the low-T of printing materials and small build envelopes. However, wide-spread use of AM in the composites industry is not yet reality due to risks involved with investments in a new production method and the lack of expertise to use AM where the benefits are greatest. The risks can be lowered with the right approach and acquiring AM expertise does not necessarily mean big investments in machines. We will present here an approach, which alloios composites manufacturers to experiment and explore the possibilities of AM without risky purchases. A case study is presented showing how a real product, such as a bicycle frame, can be manufactured using loiu-cost AM techniques.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Aalto University, Ideas cycles R.y.
Contributors: Antin, K. N., Pärnänen, T.
Number of pages: 5
Pages: 6-10
Publication date: 1 Jul 2017
Peer-reviewed: Yes

Publication information
Journal: SAMPE Journal
Volume: 53
Issue number: 4
ISSN (Print): 0091-1062
Ratings:

Scopus rating (2017): CiteScore 1 SJR 0.267 SNIP 0.74

Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Source: Scopus
Source ID: 85039171390
Research output: Contribution to journal › Article › Scientific › peer-review

Statistical analysis of E-jet print parameter effects on Ag-nanoparticle ink droplet size

In this paper, we have studied the print parameter effects on electrohydrodynamic inkjet (E-jet) resolution using statistical analysis. In order to make the E-jet manufacturing process feasible, the effect of printing parameters on the ejected droplet size must be modelled and optimized. To this end, there exist two approaches: parameter effects can be modelled using theoretical calculations or they can be generated directly from empirical data using statistical analysis. The first option has been explored by multiple research groups, whereas the latter has received less interest. In this article, the effect of printing parameters on the width of AC-pulsed E-jet deposited Ag-nanoparticle ink droplets are investigated using design of experiments (DoE) approach and statistical analysis. As a result, a statistical model for deposited droplet width is generated using four print parameters (print height, bias voltage, peak voltage and frequency) as predictors. The model can predict 94.24% of the measured width variation with a standard deviation of 1.05 μm.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Electronics and Communications Engineering, Research group: Laboratory for Future Electronics, Research group: Wireless Communications and Positioning
Contributors: Laurila, M. M., Khorramdel, B., Dastpak, A., Mäntysalo, M.
Publication date: 2 Aug 2017
Peer-reviewed: Yes

Publication information

Journal: Journal of Micromechanics and Microengineering
Volume: 27
Issue number: 9
Article number: 095005
ISSN (Print): 0960-1317
Ratings:

Scopus rating (2017): CiteScore 3.7 SJR 0.554 SNIP 1.015
Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Mechanics of Materials, Mechanical Engineering , Electrical and Electronic Engineering
Keywords: design of experiments, E-jet, printed electronics, statistical analysis
Electronic versions:

Statistical analysis of E-jet print parameter effects on Ag-nanoparticle..._. Embargo ended: 2/10/18
DOIs:

10.1088/1361-6439/aa7a71
URLs:

http://urn.fi/URN:NBN:fi:tty-201712202436. Embargo ended: 2/08/18

Bibliographical note

INT=elt,"Dastpak, A."
Source: Scopus
Source ID: 85028383527
Research output: Contribution to journal › Article › Scientific › peer-review

Locomotion of light-driven soft microrobots through a hydrogel via local melting

Soft mobile microrobots whose deformation can be directly controlled by an external field can adapt to move in different environments. This is the case for the light-driven microrobots based on liquid-crystal elastomers (LCEs). Here we show that the soft microrobots can move through an agarose hydrogel by means of light-controlled travelling-wave motions. This is achieved by exploiting the inherent rise of the LCE temperature above the melting temperature of the agarose gel, which facilitates penetration of the microrobot through the hydrogel. The locomotion performance is investigated as a function of the travelling-wave parameters, showing that effective propulsion can be obtained by adapting the generated motion to the specific environmental conditions.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Chemistry and Bioengineering, Max Planck Institute for Intelligent Systems, Max Planck ETH Center for Learning Systems, University of Florence, CNR-INO, University of Stuttgart

Contributors: Palagi, S., Mark, A. G., Melde, K., Qiu, T., Zeng, H., Parmeggiani, C., Martella, D., Wiersma, D. S., Fischer, P.
Publication date: 3 Aug 2017

Host publication information
Title of host publication: International Conference on Manipulation, Automation and Robotics at Small Scales, MARSS 2017 - Proceedings
Publisher: IEEE
ISBN (Electronic): 9781538603468
ASJC Scopus subject areas: Mechanical Engineering, Artificial Intelligence, Control and Optimization
Keywords: Hydrogels, Liquid-crystal elastomers (LCEs), Soft microrobots
DOIs:

10.1109/MARSS.2017.8001916
Source: Scopus
Source ID: 85030234395
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Pneumatically actuated elastomeric device for simultaneous mechanobiological studies & live-cell fluorescent microscopy
In this study, we demonstrate the functionality and usability of a compact, pneumatically actuated, elastomeric stimulation device for mechanobiological studies. The soft mechatronic device enables high-resolution live-cell confocal fluorescent imaging during equiaxial stretching. Several single cells can be tracked and imaged repeatedly after stretching periods. For demonstration, we provide image based analysis of dynamic change of the cell body and the nucleus area and actin fiber orientation during mechanical stimulation of mouse embryonic fibroblast (MEF) cells. Additionally, we present the characteristics of the device utilizing computational simulations and experimental validation using a particle tracking method for strain field analysis.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Micro and Nanosystems Research Group, BioMediTech, Biomedical Sciences and Technology
Contributors: Kreutzer, J., Viehrig, M., Maki, A., Kallio, P., Rahikainen, R., Hytönen, V.
Publication date: 3 Aug 2017

Host publication information
Title of host publication: International Conference on Manipulation, Automation and Robotics at Small Scales, MARSS 2017 - Proceedings
Publisher: IEEE
ISBN (Electronic): 9781538603468
ASJC Scopus subject areas: Mechanical Engineering, Artificial Intelligence, Control and Optimization
Keywords: High-resolution imaging, Mechanical stimulation, Mouse embryonic fibroblasts, Particle tracking, PDMS, Pneumatic actuation, Strain field analysis
Electronic versions:

MARSS2017 - Kreutzer
DOIs:

10.1109/MARSS.2017.8001929
URLs:

http://urn.fi/URN:NBN:fi:tty-201712202442

Bibliographical note
INT=tut-bmt,"Viehrig, Marlitt"
Source: Scopus
Source ID: 85030222654
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Feed-hopper level estimation and control in cone crushers
This paper describes a novel feed-hopper level estimation and control scheme for addressing the known problem of unreliable and occasionally corrupted feed-hopper level measurement in a cone crusher. The approach involves estimating the feed-hopper level with an adaptive time-variant state estimator. The proposed adaptive scheme delivers asymptotically unbiased feed-hopper level estimates, despite using an inherently biased state estimator with biased measurement(s) and/or model, and therefore addresses the common pitfall of state estimators. The paper details the entire control system design procedure, from the fundamental theory, through dynamic modeling and estimator/controller tuning, to the design validation and control performance evaluation. The performance of the proposed scheme is evaluated through extensive full-scale tests in various production scenarios, including process start-up, level setpoint changes, and mass flow disturbance rejection. The full-scale tests revealed a number of benefits compared to the

straightforward level control implementation. These benefits include the possibility of recovering from a temporary loss of measurement signal, smaller control effort, and increased system robustness due to an increased ability to withstand measurement errors. Therefore, the proposed scheme will enable more consistent size reduction and provide protection against performance degradation and process down-time.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, Chalmers University of Technology
Contributors: Itävuo, P., Hulthén, E., Vilkko, M.
Number of pages: 14
Pages: 82-95
Publication date: 15 Aug 2017
Peer-reviewed: Yes

Publication information
Journal: Minerals Engineering
Volume: 110
ISSN (Print): 0892-6875
Ratings:

Scopus rating (2017): CiteScore 4.9 SJR 1.248 SNIP 2.081
Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Chemistry(all), Geotechnical Engineering and Engineering Geology, Mechanical Engineering
Keywords: Adaptive state estimation, Cone crusher, Dynamic modeling, Level control, System identification
DOIs:

10.1016/j.mineng.2017.04.010
Source: Scopus
Source ID: 85018328452
Research output: Contribution to journal › Article › Scientific › peer-review

Adaptive and nonlinear control of discharge pressure for variable displacement axial piston pumps

This paper proposes, for the first time without using any linearization or order reduction, an adaptive and model-based discharge pressure control design for the variable displacement axial piston pumps (VDAPPs), whose dynamical behaviors are highly nonlinear and can be described by a fourth-order differential equation. The rigorous stability proof, with an asymptotic convergence, is given for the entire system. In the proposed novel controller design method, the specifically designed stabilizing terms constitute an essential core to cancel out all the stability-preventing terms. The experimental results reveal that rapid parameter adaptation significantly improves the feedback signal tracking precision compared to a known-parameter controller design. In the comparative experiments, the adaptive controller design demonstrates the state-of-the-art discharge pressure control performance, enabling a possibility for energy consumption reductions in hydraulic systems driven with VDAPP.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, Research group: Mobile manipulation
Contributors: Koivumäki, J., Mattila, J.
Publication date: 1 Oct 2017
Peer-reviewed: Yes

Publication information
Journal: Journal of Dynamic Systems, Measurement and Control: Transactions of the ASME
Volume: 139
Issue number: 10
Article number: 101008
ISSN (Print): 0022-0434
Ratings:

Scopus rating (2017): CiteScore 3 SJR 0.618 SNIP 1.024
Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Information Systems, Instrumentation, Mechanical Engineering, Computer Science Applications
DOIs:

10.1115/1.4036537
Source: Scopus
Source ID: 85021623538

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

Simulating the Drag Coefficient of a Spherical Autonomous Underwater Vehicle

In this paper, an AUV pressure drag simulations with different velocities are presented. The AUV's main hull is spherical but its instrumental components extend out of the hull, and interfere with the flow. A pressure drag coefficient of a sphere was simulated to decide the used turbulence model (SST k-ω), by comparing simulation results to those found in literature. Then, simulations were done with different velocities to understand the behaviour of the AUV drag coefficient. These results can be used to improve the control system of the AUV and are an important factor in the AUV energy consumption.

General information

Publication status: Published
MoE publication type: B3 Non-refereed article in conference proceedings
Organisations: Mechanical Engineering and Industrial Systems, Research area: Design, Development and LCM
Contributors: Heininen, A., Aaltonen, J., Koskinen, K. T.
Number of pages: 4
Pages: 53-56
Publication date: 9 Oct 2017

Host publication information

Title of host publication: Proceedings of the 2nd Annual SMACC Research Seminar 2017
Volume: 2
Place of publication: Tampere
Publisher: Tampere University of Technology
Editors: Aaltonen, J., Virkkunen, R., Koskinen, K. T., Kuivanen, R.
Article number: 14
ISBN (Electronic): 978-952-15-4040-0
ASJC Scopus subject areas: Mechanical Engineering
Keywords: Drag, Underwater Vehicle, Spherical robot, CFD
URLs:
http://smacc.fi/wp-content/uploads/2017/11/Proceedings-of-the-2nd-Annual-SMACC-reserch-Seminar-2017.pdf
http://urn.fi/URN:NBN:fi:tty-201712222491
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

Waves in hyperbolic and double negative metamaterials including rogues and solitons

The topics here deal with some current progress in electromagnetic wave propagation in a family of substances known as metamaterials. To begin with, it is discussed how a pulse can develop a leading edge that steepens and it is emphasised that such self-steepening is an important inclusion within a metamaterial environment together with Raman scattering and third-order dispersion whenever very short pulses are being investigated. It is emphasised that the self-steepening parameter is highly metamaterial-driven compared to Raman scattering, which is associated with a coefficient of the same form whether a normal positive phase, or a metamaterial waveguide is the vehicle for any soliton propagation. It is also shown that the influence of magnetooptics provides a beautiful and important control mechanism for metamaterial devices and that, in the future, this feature will have a significant impact upon the design of data control systems for optical computing. A major objective is fulfiled by the investigations of the fascinating properties of hyperbolic media that exhibit asymmetry of supported modes due to the tilt of optical axes. This is a topic that really merits elaboration because structural and optical asymmetry in optical components that end up manipulating electromagnetic waves is now the foundation of how to operate some of the most successful devices in photonics and electronics. It is pointed out, in this context, that graphene is one of the most famous plasmonic media with very low losses. It is a two-dimensional material that makes the implementation of an effective-medium approximation more feasible. Nonlinear non-stationary diffraction in active planar anisotropic hyperbolic metamaterials is discussed in detail and two approaches are compared. One of them is based on the averaging over a unit cell, while the other one does not include sort of averaging. The formation and propagation of optical spatial solitons in hyperbolic metamaterials is also considered with a model of the response of hyperbolic metamaterials in terms of the homogenisation ('effective medium') approach. The model has a macroscopic dielectric tensor encompassing at least one negative eigenvalue. It is shown that light propagating in the presence of hyperbolic dispersion undergoes negative (anomalous) diffraction. The theory is ten broadened out to include the influence of the orientation of the optical axis with respect to the propagation wave vector. Optical rogue waves are discussed in terms of how they are influenced, but not suppressed, by a metamaterial background. It is strongly discussed that metamaterials and optical rogue waves have both been making headlines in recent years and that they are, separately, large areas of research to study. A brief background of the inevitable linkage of them is considered and important new possibilities are discussed. After this background is revealed some new rogue wave configurations combining the two areas are presented alongside a discussion of the way forward for the future.

General information

Publication status: Published

MoE publication type: A2 Review article in a scientific journal
Organisations: Photonics, University of Salford, Sapienza University, IICBA, UMR 6174, Original Perspectives Ltd, Aalto University, ITMO University, Taras Shevchenko National University of Kyiv, Nazarbayev University
Contributors: Boardman, A. D., Alberucci, A., Assanto, G., Grimalsky, V. V., Kibler, B., McNiff, J., Nefedov, I. S., Rapoport, Y. G., Valagiannopoulos, C. A.
Publication date: 9 Oct 2017
Peer-reviewed: Yes

Publication information
Journal: Nanotechnology
Volume: 28
Issue number: 44
Article number: 444001
ISSN (Print): 0957-4484
Ratings:

Scopus rating (2017): CiteScore 5.2 SJR 1.079 SNIP 0.885
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Mechanics of Materials, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: rogues, solitons, waves
DOIs:

10.1088/1361-6528/aa6792
Source: Scopus
Source ID: 85032180863
Research output: Contribution to journal › Review Article › Scientific › peer-review

Global energy consumption due to friction and wear in the mining industry
Calculations on the global energy consumption due to friction and wear in the mineral mining industry are presented. For the first time, the impact of wear is also included in more detailed calculations in order to show its enormous tribological and economic impacts on this industry. A large variety of mining equipment used for the extraction, haulage and beneficiation of underground mining, surface mining and mineral processing were analysed. Coefficients of friction and wear rates of moving mechanical assemblies were estimated based on available information in literature in four general cases: (1) a global average mine in use today, (2) a mine with today's best commercial technology, (3) a mine with today's most advanced technology based upon the adaptation of the latest R&D achievements, and (4) a mine with best futuristic technology forecasted in the next 10 years. The following conclusions were reached: • Total energy consumption of global mining activities, including both mineral and rock mining, is estimated to be 6.2% of the total global energy consumption. About 40% of the consumed energy in mineral mining (equalling to 4.6 EJ annually on global scale) is used for overcoming friction. In addition, 2 EJ is used to remanufacture and replace worn out parts and reserve and stock up spare parts and equipment needed due to wear failures. The largest energy consuming mining actions are grinding (32%), haulage (24%), ventilation (9%) and digging (8%). • Friction and wear is annually resulting in 970 million tonnes of CO_2 emissions worldwide in mineral mining (accounting for 2.7% of world CO_2 emissions). • The total estimated economic losses resulting from friction and wear in mineral mining are in total 210,000 million Euros annually distributed as 40% for overcoming friction, 27% for production of replacement parts and spare equipment, 26% for maintenance work, and 7% for lost production. • By taking advantage of new technology for friction reduction and wear protection in mineral mining equipment, friction and wear losses could potentially be reduced by 15% in the short term (10 years) and by 30% in the long term (20 years). In the short term this would annually equal worldwide savings of 31,100 million euros, 280 TWh energy consumption and a CO_2 emission reduction of 145 million tonnes. In the long term, the annual benefit would be 62,200 million euros, 550 TWh less energy consumption, and a CO_2 emission reduction of 290 million tonnes. Potential new remedies to reduce friction and wear in mining include the development and uses of new materials, especially materials with improved strength and hardness properties, more effective surface treatments, high-performance surface coatings, new lubricants and lubricant additives, and new designs of moving parts and surfaces of e.g. liners, blades, plates, shields, shovels, jaws, chambers, tires, seals, bearings, gearboxes, engines, conveyor belts, pumps, fans, hoppers and feeders.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland , Argonne National Laboratory
Contributors: Holmberg, K., Kivikytö-Reponen, P., Härkisaari, P., Valtonen, K., Erdemir, A.
Number of pages: 24
Pages: 116-139
Publication date: 1 Nov 2017
Peer-reviewed: Yes

Publication information
Journal: Tribology International
Volume: 115
ISSN (Print): 0301-679X
Ratings:

Scopus rating (2017): CiteScore 5.1 SJR 1.52 SNIP 2.059
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Energy, Friction, Mining, Wear
Electronic versions:

Global energy consumption due to friction and wear in the mining industry_accepted. Embargo ended: 5/05/19
DOIs:

10.1016/j.triboint.2017.05.010
URLs:

http://urn.fi/URN:NBN:fi:tty-201706131593. Embargo ended: 5/05/19
Source: Scopus
Source ID: 85019720563
Research output: Contribution to journal › Article › Scientific › peer-review

Noncovalent functionalization of reduced graphene oxide with pluronic F127 and its nanocomposites with gum arabic
Nanocomposites of pluronic F127 modified reduced graphene oxide (PF127-rGO) with polyethylene glycol plasticize gum arabic (PGA) was prepared by evaporating an aqueous solution mixture of PF127-rGO and PGA. PF127-rGO was synthesized by the in-situ reduction of graphene oxide using hydrazine in presence of pluronic F127 and characterized by the Uv–Vis spectroscopy, transmission electron microscopy (TEM), wide angle x-ray scattering (WAXS), Fourier transforms infrared spectroscopy (FTIR), thermogravimetric analysis (TGA) and Raman spectroscopy. The Uv–Vis and Raman spectroscopy results indicate that pluronic F127 functionalization does not hamper the structure of rGO, and TEM image indicates, the pluronic F127 anchored rGO sheets remain exfoliated in diluted aqueous solution of PF127-rGO. WAXS, FTIR and TGA studies confirms the functionalization of rGO with pluronic F127. PF127-rGO 2.5, PF127-rGO 5 and PF127-rGO 7.5 nanocomposites were fabricated, where the numbers represent the weight percentage of PF127-rGO with respect to PGA. The composite films were characterized by field emission scanning electron microscopy (FESEM), FTIR, WAXS and mechanical property study. FESEM and WAXS studies show good dispersion of PF127-rGO sheets in the PGA matrix. The FTIR results indicate a significant interaction between functional groups of PF127-rGO and functional groups of PGA. PF127-rGO 7.5 shows a 124% increase of stress at break and 185% increase of Young's modulus compared to pure PGA.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Plastics and Elastomer Technology, Khulna University of Engineering & Technology (KUET), Chonbuk National University, Swinburne University of Technology
Contributors: Layek, R. K., Uddin, M. E., Kim, N. H., Tak Lau, A. K., Lee, J. H.
Number of pages: 9
Pages: 155-163
Publication date: 1 Nov 2017
Peer-reviewed: Yes

Publication information
Journal: Composites Part B : Engineering
Volume: 128
ISSN (Print): 1359-8368
Ratings:

Scopus rating (2017): CiteScore 9.3 SJR 2.039 SNIP 2.106
Original language: English
ASJC Scopus subject areas: Ceramics and Composites, Mechanics of Materials, Mechanical Engineering, Industrial and Manufacturing Engineering
Keywords: Electron microscopy, Mechanical properties, Nano-structures, Polymer-matrix composites (PMCs), Thermal analysis
DOIs:

10.1016/j.compositesb.2017.07.010
Source: Scopus
Source ID: 85024888498
Research output: Contribution to journal › Article › Scientific › peer-review

A Reduced-Order Two-Degree-of-Freedom Composite Nonlinear Feedback Control for a Rotary DC Servo Motor

We study in this paper nonlinear control of a rotary DC servo motor application. To be more specific, we design a reduced-order two-degree-of-freedom (2DOF) composite nonlinear feedback (CNF) controller for a Quanser QUBE-Servo 2 unit with a disc attachment. We compare our results with a carefully tuned proportional-derivative (PD) controller with set point weighting. Our simulation and experimental results show that the closed-loop system using 2DOF CNF controller yields much better set point tracking performance compared with the system using conventional PD-controller in terms of settling time.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering, Research area: Information Systems in Automation, Research area: Dynamic Systems, Research area: Information Systems in Automation
Contributors: Pyrhönen, V., Koivisto, H., Vilkko, M.
Number of pages: 7
Pages: 2065-2071
Publication date: 12 Dec 2017

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Place of publication: Melbourne, Australia
ISBN (Electronic): 978-1-5090-2872-6
ASJC Scopus subject areas: Control and Systems Engineering, Electrical and Electronic Engineering, Mechanical Engineering
Keywords: Nonlinear control, Composite nonlinear feedback, motion control, Robust control, High performance control, Servo systems
Electronic versions:

A Reduced-Order Two-Degree-of-Freedom Composite Nonlinear Feedback Control for a Rotary DC Servo Motor
DOIs:

10.1109/CDC.2017.8263951
URLs:

http://urn.fi/URN:NBN:fi:tuni-201910224004
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Conjugated Heat Transfer Simulation of a Fin-and-Tube Heat Exchanger

Heat transfer and pressure drop of a fin-and-tube heat exchanger are studied by taking into account the conjugated heat transfer between the flow and the fin. The temperature distribution of the fin is calculated in respect to the convective heat transfer of the air flowing through the tube bank channel. Contemporary enhancement methods emphasize the importance of local turbulence augmentation which effects the convective heat transfer. In this paper, the importance of conjugated heat transfer, where the temperature of the flow and fin are coupled together is emphasized and compared with a constant surface temperature boundary condition simulation and experiment, which are found in the literature.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Mechanical Engineering and Industrial Systems
Contributors: Välikangas, T., Karvinen, R.
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Early online date: 12 Sep 2017

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ASJC Scopus subject areas: Condensed Matter Physics, Mechanical Engineering, Fluid Flow and Transfer Processes

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Source ID: 85029408517
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Digital image correlation study of the deformation and functioning of the human heart during open-heart surgery
Currently, ultrasound technology is routinely used for monitoring of the left side of the human heart during open-heart surgery. However, this method shows shortcomings in providing accurate information of the right ventricle and atrium. The aim of this paper is to demonstrate how Digital Image Correlation (DIC) can be used to monitor the functioning of the heart during open-heart surgery and potentially overcome some of the shortcomings of ultrasound methods. Being a contact-free method is a major asset from a practical implementation perspective of DIC. In this paper, we present the methodology of the experiment and some preliminary results of a study in which a DIC system was installed in an operating room and image sequences of the heart were taken at three stages of the surgery. We present a procedure for obtaining DIC measurements in this challenging setting, discuss how the data was extracted as well as how the measured values changed during the operation in the context of the surgical stages and interventions performed.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science, Research group: Materials Characterization
Contributors: Soltani, A., Curtze, S., Lahti, J., Järvelä, K., Laurikka, J., Hokka, M., Kuokkala, V. T.
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Publisher: Springer New York LLC
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Keywords: Biomaterial characterization, Deformation, DIC, Motion, Open heart surgery
DOIs:
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Source: Scopus
Source ID: 85032509230
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Effects of adiabatic heating estimated from tensile tests with continuous heating
The mechanical behavior of metastable austenitic stainless steels is strongly influenced by the strain induced phase transformation of austenite into martensite. The phase transformation rate is significantly affected by the strain rate and by the adiabatic heating at higher strain rates. Uncoupling of the effects of strain rate and adiabatic heating can lead to a better understanding of the strain-induced martensitic transformation and allow more accurate material modeling. This paper presents a preliminary analysis of the effects of adiabatic heating during a tensile test. The adiabatic heating as a function of strain was calculated from the stress-strain curves obtained in adiabatic conditions. Then the tensile tests were carried out at a lower strain rate while continuously heating the specimen at the same rate as obtained in the adiabatic conditions. With this method, the thermal conditions of the adiabatic tests were reproduced in the low rate conditions, which would normally be isothermal without the external heating. The martensite fraction was evaluated using the magnetic balance method. In this paper, we present a detailed description of the experimental procedure and discuss the observed changes in the mechanical behavior and microstructure of the studied steel.

General information
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MoE publication type: A4 Article in a conference publication
Organisations: Materials Science, Research group: Materials Characterization
Contributors: Vazquez Fernandez, N., Isakov, M., Hokka, M., Kuokkala, V. T.
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ASJC Scopus subject areas: Engineering(all), Computational Mechanics, Mechanical Engineering
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jufoid=72540
Source: Scopus
Source ID: 85033464703
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Erosive-abrasive wear behavior of carbide-free bainitic and boron steels compared in simulated field conditions

The wear resistance of carbide-free bainitic microstructures have recently shown to be excellent in sliding, sliding-rolling, and erosive-abrasive wear. Boron steels are often an economically favorable alternative for similar applications. In this study, the erosive-abrasive wear performance of the carbide-free bainitic and boron steels with different heat treatments was studied in mining-related conditions. The aim was to compare these steels and to study the microstructural features affecting wear rates. The mining-related condition was simulated with an application oriented wear test method utilizing dry abrasive bed of 8–10 mm granite particles. Different wear mechanisms were found; in boron steels, micro-cutting and micro-ploughing were dominating mechanisms, while in the carbide-free bainitic steels, also impact craters with thin platelets were observed. Moreover, the carbide-free bainitic steels had better wear performance, which can be explained by the different microstructure. The carbide-free bainitic steels had fine ferritic-austenitic microstructure, whereas in boron steels microstructure was martensitic. The level of retained austenite was quite high in the carbide-free bainitic steels and that was one of the factors improving the wear performance of these steels. The hardness gradients with orientation of the deformation zone on the wear surfaces were one of the main affecting factors as well. Smoother work hardened hardness profiles were considered beneficial in these erosive-abrasive wear conditions.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, Lulea University of Technology, Univ of Oulu
Contributors: Vuorinen, E., Heino, V., Ojala, N., Haiko, O., Hedayati, A.
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Pages: 3-13
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Source: Scopus
Source ID: 85040443068
Research output: Contribution to journal › Article › Scientific › peer-review

Fin-and-tube heat exchanger enhancement with a combined herringbone and vortex generator design

Vortex generators (VGs) are the most commonly investigated enhancement methods in the field of improved heat exchangers. The aim of present work is to study the effect of VGs in a fin-and-tube heat exchanger (FTHE) with herringbone fin shape. The delta winglet VG design with length (s) and height (H) is selected based on previous studies. The investigated VG design is simple and considered realistic from the manufacturing point of view. The combined enhancement with herringbone fin and the VG is evaluated by simulating the conjugate heat transfer and the air flow. The structured mesh is created for both solid and fluid domains to solve the model numerically using a coupled open source solver in OpenFOAM. The influence of flow condition on the performance enhancement is studied by changing the Reynolds number in a range Re=1354–6157. The study showed that VGs not only increase the heat transfer in the herringbone fin but also decrease the pressure drop. The highest and longest investigated VG design is found to perform the best because of its ability to delay the flow detachment from the tube, to feed high kinetic energy flow to the recirculation zone and to create longitudinal vortices in the downstream region from the VG. The fin with VG design s=0.5D and H=0.6F_p enhances the overall performance by 5.23% in comparison to the fin without VG. The results demonstrated the usefulness of VGs for the performance enhancement in connection with a herringbone fin design.

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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Bio- and Circular Economy, Physics, Chemistry and Bioengineering, Aalborg University
Contributors: Välikangas, T., Singh, S., Sørensen, K., Condra, T.
Number of pages: 15
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Source ID: 85034060389
Research output: Contribution to journal › Article › Scientific › peer-review

Knowledge-based artificial neural network (KB-ANN) in engineering: Associating functional architecture modeling, dimensional analysis and causal graphs to produce optimized topologies for KB-ANNs

This article documents a study on artificial neural networks (ANNs) applied to the field of engineering and more specifically a study taking advantage of prior domain knowledge of engineering systems to improve the learning capabilities of ANNs by reducing the dimensionality of the ANNs. The proposed approach ultimately leads to training a smaller ANN, offering advantage in training performances such as lower Mean Squared Error, lower cost and faster convergence. The article proposes to associate functional architecture, Pi numbers, and causal graphs and presents a design process to generate optimized knowledge-based ANN (KB-ANN) topologies. The article starts with a literature survey related to ANN and their topologies. Then, an important distinction is made between system behavior centered topologies and ANN centered topologies. The Dimensional Analysis Conceptual Modeling (DACM) framework is introduced as a way of implementing the system behavior centered topology. One case study is analyzed with the goal of defining an optimized KB-ANN topology. The study shows that the KB-ANN topology performed significantly better in term of the size of the required training set than a conventional fully-connected ANN topology. Future work will investigate the application of KB-ANNs to additive manufacturing.

General information
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MoE publication type: A4 Article in a conference publication
Organisations: Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Simon Fraser University
Contributors: Coatanéa, E., Wu, D., Tsarkov, V., Gary Wang, G., Modi, S., Jafarian, H.
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ISBN (Electronic): 9780791851739
ASJC Scopus subject areas: Mechanical Engineering, Computer Graphics and Computer-Aided Design, Computer Science Applications, Modelling and Simulation
Keywords: Additive Manufacturing, Artificial Neural Networks, Classifiers, Dimensional Analysis, Empirical learning, Knowledge Based Artificial Neural Network
DOIs:

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Source: Scopus
Source ID: 85056903740
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Light Robots: Bridging the Gap between Microrobotics and Photomechanics in Soft Materials
For decades, roboticists have focused their efforts on rigid systems that enable programmable, automated action, and sophisticated control with maximal movement precision and speed. Meanwhile, material scientists have sought compounds and fabrication strategies to devise polymeric actuators that are small, soft, adaptive, and stimuli-responsive. Merging these two fields has given birth to a new class of devices-soft microrobots that, by combining concepts from microrobotics and stimuli-responsive materials research, provide several advantages in a miniature form: external, remotely controllable power supply, adaptive motion, and human-friendly interaction, with device design and action often inspired by biological systems. Herein, recent progress in soft microrobotics is highlighted based on light-responsive liquid-crystal elastomers and polymer networks, focusing on photomobile devices such as walkers, swimmers, and mechanical oscillators, which may ultimately lead to flying microrobots. Finally, self-regulated actuation is proposed as a new pathway toward fully autonomous, intelligent light robots of the future.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, University of Warsaw, University of Florence
Contributors: Zeng, H., Wasylczyk, P., Wiersma, D. S., Priimagi, A.
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Peer-reviewed: Yes

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Article number: 1703554
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
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20170830_Light Robots_revised_GOA. Embargo ended: 25/10/18
DOIs:

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URLs:

http://urn.fi/URN:NBN:fi:tty-201812192871
Source: Scopus
Source ID: 85031898351

Techno-economic evaluation of integrating torrefaction with anaerobic digestion

In recent days, the interest on torrefaction is increasing owing to its ability to improve biomass properties to a level of competing with coal. However, its techno-economic feasibility still need to be optimized. Integrating torrefaction with other thermochemical and biochemical processes could be a feasible option to improve the performance of the torrefaction process. In that regard, this study evaluates the techno-economic feasibility of integrating the torrefaction with anaerobic digestion (AD). In addition, new process configurations were studied to identify the possible heat energy recovery options. Technical feasibility was tested through mass and energy balance at each process unit. The economic indicators such as net present value (€), minimum selling price and internal rate on return (%) were used to evaluate the economic performance. At 10 t/h of torrefied biomass pellets production capacity, the estimated bio-methane production from AD was 369 m^3/h. The economic evaluation shows that the minimum selling price of the torrefied biomass to reach the breakeven could be reduced from 199 €/t for standalone torrefaction to 185 €/t in case of torrefaction integrated with AD. The sensitivity analysis shows that feedstock and total capital investment were the most sensitive input parameters. This study shows that integrating the torrefaction with AD has better technical and economic feasibility than standalone torrefaction.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy
Contributors: Doddapaneni, T. R. K. C., Praveenkumar, R., Tolvanen, H., Rintala, J., Konttinen, J.
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Journal: Applied Energy
Volume: 213
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Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law
Keywords: Energy recovery, Minimum selling price, Process integration, Techno-economic analysis, Torrefaction – anaerobic digestion, Torrefied pellets
DOIs:

10.1016/j.apenergy.2018.01.045
Source: Scopus
Source ID: 85041461877
Research output: Contribution to journal › Article › Scientific › peer-review

TOpti: a flexible framework for optimising energy management for various ship machinery topologies

In the early stages of the ship design process, the system designer must choose which type of machinery system will be used to power the ship. Hybrid power systems, which are familiar in the automotive industry, have started making a breakthrough in the marine industry. However, defining the length of the financial payback period is not trivial for ship designers, which makes it harder to adopt these more expensive technologies. The shortage of on-board machinery integration software for maritime engineers has motivated the authors of this article to develop a tool that can assist ship designers in making the right choices early in the design process. Discovering the optimal power system design for a specified vessel’s operation requires optimal machinery control. This article presents a novel method to optimise the machinery control of a system specified by the tool user. A case study is presented using a fishing boat with both diesel-mechanical and hybrid electric power systems.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, Wärtsilä Norway AS
Contributors: Jaurola, M., Hedin, A., Tikkanen, S., Huhtala, K.
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ASJC Scopus subject areas: Oceanography, Ocean Engineering, Mechanics of Materials, Mechanical Engineering
Keywords: Fishing boat, Hybrid propulsion, Numerical optimisation, Optimal energy management, Ship power system
Electronic versions:

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DOIs:

10.1007/s00773-018-0617-4
URLs:

http://urn.fi/URN:NBN:fi:tty-201901081027
Source: Scopus
Source ID: 85058061920
Research output: Contribution to journal › Article › Scientific › peer-review

Ultrafast Processing of Hierarchical Nanotexture for a Transparent Superamphiphobic Coating with Extremely Low Roll-Off Angle and High Impalement Pressure

Low roll-off angle, high impalement pressure, and mechanical robustness are key requirements for super-liquid-repellent surfaces to realize their potential in applications ranging from gas exchange membranes to protective and self-cleaning materials. Achieving these properties is still a challenge with superamphiphobic surfaces, which can repel both water and low-surface-tension liquids. In addition, fabrication procedures of superamphiphobic surfaces are typically slow and expensive. Here, by making use of liquid flame spray, a silicon dioxide-titanium dioxide nanostructured coating is fabricated at a high velocity up to 0.8 m s^{-1}. After fluorosilanization, the coating is superamphiphobic with excellent transparency and an extremely low roll-off angle; 10 µL drops of n-hexadecane roll off the surface at inclination angles even below 1°. Falling drops bounce off when impacting from a height of 50 cm, demonstrating the high impalement pressure of the coating. The extraordinary properties are due to a pronounced hierarchical nanotexture of the coating.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Physics, Max Planck Institute for Polymer Research
Contributors: Teisala, H., Geyer, F., Haapanen, J., Juuti, P., Mäkelä, J. M., Vollmer, D., Butt, H. J.
Publication date: 2018
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Early online date: 2018

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Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: Omniphobic, Spray coating, Superhydrophobic, Superoleophobic, Wetting
DOIs:

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Bibliographical note
EXT="Teisala, Hannu"
Source: Scopus
Source ID: 85042475436
Research output: Contribution to journal › Article › Scientific › peer-review

Analysis of common rail pressure signal of dual-fuel large industrial engine for identification of injection duration of pilot diesel injectors

In this paper, we address the problem of identification of injection duration of common rail (CR) diesel pilot injectors of dual-fuel engines. In these pilot injectors, the injected volume is small and the repeatability of injections and identification of drifts of injectors are important factors, which need to be taken into account in order to achieve good repeatability (shot-

to-shot with every cylinder) and therefore a well-balanced engine and furthermore reduced overall wear. This information can then be used for calibration and diagnostics purposes to guarantee engine longevity facilitated by consistent operating conditions throughout the life of the unit. A diagnostics method based on analysis of CR pressure with experimental results is presented in this paper. Using the developed method, the relative duration of injection events can be identified for multiple injectors. We use the phenomenon of drop in rail pressure due to an injection event as a feature of the injection process. The method is based on filtered CR pressure data during and after the injection event. First, the pressure signal during injection is extracted after control of each injection event. After that, the signal is normalized and filtered. Then a derivative of the filtered signal is calculated. Change in the derivative of the filtered signal larger than a predefined threshold indicates an injection event that can be detected and its relative duration can be identified. We present the experimental results and demonstrate the efficacy of the proposed methods using two different types of pressure sensors. We are able to properly identify a change of ≥10 μs (2%, 500 μs) in injection time. This shows that the developed method detects drifts in injection duration and the magnitude of drift. This information can be used for adaptive control of injection duration, so that finally the injected fuel volume is the same as the original.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering
Contributors: Krogerus, T., Hyvönen, M., Huhtala, K.
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ISSN (Print): 0016-2361
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Signal Processing, Modelling and Simulation, Applied Mathematics
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URLs:

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

Generic platform for manufacturing execution system functions in knowledge-driven manufacturing systems
Information technologies grow rapidly nowadays with the advance and extension of computing capabilities. This growth affects several fields, which consume these technologies. Industrial Automation is not an exception. This publication describes a general and flexible architecture for implementing Manufacturing Execution System (MES) function, which can be deployed in multiple industrial cases. These features are achieved by combining the flexibility of knowledge-driven systems with the vendor-independent property of RESTful web services. With deployment of this solution, MES functions may gain more versatility and independency. This research work is a continuation of the development of the OKD-MES (Open Knowledge-Driven Manufacturing Execution System) framework during the execution of the eScop project. The OKD-MES framework consists on a semantic-based solution for controlling and enhancing the flexibility and re-configurability of MES. In such scope, this research presents MES functions architecture that might be implemented in the OKD-MES framework in order to increase the flexibility of event-driven manufacturing systems.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, Research group: Factory automation systems technology, Politecnico di Milano
Contributors: Mohammed, W. M., Ramis Ferrer, B., Iarovyi, S., Negri, E., Fumagalli, L., Lobov, A., Martinez Lastra, J. L.
Number of pages: 13
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Publication date: 4 Mar 2018
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Original language: English
ASJC Scopus subject areas: Aerospace Engineering, Mechanical Engineering, Computer Science Applications, Electrical and Electronic Engineering
Keywords: Knowledge-driven manufacturing systems, manufacturing execution system functions, semantics
DOIs:
10.1080/0951192X.2017.1407874
Source: Scopus
Source ID: 85034843058
Research output: Contribution to journal › Article › Scientific › peer-review

Hydrazone crosslinked hyaluronan-based hydrogels for therapeutic delivery of adipose stem cells to treat corneal defects

Corneal blindness is a worldwide problem, plagued by insufficient amount of high-quality donor tissue. Cell therapy using human adipose stem cells (hASCs) has risen as an alternative to regenerate damaged corneal stromal tissue, the main structural and refractive layer of the cornea. Herein we propose a method to deliver hASCs into corneal defects in hyaluronan (HA)-based hydrogels, which form rapidly in situ by hydrazone crosslinking. We fabricated two different HA-based hydrazone-crosslinked hydrogels (HALD1-HACDH and HALD2-HAADH), and characterized their swelling, degradation, mechanical, rheological and optical properties and their ability to support hASC survival. To promote hASC attachment and survival, we incorporated collagen I (col I) to the more stable HALD1-HACDH hydrogel, since the HALD2-HAADH hydrogel suffered swift degradation in culture conditions. We then used an organ culture model with excised porcine corneas to study the delivery of hASCs in these three hydrogels for stromal defect repair. Although all hydrogels showed good hASC survival directly after encapsulation, only the collagen-containing HALD1-HACDH-col I hydrogel showed cells with elongated morphology, and significantly higher cell metabolic activity than the HALD1-HACDH gel. The addition of col I also increased the stiffness and reduced the swelling ratio of the resulting hydrogel. Most importantly, the corneal organ culture model demonstrated these hydrogels as clinically feasible cell delivery vehicles to corneal defects, allowing efficient hASC integration to the corneal stroma and overgrowth of corneal epithelial cells.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Materials Science, Research group: Micro and Nanosystems Research Group, Research group: Biomaterials and Tissue Engineering Group, BioMediTech Institute and Faculty of Medicine and Life Sciences, BioMediTech Institute and Faculty of Biomedical Sciences and Engineering
Contributors: Koivusalo, L., Karvinen, J., Sorsa, E., Jönkkäri, I., Väliaho, J., Kallio, P., Ilmarinen, T., Miettinen, S., Skottman, H., Kellomäki, M.
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Volume: 85
ISSN (Print): 0928-4931
Ratings:
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering
Keywords: Adipose stem cells, Cell delivery, Collagen I, Corneal stroma, Hyaluronan, Hydrogel
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Bibliographical note

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Source: Scopus
Source ID: 85038877709
Research output: Contribution to journal › Article › Scientific › peer-review

Investigating the kinetics and biofuel properties of Alstonia congensis and Ceiba pentandra via torrefaction

Alstonia congensis (Ahun) and Ceiba pentandra (Araba) were chosen as representations of tropical wood in this study. The use of untreated wood for energy recovery could lead to a high loss in efficiency. One way of circumventing this in a developing country such as Nigeria is by exposing the fuel materials to a pre-treatment, such as torrefaction, prior to deployment. Attempts were made to improve the combustion properties of these resources and also to investigate their torrefaction kinetics. Derivations of kinetic parameters using Coats-Redfern method were discontinued due to inconsistent results. A non-linear regression method was then employed and the results compared to the average value obtained by the FWO method, which was considered more viable than the Coats-Redfern method. The kinetic parameters (E_a,A and n) derived by the regression method are 134.45 kJ/mol, 1.83E+13 min^{-1} and 2.15, respectively, for Araba and 143.38 kJ/mol, 1.90E+10 min^{-1} and 2.28, respectively, for Ahun. The thermal behaviour of the samples showed that a lower mass yield resulted in a lower energy yield, while the heating values increased with the temperature of torrefaction. The results obtained in this study affirm the possibility of obtaining an optimum conversion of these resources for energy recovery.

General information

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Contributors: Oluoti, K., Doddapaneni, T. R. K., Richards, T.
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Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Pollution, Energy(all), Mechanical Engineering, Industrial and Manufacturing Engineering, Electrical and Electronic Engineering
Keywords: Alstonia congensis, Ceiba pentandra, Energy densification, Kinetic parameters, Mini-grid, Torrefaction
DOIs:

10.1016/j.energy.2018.02.086
Source: Scopus
Source ID: 85042679330
Research output: Contribution to journal › Article › Scientific › peer-review

Computational design of a novel medium-carbon, low-alloy steel microalloyed with niobium

The design of a new steel with specific properties is always challenging owing to the complex interactions of many variables. In this work, this challenge is dealt with by combining metallurgical principles with computational thermodynamics and kinetics to design a novel steel composition suitable for thermomechanical processing and induction heat treatment to achieve a hardness level in excess of 600 HV with the potential for good fracture toughness. CALPHAD-based packages for the thermodynamics and kinetics of phase transformations and diffusion, namely Thermo-Calc® and JMatPro®, have been combined with an interdendritic segregation tool (IDS) to optimize the contents of chromium, molybdenum and niobium in a proposed medium-carbon low-manganese steel composition. Important factors taken into account in the modeling and optimization were hardenability and as-quenched hardness, grain refinement and alloying cost. For further investigations and verification, the designed composition, i.e., in wt.% 0.40C, 0.20Si, 0.25Mn, 0.90Cr, 0.50Mo, was cast with two nominal levels of Nb: 0 and 0.012 wt.%. The results showed that an addition of Nb decreases the austenite grain size during casting and after slab reheating prior to hot rolling. Validation experiments showed that the predicted properties, i.e., hardness, hardenability and level of segregation, for the designed composition were realistic. It is also demonstrated that the applied procedure could be useful in reducing the number of experiments required for developing compositions for other new steels.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Metals Technology, Univ of Oulu, Materials Science Research Group, EFD Induction a.s
Contributors: Javaheri, V., Nyyssönen, T., Grande, B., Porter, D.
Number of pages: 15
Pages: 2978-2992

Publication date: Jun 2018
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Volume: 27
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: CALPHAD, computational design, homogenization, IDS, JMatPro, microsegregation, prior austenite grain size, Thermo-Calc, wear resistance steel
DOIs:

10.1007/s11665-018-3376-9
URLs:

http://www.scopus.com/inward/record.url?scp=85045890232&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 85045890232
Research output: Contribution to journal › Article › Scientific › peer-review

Luminescence of Er^{3+} doped oxyfluoride phosphate glasses and glass-ceramics
Glasses with the composition (75 $NaPO_3$-(25-x) CaO-xCaF_2) (in mol %) were prepared with 0.15 mol% of Er_2O_3. The effect of the glass composition and of heat treatment on the spectroscopic properties of the newly developed glasses is reported. With the progressive replacement of CaO by CaF_2, the Er^{3+}:$^4I_{13/2}$ lifetime and the intensity of the upconversion emission increase whereas the intensity of the emission at 1.5 μm decreases due to the decrease in the phonon energy in the as-prepared glasses. The glasses were heat treated at 20 °C above their respective glass transition temperature for 17 h to form nuclei and then at their crystallization temperature from 15min to 1 h to grow the nuclei into crystals. The heat treatment leads to the precipitation of crystalline phases, the composition of which depends upon the glass composition. As the Er^{3+}:$^4I_{13/2}$ lifetime increases and the intensity of the upconversion increases for the glass with x = 0 after heat treatment, the Er^{3+} ions are expected to be incorporated into the phosphate-based crystals. However, as the shape of the emission band at 1.5 μm remains unchanged and the intensity of the upconversion decreases significantly after heat treatment of the glasses with x > 10, the crystals found in the glass-ceramics with x > 10 are thought to free of Er^{3+} ions. Although Er^{3+} ions entered in the CaF_2 crystals precipitating in aluminosilicate glass, the Er^{3+} ions are believed to remain in the amorphous phosphate part of the glass-ceramic containing CaF_2 crystals.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Faculty of Engineering Sciences, Research group: Biomaterials and Tissue Engineering Group, Materials Science, Photonics, Istituto Superiore Mario Boella
Contributors: Nommeots-Nomm, A., Boetti, N. G., Salminen, T., Massera, J., Hokka, M., Petit, L.
Number of pages: 7
Pages: 224-230
Publication date: 30 Jun 2018
Peer-reviewed: Yes

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Volume: 751
ISSN (Print): 0925-8388
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Scopus rating (2018): CiteScore 6.7 SJR 1.065 SNIP 1.412
Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Metals and Alloys, Materials Chemistry
Keywords: CaF crystals in glass, Er luminescence, Oxyfluoride phosphate glasses and glass-ceramics
DOIs:

10.1016/j.jallcom.2018.04.101
Source: Scopus
Source ID: 85045405038
Research output: Contribution to journal › Article › Scientific › peer-review

Persistent luminescent borosilicate glasses using direct particles doping method

Persistent luminescence (PeL) was obtained, from the first time to the best of our knowledge, from borosilicate bulk glasses. The glasses were prepared using direct doping method. Commercial PeL $SrAl_2O_4:Eu^{2+},Dy^{3+}$ microparticles (MPs) were added in the borosilicate glass after melting. The persistent luminescence can be augmented when casting the glass 3 min after adding the MPs at 950 °C. Although the borosilicate glasses exhibit persistent luminescence, the glass melt has a corrosive behavior on the MPs leading to the diffusion of Al and Sr into the glasses.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Turku University of Applied Science
Contributors: Roldán Del Cerro, P., Salminen, T., Lastusaari, M., Petit, L.
Number of pages: 4
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Publication date: 1 Jul 2018
Peer-reviewed: Yes

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Journal: Scripta Materialia
Volume: 151
ISSN (Print): 1359-6462
Ratings:

Scopus rating (2018): CiteScore 7.6 SJR 2.185 SNIP 1.997
Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering, Metals and Alloys
Keywords: Borosilicate glasses, Corrosion, Direct particle doping method, Persistent luminescence, SrAlO:Eu,Dy microparticles
DOIs:

10.1016/j.scriptamat.2018.03.034
Source: Scopus
Source ID: 85056171139
Research output: Contribution to journal › Article › Scientific › peer-review

Enhanced resonant nonlinear absorption and optical limiting in Er^{3+} ions doped multicomponent tellurite glasses

Nonlinear optical properties of multicomponent tellurite glasses doped with Er^{3+} ions were investigated by open aperture Z-scan measurements. Compositional and linear optical properties of the glasses were examined by the energy dispersive X-ray spectrum and UV–vis–NIR absorption spectrum analysis respectively. The mechanism behind the optical nonlinearity and optical limiting efficiency was successfully explained by evaluating the physical properties such as density, refractive index and polarizability of the glasses. The nonlinear properties critically depend on the polarizability, which is found to increase with the addition of Er^{3+} ions by the creation of non-bridging oxygen ions. By the systematic addition of Er^{3+} ions, we have dictated the physical properties and thus tuned the optical limiting efficiency of the glasses. This makes the Er^{3+}-doped multicomponent tellurite glasses flexible tunable optical limiters for potential device applications.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Mahatma Gandhi University
Contributors: Sajna, M. S., Perumbilavil, S., Prakashan, V. P., Sanu, M. S., Joseph, C., Biju, P. R., Unnikrishnan, N. V.
Number of pages: 9
Pages: 227-235
Publication date: 1 Aug 2018
Peer-reviewed: Yes

Publication information

Journal: Materials Research Bulletin
Volume: 104
ISSN (Print): 0025-5408
Ratings:

Scopus rating (2018): CiteScore 5.4 SJR 0.744 SNIP 0.921
Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering
Keywords: Multiphoton absorption, Optical limiting, Optical nonlinearity, Tellurite glasses, Z-scan technique

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10.1016/j.materresbull.2018.04.026
Source: Scopus
Source ID: 85046365437
Research output: Contribution to journal › Article › Scientific › peer-review

Complete Odometry Estimation of a Vehicle Using Single Automotive Radar and a Gyroscope

In this paper, we propose an algorithm for complete odometry of a vehicle on a horizontal plane., that is., estimation of linear velocity vector (forward and sideslip speeds) and angular speed of a vehicle. The vehicle is equipped with an automotive Radar sensor and a vertical gyro. The Radar sensor provides radial speed and azimuth angle of number of objects in the environment. We first derive the kinematic constraints imposed on the vehicle motion and stationary points in the environment. Using the constraints we classify the points detected by the Radar to stationary and non-stationary points. It is known that using data from a single Radar., the abovementioned constraints are singular. Previous works have thus proposed the use of more than one Radar sensor., or they have neglected the sideslip speed. In our work, we then use the Radar data of the stationary objects and a gyro data to solve an optimization algorithm to calculate vehicle odometry. Experimentation has been performed with a non-road vehicle driven on a straight path and on a circular path. We report our findings and show efficacy of the algorithm in comparison to the state of art [8] as well as wheel odometry and a complete navigation solution (including GNSS) as the reference path.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering
Contributors: Ghabcheloo, R., Siddiqui, S.
Number of pages: 6
Pages: 855-860
Publication date: 20 Aug 2018

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Article number: 8442474
ISBN (Print): 9781538678909
ASJC Scopus subject areas: Artificial Intelligence, Control and Systems Engineering, Mechanical Engineering, Control and Optimization
DOIs:
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Bibliographical note

INT=aut,"Siddiqui, Shadman"
Source: Scopus
Source ID: 85053455838
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Experimental and numerical study of wall layer development in a tribocharged fluidized bed

The effects of triboelectricity in a small-scale fluidized bed of polyethylene particles were investigated by imaging the particle layer in the vicinity of the column wall and by measuring the pressure drop across the bed. The average charge on the particles was altered by changing the relative humidity of the gas. A triboelectric charging model coupled with a computational fluid dynamics-discrete element method (CFD-DEM) model was utilized to simulate gas-particle flow in the bed. The electrostatic forces were evaluated based on a particle-particle particle-mesh method, accounting for the surface charge on the insulating walls. It was found that simulations with fixed and uniform charge distribution among the particles capture remarkably well both the agglomeration of the particles on the wall and the associated decrease in the pressure drop across the bed. With a dynamic tribocharging model, the charging rate had to be accelerated to render the computations affordable. Such simulations with an artificial acceleration significantly over-predict charge segregation and the wall becomes rapidly sheeted with a single layer of strongly charged particles.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Mechanical Engineering and Industrial Systems, Research area: Design, Development and LCM, Princeton University, Herriot-Watt University
Contributors: Sippola, P., Kolehmainen, J., Ozel, A., Liu, X., Saarenrinne, P., Sundaresan, S.
Number of pages: 25
Pages: 860-884

Publication date: 25 Aug 2018
Peer-reviewed: Yes

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Journal: Journal of Fluid Mechanics
Volume: 849
ISSN (Print): 0022-1120
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Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering
Keywords: fluidized beds, multiphase and particle-laden flows
Electronic versions:

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DOIs:

10.1017/jfm.2018.412
URLs:

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Bibliographical note
EXT="Kolehmainen, Jari"
Source: Scopus
Source ID: 85049138540
Research output: Contribution to journal › Article › Scientific › peer-review

Inertial Sensor-Based State Estimation of Flexible Links Subject to Bending and Torsion

In this study, we propose an observer design based on inertial sensors and the finite element (FE) method to estimate the flexural states of a long-reach and highly flexible manipulator in a 3D plane of motion. Vertical and lateral dynamic bendings are considered, along with deformation due to torsion. The aim is to achieve accurate end-point positioning by using the estimated flexural degrees-of-freedom, which are formulated using an FE model. The states are reconstructed based on angular velocity measurements, which are obtained from strap-on inertial sensors placed along the flexible link. For validation, a motion-capture setup consisting of three OptiTrack cameras is used. The experiments are conducted on a hydraulic manipulator that has a single 4.5-m long flexible link with a tip mass. The validation is carried out by comparing the estimates to the OptiTrack reference measurements. The results demonstrate that this method provides satisfactory end-point positioning, while also being convenient for use in heavy-duty mobile manipulators.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering, Research group: Innovative Hydraulic Automation
Contributors: Mäkinen, P., Mononen, T., Mattila, J.
Number of pages: 8
Publication date: 27 Aug 2018

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ISBN (Print): 9781538646434
ASJC Scopus subject areas: Control and Optimization, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Instrumentation
Keywords: finite element method, inertial sensors, state estimation
Electronic versions:

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URLs:

http://urn.fi/URN:NBN:fi:tuni-202001271550
Source: Scopus
Source ID: 85053925148
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Real-time and Robust Collaborative Robot Motion Control with Microsoft Kinect ® v2

Recent development in depth sensing provide various opportunities for the development of new methods for Human Robot Interaction (HRI). Collaborative robots (co-bots) are redefining HRI across the manufacturing industry. However, little work has been done yet in the field of HRI with Kinect sensor in this industry. In this paper, we will present a HRI study using nearest-point approach with Microsoft Kinect v2 sensor's depth image (RGB-D). The approach is based on the Euclidean distance which has robust properties against different environments. The study aims to improve the motion performance of Universal Robot-5 (UR5) and interaction efficiency during the possible collaboration using the Robot Operating System (ROS) framework and its tools. After the depth data from the Kinect sensor has been processed, the nearest points differences are transmitted to the robot via ROS.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Signal Processing, Research group: Vision
Contributors: Teke, B., Lanz, M., Kämäräinen, J., Hietanen, A.
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Title of host publication: 2018 14th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, MESA 2018
Publisher: IEEE
Article number: 8449156
ISBN (Print): 9781538646434
ASJC Scopus subject areas: Control and Optimization, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Instrumentation
Keywords: collaborative robots, human-robot collaboration, Human-robot interaction, Microsoft Kinect v2, ROS, trajectory planning
Electronic versions:

08449156
DOIs:

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http://urn.fi/URN:NBN:fi:tty-201907151956

Bibliographical note

INT=mei,"Teke, Burak"
Source: Scopus
Source ID: 85053893135
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Role-based visualization of industrial IoT-based systems

The competition among manufacturers in the global markets calls for the enhancement of the agility and performance of the production process and the quality of products. As a result, the production systems should be designed in such a way to provide decision makers with visibility and analytics. To fulfill these objectives, the development of information systems in manufacturing industries has intensified in the past few years. On the other hand, the volume of data which is being generated on the shop floor is rising. To improve the efficiency of manufacturing processes, this amount of data should be analyzed by decision makers. To cope with this challenge, advanced visualization is needed to assist users to gain insight into data and make effective decisions faster. This paper describes an approach for building a role-based visualization of industrial IoT. We propose an extendible architecture that anticipates the future growth of data. By using the IoT platform introduced in this paper, selected Key Performance Indicators(KPI) can be monitored by different levels of enterprise. The prototype IoT dashboard has been implemented for a pilot production line 'Festo didactic training line' located in Seinäjoki University of Applied Sciences(SeAMK) and results have been validated.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Seinäjoki University of Applied Sciences
Contributors: Mahmoodpour, M., Lobov, A., Lanz, M., Mäkelä, P., Rundas, N.
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Publisher: IEEE
Article number: 8449183
ISBN (Print): 9781538646434
ASJC Scopus subject areas: Control and Optimization, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Instrumentation
Keywords: Data Collection, Information Visualization, Internet of Things (IoT)
DOIs:
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Source: Scopus
Source ID: 85053938410
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Solvothermal synthesis derived Co-Ga codoped ZnO diluted magnetic degenerated semiconductor nanocrystals

Here we are reporting solvothermal synthesis derived diluted magnetic and plasmonic Co-Ga co-doped ZnO nanocrystals with high magnetization values (from 1.02 to 4.88 emu/g) at room temperature. Co-Ga co-doped ZnO nanocrystals show up to 2 fold increase in saturation magnetization compared to Co doped ZnO nanocrystals at the same Co concentration, with the observed room temperature magnetization higher than previously reported values for multifunctional magnetic and plasmonic nanocrystals, and the effect of Ga suggesting some role of the correspondingly introduced itinerant charge. While at the lowest Ga content the nanoparticles appear homogeneously doped, we note that already a moderate Ga content of several percent triggers a fraction of Co to segregate in metallic form in the bulk of the nanoparticles. However, the amount of segregated Co is not sufficient to account for the total effect, whereas a dominating contribution to the observed magnetism has to be related to itinerant charge mediated exchange interactions.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Institute of Physics, University of Tartu, Riga Technical University, University of Turku, Helmholtz Centre Berlin for Materials and Energy, University of Latvia, RMS Foundation, Institute of Solid State Physics University of Latvia
Contributors: Šutka, A., Käämbre, T., Joost, U., Kooser, K., Kook, M., Duarte, R. F., Kisand, V., Maiorov, M., Döbelin, N., Smits, K.
Number of pages: 9
Pages: 164-172
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Volume: 763
ISSN (Print): 0925-8388
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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Metals and Alloys, Materials Chemistry
Keywords: Degenerated semiconductors, Diluted magnetic semiconductors, Doping, Plasmonic nanocrystals, Solvothermal synthesis, ZnO
DOIs:
10.1016/j.jallcom.2018.05.036

Bibliographical note

int=fot,"Joost, Urmas"
Source: Scopus
Source ID: 85048730804
Research output: Contribution to journal › Article › Scientific › peer-review

Icephobicity of Slippery Liquid Infused Porous Surfaces under Multiple Freeze–Thaw and Ice Accretion–Detachment Cycles

Surface engineering can be used to prevent ice accumulation and adhesion in environments that deal with icing problems. One recent engineering approach, slippery liquid infused porous surfaces (SLIPS), comprises a smooth and slippery lubricating surface, where lubricant is trapped within the pores of a solid material to repel various substances, such as water and ice. However, it remains unclear whether the slippery surfaces retain their icephobic characteristics under the impact of supercooled water droplets or repeated freezing and melting cycles. Here, the icephobic properties of SLIPS are evaluated under multiple droplet freeze–thaw and ice accretion–detachment cycles and compared to hydrophobic and

superhydrophobic surfaces. The experiments are designed to mimic real environmental conditions, thus, the icephobicity is investigated in icing wind tunnel, where ice accretion occurs through the impact of supercooled water droplets. The adhesion of ice remained extremely low, <10 kPa, which is four times lower than ice adhesion onto smooth fluoropolymer surfaces, even after repeated ice accretion–detachment cycles. Moreover, cyclic droplet freeze–thaw experiments provide insight into the effects of temperature cycling on SLIPS wettability, showing stable wetting performance. The results suggest liquid infused porous surfaces as a potential solution to icephobicity under challenging and variating environmental conditions.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Surface Engineering, Materials Science, Physics, Bioscience and Materials/Surface, RISE Research Institutes of Sweden, Physics at Interfaces, Max Planck Institute for Polymer Research, Paper Converting and Packaging Technology
Contributors: Niemelä-Anttonen, H., Koivuluoto, H., Tuominen, M., Teisala, H., Juuti, P., Haapanen, J., Harra, J., Stenroos, C., Lahti, J., Kuusipalo, J., Mäkelä, J. M., Vuoristo, P.
Publication date: Oct 2018
Peer-reviewed: Yes
Early online date: 2018

Publication information
Journal: Advanced Materials Interfaces
Volume: 5
Issue number: 20
ISSN (Print): 2196-7350
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Scopus rating (2018): CiteScore 6.4 SJR 1.57 SNIP 0.849
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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering
Keywords: functional coatings, ice adhesion, icephobic surfaces, slippery liquid infused porous surfaces (SLIPS), superhydrophobic surfaces
DOIs:

10.1002/admi.201800828

Bibliographical note
EXT="Teisala, Hannu"
Source: Scopus
Source ID: 85052396689
Research output: Contribution to journal › Article › Scientific › peer-review

Flux-Weakening Control for IPMSM Employing Model Order Reduction
The variation of magnetic parameters due to the magnetic saturation and cross coupling can affect the efficiency and the stability of the control system in electrical machines, especially at high-speed operation. This paper presents an approach independent of the magnetic model parameters to control synchronous motors at the flux-weakening region. In this approach, a model order reduction technique is applied to reduce the finite element model of a synchronous machine. The stator current components and the flux linkage components are the inputs and the outputs of the reduced model, respectively. The reduced model and its inversion are employed to calculate the current reference components from the reference torque. Field oriented control scheme is utilized to implement the overall control system. The proposed control system is validated by means of simulation and experiment on a 2.2 kW permanent magnet synchronous machine.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering, Aalto University, Tallinn University of Technology
Contributors: Far, M. F., Mustafa, B., Martin, F., Rasilo, P., Belahcen, A.
Number of pages: 7
Pages: 1510-1516
Publication date: 24 Oct 2018

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Publisher: IEEE
ISBN (Electronic): 9781538624777
ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering, Mechanical Engineering

Keywords: Flux weakening, Interior permanent magnet synchronous motor, Model order reduction, Orthogonal interpolation method, Vector control
Electronic versions:

Flux-Weakening Control for IPMSM Employing Model Order Reduction
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10.1109/ICELMACH.2018.8506693
URLs:

http://urn.fi/URN:NBN:fi:tuni-201910023644
Source: Scopus
Source ID: 85057179831
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Model Order Reduction of Bearingless Reluctance Motor Including Eccentricity

Eccentricity in a bearingless motor may occur during different operating states of the machine. This rises challenges in designing robust control for the machine with a lumped parameter model, due to the cross coupling of the windings with respect to the eccentric position of the rotor, the saturation of the ferromagnetic material, and spatial complexity. The non-linearity of the ferromagnetic material and the spatial harmonics can be considered in a finite element model of the machine, although applying it in a real time system is unreasonable. We propose a novel method based on orthogonal interpolation to reduce the order of the 2D finite element model of a bearingless synchronous reluctance motor, suitable for implementation in a real-time system. The winding currents and the eccentricity are given as inputs to the reduced model and the nodal values of the magnetic vector potential is obtained as the output, wherefrom the flux linkages, torque, and forces can be computed easily.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering, Aalto University, Tallinn University of Technology
Contributors: Far, M. F., Mukherjee, V., Martin, F., Rasilo, P., Belahcen, A.
Number of pages: 7
Pages: 2243-2249
Publication date: 24 Oct 2018

Host publication information

Title of host publication: 2018 23rd International Conference on Electrical Machines, ICEM 2018
Publisher: IEEE
ISBN (Electronic): 9781538624777
ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering, Mechanical Engineering
Keywords: Bearingless synchronous reluctance motor, Eccentricity, Finite element analysis, Model order reduction, Orthogonal interpolation method
Electronic versions:

Model Order Reduction of Bearingless Reluctance Motor Including Eccentricity
DOIs:

10.1109/ICELMACH.2018.8506758
URLs:

http://urn.fi/URN:NBN:fi:tuni-201910023643
Source: Scopus
Source ID: 85057162208
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Enhanced multiaxial fatigue criterion that considers stress gradient effects

Modification of a fatigue criterion valid for homogeneous multiaxial stress states to account for the beneficial effect of stress gradients is traditionally performed by modifying the stress terms in the fatigue criterion and thereby introducing new parameters that need to be calibrated. Here the stress terms are left unchanged and, instead, the parameters in the fatigue criterion are modified. This modification is performed, in principle, along the lines of Siebel and Stieler and it introduces Neuber's parameter as the only new parameter; however, as soon as the ultimate strength of the material is known, also Neuber's parameter is known. Therefore, the methodology introduced implies that no new calibration process is needed. Here a specific fatigue criterion valid for homogeneous multiaxial stress states is enhanced by this procedure and predictions of this simple approach are compared with a broad range of experimental data and good accuracy is achieved. Moreover, the approach adopted can be applied to other fatigue criteria than the one considered here.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed
Organisations: Civil Engineering, Lund University
Contributors: Ottosen, N. S., Ristinmaa, M., Kouhia, R.
Number of pages: 12
Pages: 128-139
Publication date: 1 Nov 2018
Peer-reviewed: Yes

Publication information
Journal: International Journal of Fatigue
Volume: 116
ISSN (Print): 0142-1123
Ratings:

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Original language: English
ASJC Scopus subject areas: Modelling and Simulation, Materials Science(all), Mechanics of Materials, Mechanical Engineering, Industrial and Manufacturing Engineering
Keywords: Fatigue, Gradient effects, Multiaxial fatigue
DOIs:

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Source: Scopus
Source ID: 85048733879
Research output: Contribution to journal › Article › Scientific › peer-review

Less Is More: Enhancement of Second-Harmonic Generation from Metasurfaces by Reduced Nanoparticle Density
We investigate optical second-harmonic generation (SHG) from metasurfaces where noncentrosymmetric V-shaped gold nanoparticles are ordered into regular array configurations. In contrast to expectations, a substantial enhancement of the SHG signal is observed when the number density of the particles in the array is reduced. More specifically, by halving the number density, we obtain over 5-fold enhancement in SHG intensity. This striking result is attributed to favorable interparticle interactions mediated by the lattice, where surface-lattice resonances lead to spectral narrowing of the plasmon resonances. Importantly, however, the results cannot be explained by the improved quality of the plasmon resonance alone. Instead, the lattice interactions also lead to further enhancement of the local fields at the particles. The experimental observations agree very well with results obtained from numerical simulations including lattice interactions.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Institute of Physics, Nicolaus Copernicus University, University of Eastern Finland, CRPP
Contributors: Czaplicki, R., Kiviniemi, A., Huttunen, M. J., Zang, X., Stolt, T., Vartiainen, I., Butet, J., Kuittinen, M., Martin, O. J., Kauranen, M.
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ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: interparticle interactions, Metal nanoparticles, nonlinear optics, plasmonic resonances, second-harmonic generation, surface-lattice resonances
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10.1021/acs.nanolett.8b03378
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URLs:

https://arxiv.org/abs/1808.06439 (ArXiv version)
Source: Scopus
Source ID: 85058303843
Research output: Contribution to journal › Article › Scientific › peer-review

A TOpti simulation for finding fuel saving by optimising propulsion control and power management

The optimisation of load shares between parallel power sources is essential for fuel-efficient propulsion systems. A more complete power management problem can be formulated by including the propeller and its propulsion control. Not only does this allow for a reduction in the propeller load under the changing operating conditions of the vessel, but also it enables the minimisation of the machinery's fuel consumption at load- and speed-dependent efficiency models. The need to optimise the design of the machinery in marine vessels has motivated the authors of the current article to develop a design tool for this purpose. The present case study gives an overview of the tool's features and compares the optimal power management of a fishing boat with different propulsion control variants. Compared with a controllable pitch propeller, which is operated at a fixed speed, reductions in fuel consumption were achieved with reduced propeller speeds. The best fuel savings, approximately 11%, were achieved using a two-speed gearbox with a controllable pitch propeller.

General information

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Organisations: Automation Technology and Mechanical Engineering, Wärtsilä Norway AS
Contributors: Jaurola, M., Hedin, A., Tikkanen, S., Huhtala, K.
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ISSN (Print): 0948-4280
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Original language: English
ASJC Scopus subject areas: Oceanography, Ocean Engineering, Mechanics of Materials, Mechanical Engineering
Keywords: Energy-efficient propulsion, Fishing boat, Numerical optimisation, Power management, Propulsion control
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http://urn.fi/URN:NBN:fi:tty-201906201899
Source: Scopus
Source ID: 85066300411
Research output: Contribution to journal › Article › Scientific › peer-review

Behaviour of leaded tin bronze in simulated seawater in the absence and presence of tribological contact with alumina counterbody: Corrosion, wear and tribocorrosion

Corrosion, wear and tribocorrosion behaviours of leaded tin bronze were examined in simulated seawater using alumina counterbody for tribological contact. Active dissolution of alloy and corrosion product development on surfaces were the dominant corrosion mechanisms. Tribological contact with counterbody removed majority of the products, thus contributing to active dissolution of freshly exposed surface. This wear-induced corrosion mechanism contributed to 45% and 60% of total material losses at the two highest potentials, 50 mV and 250 mV vs. Ag/AgCl. Pure wear of alloy occurred in the form of abrasive wear. At anodic potentials under tribological contact, corrosion raised the friction coefficient as compared to pure wear and increased wear of the alloy. These results are presented and discussed in this paper.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Photonics, VTT Technical Research Centre of Finland
Contributors: Huttunen-Saarivirta, E., Isotahdon, E., Metsäjoki, J., Salminen, T., Ronkainen, H., Carpén, L.
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Early online date: 22 Aug 2018

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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Contact: sliding, Surface: chemical analysis, Synergism: tribochemistry, Wear: corrosive
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EXT="Metsäjoki, J."
EXT="Isotahdon, E."
Source: Scopus
Source ID: 85052665246
Research output: Contribution to journal › Article › Scientific › peer-review

Deposition of dry particles on a fin-and-tube heat exchanger by a coupled soft-sphere DEM and CFD

In this study, a novel computational model is utilized for investigating fouling of two commonly encountered heat exchanger fin shapes in an air-conditioning application. The computational method utilizes the discrete element method (DEM) coupled with a large-eddy simulation (LES) framework. The fin-and-tube heat exchangers (FTHE) are investigated for three different Reynolds numbers (Re_{Dh} =243, 528, 793), three different particle sizes (D_p= 5, 10, 20 μm) and two different adhesive particle types based on the experimental values in the literature. The code is first benchmarked from the CFD and DEM viewpoints. A comprehensive fouling study of the FTHE's, consisting of altogether 36 simulations, is then carried out. The major numerical findings of the paper consist of the following four features. First, with low adhesive particles, the plain fin shape has a 3.45 higher volume fouling rate with Re_{Dh} =793 than at Re_{Dh} =264. With the herringbone fin shape, and the low adhesive particles, the volume fouling rate is 1.76 higher with Re_{Dh} =793 than at Re_{Dh} =264. Second, for the high adhesive particles, the plain fin has a 5.4 times higher volume fouling rate at Re_{Dh} =793 than for Re_{Dh} =264. The herringbone fin shape has a 3.92 times higher volume fouling rate with the highest Reynolds number of Re_{Dh} =793 compared to Re_{Dh} =264. Third, high adhesive particles have 3.0 times higher volume fouling rate than low adhesive particles for both fin shapes, all particle sizes and all Reynolds numbers combined. And finally, herringbone fins have 1.74 times higher volume fouling rate than plain fins for low adhesive particles. For high adhesive particles, herringbone has 1.8 times higher volume fouling rate and when both particle types are summed together, herringbone has a 1.78 times higher volume fouling rate than the plain fin shape. As a major finding of the study, the high adhesive particle collection efficiency increases monotonously with the Stokes and Reynolds numbers while low adhesive particle collection efficiency poses a non-monotonous trend.

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Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, Aalborg University, Aalto University
Contributors: Välikangas, T., Hærvig, J., Kuuluvainen, H., Dal Maso, M., Peltonen, P., Vuorinen, V.
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ASJC Scopus subject areas: Condensed Matter Physics, Mechanical Engineering, Fluid Flow and Transfer Processes
Keywords: CFD-DEM, Dry-particle, Fin-and-tube heat exchanger, Fouling, Herringbone fin, Large-eddy simulation, Plain fin, Soft sphere
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URLs:
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Source: Scopus
Source ID: 85075984403
Research output: Contribution to journal › Article › Scientific › peer-review

Design and Control of a Flexible Joint as a Hydraulic Series Elastic Actuator for Manipulation Applications

Lightweight arms with electrical servomotor drives have demonstrated outstanding performance and speed in exoskeletons, prosthesis, and legged robot applications. They all share a similarity in actuation, which is based on series elastic actuators (SEAs). In SEAs, the system benefits from known compliance in the actuation that improves the overall performance, especially in contact with an environment that can have an unknown stiffness in assembly tasks. In some of these cases, harmonic drives or gears on the power transmission lines create the robot's compliance. For hydraulically actuated SEAs, Pratt and Krupp addressed the SEA challenges for lightweight hydraulic manipulators. However, this paper focuses on the design and control architecture of SEAs in heavy-duty manipulation having hydraulic load dynamics with variable stiffness or damping of fluid flexibility. This system faces challenging issues of payload dynamics and compressibility of fluid with high order system. A hydraulic SEA concept is designed, and a fifth-order state space SEA model is feedback controlled in a free space motion to demonstrate load dynamics of hydraulic actuation. In addition, a P controller and a controller based on integral of time-weighted absolute error (ITAE) are designed. The simulation results show the latter has better performance in the spring deflection of the SEA. A mixed working condition that changes from a purely inertia payload to an inertia and elastic reaction force is designed to examine the switching smoothness for varying payloads, and the control adaptability of controllers in different working conditions.

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MoE publication type: A4 Article in a conference publication
Organisations: Automation Technology and Mechanical Engineering, Research group: Innovative Hydraulic Automation, Chang'an University, Tampere University
Contributors: Cao, X., Aref, M. M., Mattila, J.
Number of pages: 6
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Keywords: Elastic Actuator, Heavy Duty Manipulation
DOIs:
10.1109/CIS-RAM47153.2019.9095773

Bibliographical note

INT=atme,"Cao, Xuepeng"
Source: Scopus
Source ID: 85085856758
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Dissolution, bioactivity and osteogenic properties of composites based on polymer and silicate or borosilicate bioactive glass

Bioactive glass (BAG)/Poly (Lactic Acid) (PLA) composites have great potential for bone tissue engineering. The interest in these materials is to obtain a scaffold with tailorable properties bringing together the advantages of the composites' constituents such as the biodegradability, bioactivity and osteoinduction. The materials studied are PLA/13–93 and PLA/13-93B20 (20% of SiO_2 is replaced with B_2O_3 in the 13–93 composition). To characterize them, they were dissolved in TRIS buffer and Simulated Body Fluid (SBF) in vitro. Over the 10 weeks of immersion in TRIS, the ion release from the composites was constant. Following immersion in SBF for 2 weeks, the hydroxyapatite (HA) layer was found to precipitate at the composites surface. By adding Boron, both these reactions were accelerated, as the borosilicate glass dissolves faster than pure silicate glass alone. Polymer degradation was studied and showed that during immersion, the pure PLA rods maintained their molecular weight whereby the composites decreased with time, but despite this the mechanical properties remained stable for at least 10 weeks. Their ability to induce osteogenic differentiation of myoblastic cells was also demonstrated with cell experiments showing that C2C12 cells were able to proliferate and spread on the composites.

The Myosin Heavy Chain and Osteopontin were tracked by immunostaining the cells and showed a suppression of the myosin signal and the presence of osteopontin, when seeded onto the composites. This proves osteoinduction occurred. In studying the mineralization of the cells, it was found that BAG presence conditions the synthesizing of mineral matter in the cells. The results show that these composites have a potential for bone tissue engineering.

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Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Tampere University of Technology, Maison Internationale de la Recherche (MIR)
Contributors: Houaoui, A., Lyyra, I., Agniel, R., Pauthe, E., Massera, J., Boissière, M.
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering
Keywords: Bioactive glass, Composite material, Osteogenic differentiation
DOIs:

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Source: Scopus
Source ID: 85074174905
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of microstructure on the abrasive wear resistance of steels with hardness 450 HV

Hardness has been considered the main factor controlling the abrasive wear of steels. However, microstructure also affects the wear behavior. Four steels with different microstructures were produced with a Gleeble 3800 thermomechanical simulator and tested for abrasive wear behavior. Different cooling rates and heat treatments were applied to obtain a surface hardness of approximately 450 HV. Mainly tempered martensite, pearlite and some bainite could be observed in the microstructures. Scratch testing with a CETR UMT-2 tribometer was conducted to produce wear tracks. The results revealed that each steel showed distinct wear behavior.

General information
Publication status: Published
MoE publication type: B1 Article in a scientific magazine
Organisations: Research group: Materials Characterization, Materials Science and Environmental Engineering, University of Oulu
Contributors: Haiko, O., Heino, V., Porter, D. A., Uusitalo, J., Kömi, J.
Number of pages: 4
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Scopus rating (2019): SJR 0.146 SNIP 0.277
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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Abrasion, Microstructure, Steel
DOIs:

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Source: Scopus
Source ID: 85084455366

Research output: Contribution to journal › Article › Scientific

Effect of polyolefin molecular structure on product properties in extrusion coating

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science and Environmental Engineering, Research group: Paper Converting and Packaging
Contributors: Suokas, E.
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Pages: 89-98
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ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Media Technology, Materials Science(all)
Source: Scopus
Source ID: 85073771221
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Enablers and barriers of smart data-based asset management services in industrial business networks
Recent academic research has paid particular attention to how digitalization disrupts current business models and business environments. Furthermore, servitization has gained significant attention. However, so far only a fraction of the wide range of opportunities related to digitalization has been realized. In this paper we aim to better understand the drivers, limitations and stakeholder expectations in different industrial business environments. In the proposed paper, we address digitalization in the area of engineering asset management from the following perspectives: (1) enablers and barriers of digitalized asset management service business, (2) availability and use of data for decision-making support, and (3) changes for business models. We also further contemplate which decision-making situations need to be supported by digital asset services. The paper is based on data received from a company workshop and a literature review.

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MoE publication type: A3 Part of a book or another research book
Organisations: Mechanical Engineering and Industrial Systems, Research area: Design, Development and LCM, VTT Technical Research Centre of Finland
Contributors: Ahonen, T., Hanski, J., Hyvärinen, M., Kortelainen, H., Uusitalo, T., Vainio, H., Kunttu, S., Koskinen, K.
Number of pages: 10
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Bibliographical note
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Source: Scopus
Source ID: 85056662614
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Impact wear and mechanical behavior of steels at subzero temperatures
In this study, the deformation behavior of three steels was studied at Arctic temperatures by controlled single and multiple oblique angle impacts. The results were compared with the mechanical properties of the steels determined at the

corresponding temperatures. At subzero temperatures, the hardness and strength of the studied steels increased and their ability to deform plastically steadily decreased. In the martensitic steels, adiabatic shear bands were observed to form during the impacts at subzero temperatures, indicating that the deformation ability of the steels was critically impaired. At −60 °C, the adiabatic shear bands commonly acted as initiation sites for subsurface cracks. Moreover, the surface characterization of the test samples revealed formation of cracks and wear particles, which was connected to the opening of grain boundaries and martensite laths at low temperatures. Finite Element Modeling was also used to obtain more information about the impact event.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, University of Nottingham
Contributors: Valtonen, K., Ratia, V., Ramakrishnan, K. R., Apostol, M., Terva, J., Kuokkala, V.
Number of pages: 18
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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
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Source: Scopus
Source ID: 85053014382
Research output: Contribution to journal › Article › Scientific › peer-review

Investigation on positioning control strategy and switching optimization of an equal coded digital valve system

This article concerns high accuracy positioning control with switching optimization for an equal coded digital valve system. Typically, pulse number modulation control cannot realize micro-positioning due to the characteristics of step-wise flow variation, therefore, a new position controller consisting of a model-based pulse number modulation and a differential pulse width modulation strategy is proposed to control the position of a hydraulic cylinder at high and low velocity cases, respectively. In addition, in order to solve several problems caused by the pulse number modulation and differential pulse width modulation, such as increased number of switchings and large difference among number of switchings of valves, a switching optimization consisting of a switching cost function, a circular buffer and a circular switching method is proposed. An adaptive weight of the switching cost function is proposed for the first time to reduce the total number of switchings under different pressure differences and its design criterion is presented. A circular buffer and a new circular switching method are used to improve the degree of equal distribution of switchings when the pulse number modulation and differential pulse width modulation are used, respectively. Comparative experimental results indicated that the average and the minimum positioning error for the proposed controller are only 10 and 1 μm, respectively. The number of switchings and the degree of equal distribution of switchings are significantly optimized. Moreover, the pressure fluctuations caused by the proposed controller remain acceptable.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Automation Technology and Mechanical Engineering, Research group: Innovative Hydraulic Automation, Nanjing University of Aeronautics and Astronautics
Contributors: Gao, Q., Linjama, M., Paloniitty, M., Zhu, Y.
Publication date: 2019
Peer-reviewed: Yes

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ISSN (Print): 0959-6518
Ratings:

Scopus rating (2019): CiteScore 2.5 SJR 0.386 SNIP 0.915
Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Mechanical Engineering
Keywords: adaptive switching cost function, circular buffer, circular switching, differential pulse number modulation, Digital hydraulics
DOIs:

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Source: Scopus
Source ID: 85074978849
Research output: Contribution to journal › Article › Scientific › peer-review

Kirigami-Based Light-Induced Shape-Morphing and Locomotion

The development of stimuli-responsive soft actuators, a task largely undertaken by material scientists, has become a major driving force in pushing the frontiers of microrobotics. Devices made of soft active materials are oftentimes small in size, remotely and wirelessly powered/controlled, and capable of adapting themselves to unexpected hurdles. However, nowadays most soft microscale robots are rather simple in terms of design and architecture, and it remains a challenge to create complex 3D soft robots with stimuli-responsive properties. Here, it is suggested that kirigami-based techniques can be useful for fabricating complex 3D robotic structures that can be activated with light. External stress fields introduce out-of-plane deformation of kirigami film actuators made of liquid crystal networks. Such 2D-to-3D structural transformations can give rise to mechanical actuation upon light illumination, thus allowing the realization of kirigami-based light-fuelled robotics. A kirigami rolling robot is demonstrated, where a light beam controls the multigait motion and steers the moving direction in 2D. The device is able to navigate along different routes and moves up a ramp with a slope of 6°. The results demonstrate a facile technique to realize complex and flexible 3D structures with light-activated robotic functions.

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Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, National Taipei University of Technology
Contributors: Cheng, Y. C., Lu, H. C., Lee, X., Zeng, H., Priimagi, A.
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: actuation, kirigami, light steering, liquid crystal network, soft robots
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Source ID: 85076353405
Research output: Contribution to journal › Article › Scientific › peer-review

Market implementation of active and intelligent packaging-opportunities from a socio-economic perspective

General information

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Organisations: Materials Science and Environmental Engineering, Research group: Paper Converting and Packaging
Contributors: Lahti, J.
Number of pages: 9

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ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Media Technology, Materials Science(all)
Source: Scopus
Source ID: 85073779128
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

M-Estimator Application in Real-Time Sensor Fusion for Smooth Position Feedback of Heavy-Duty Field Robots
In this paper, we study the performance of a complementary filter with adaptive weights in a sensor fusion application for real-time localization of an omnidirectional field robot. The test-case robot is a large, four-wheel drive and steer (4WDS) construction vehicle with nonlinear internal dynamics and hydraulic driving and steering actuators. Our objective is to provide the vehicle's real-time controller with robust, smooth feedback that prevents unnecessary oscillations in steering, which can waste significant amounts of energy. We do so by assigning weights for measurements based on their consistency with the robot's motions. The calculations are based on two main data sources: (1) measured velocity vectors from wheel driving (odometer) and steering of the 4WDS test-case robot; and (2) data obtained from a differential global navigation satellite system on the absolute pose of the robot. We show that the sensor fusion is robust to the noise and single point failures of the sensors, while the maximum heading oscillations are reduced by 70%-95%, preserving the accuracy of the global positioning system. Moreover, we demonstrate the feasibility and efficacy of the real-time implementation of this filtering method in path-following control of the robot.

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MoE publication type: A4 Article in a conference publication
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Contributors: Liikanen, H., Aref, M. M., Mattila, J.
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ASJC Scopus subject areas: Artificial Intelligence, Mechanical Engineering, Control and Optimization
Keywords: GNSS, GPS, heavy-dutyfield robot, motion estimation, path following, sensor fusion, wheel odometry
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10.1109/CIS-RAM47153.2019.9095821
Source: Scopus
Source ID: 85085865017
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nanocellulose and Polylactic Acid Based Multilayer Coatings for Barrier Applications

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Contributors: Lahti, J.
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Source: Scopus
Source ID: 85073782128
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Remote diagnostics application software for remote handling equipment
The ITER Remote Handling Control System (RHCS) controllers provide measurement and diagnostics data about the remote handling equipment and tools they control. This paper presents the Remote Diagnostics Application (RDA) software for the analysis and archiving of the RHCS diagnostics data. The RDA provides a basic set of diagnostics tools, including trends, spectra, histograms, scatter plots, cross-correlation plots, as well as archiving and retrieval of history data. The ITER RH operators can extend diagnostics capabilities for specific RH equipment needs by incorporating custom diagnostics functions. To facilitate customization, RDA implements an architecture with three nested levels: the RDA Framework, its Diagnostics Workbenches and their Diagnostics Primitives. The RDA Framework has a user interface that can load one or several special diagnostics cases implemented as custom Diagnostics Workbenches with custom or default Diagnostics Primitives, such as rules, analysis functions and filters. As a result, the RDA features a diagnostics framework to execute complex and dedicated diagnostics and prognostics for the RH experts to monitor performance data, to run diagnostics tests and rules on equipment systems and to analyse historical data. The RDA helps the RH operators reduce downtime of the Remote Handling systems by exposing failure conditions and maintenance needs.

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Contributors: Alanen, J., Ruiz Morales, E., Muhammad, A., Saarinen, H., Minkkinen, J.
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ISSN (Print): 0920-3796
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ASJC Scopus subject areas: Civil and Structural Engineering, Nuclear Energy and Engineering, Materials Science(all), Mechanical Engineering
Keywords: Control system, Diagnostics, Prognostics, Remote handling, Software
DOIs:

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Bibliographical note
EXT="Saarinen, Hannu"
Source: Scopus
Source ID: 85060619368
Research output: Contribution to journal › Article › Scientific › peer-review

Running-in effects on friction of journal bearings under slow sliding speeds
Hydrodynamic thrust and journal bearings are facing challenges in modern heavy-duty machinery where full film lubrication cannot always be achieved or sustained. This is due to reasons such as start–stop operation, increased power density and the use of thinner lubricants. Although this leads to increased overall efficiency, bearings are operating more often under mixed lubrication conditions. This is why the running-in behavior of the bearing material is important. In this study, running-in behavior of traditional leaded tin bronze and its environmentally sustainable alternative, bimetal bismuth, was studied. Experimental friction tests were performed with journal bearings under full film and mixed lubrication conditions in order to find the Stribeck curves. The results are analyzed using frictional energy, and friction coefficient values based on continuous friction monitoring. Remarkable reduction of friction was observed with both bearing materials due to running-in.

General information
Publication status: Published

MoE publication type: A1 Journal article-refereed
Organisations: Research group: Tribology and Machine Elements, Materials Science and Environmental Engineering, Metso Minerals, Inc., Kugler Bimetal SA
Contributors: Linjamaa, A., Lehtovaara, A., Kallio, M., Léger, A.
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Publication information
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ASJC Scopus subject areas: Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
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DOIs:

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Source: Scopus
Source ID: 85069872376
Research output: Contribution to journal › Article › Scientific › peer-review

Slurry and dry particle erosion wear properties of WC-10Co4Cr and Cr_3C_2-25NiCr hardmetal coatings deposited by HVOF and HVAF spray processes

Thermally sprayed hardmetal coatings were produced to provide improved erosion wear compared to conventional cast GX4CrNi13-4 martensitic steel (CA6NM) used in hydro turbine components. Sprayed coatings and reference materials were tested with high-speed slurry pot tester using either fine or coarse quartz as the erosive media. Additional erosion tests were carried out with centrifugal dry erosion tester. Tungsten carbide based coatings provided the highest wear resistance due to the high hardness and even distribution of the fine carbide particles. The cast 13-4 steel samples experienced up to 180 times higher wear rates in fine quartz slurry and up to 36 times higher wear rates in coarse slurry compared to the sprayed coatings.

General information
Publication status: Published
MoE publication type: B1 Article in a scientific magazine
Organisations: Research group: Surface Engineering, Materials Science and Environmental Engineering, Research group: Materials Characterization, VZÚ Plzeò
Contributors: Matikainen, V., Rubio Peregrina, S., Ojala, N., Koivuluoto, H., Schubert, J., Houdková, Vuoristo, P.
Number of pages: 4
Pages: 58-61
Publication date: 2019
Peer-reviewed: No

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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Coating, Erosion, Hardmetal, Slurry erosion, Thermal spray
DOIs:

10.30678/FJT.83590

Bibliographical note
INT=msee,"Rubio Peregrina, S."
Source: Scopus
Source ID: 85084464052
Research output: Contribution to journal › Article › Scientific

Spodumene tailings for porcelain and structural materials: Effect of temperature (1050–1200°C) on the sintering and properties

The use of industrial by-products as substitute to conventional natural resources in ceramic production is of interest from an environment preservation and solid wastes management. This paper deals with the recycling of tailings from spodumene concentration during lithium production (Quartz Feldspar Sand; QFS), for the production of porcelain and structural materials. The QFS obtained from spodumene processing consisted mainly of quartz, albite, microcline with traces of muscovite. Mixtures of QFS and standard porcelain ingredients were sintered at 1050–1200 °C at 50 °C intervals and their properties were compared with a conventional porcelain composition prepared under the same conditions. Phase composition was assessed by XRD analysis using Rietveld refinement. Tests such as water absorption, apparent density, sintering shrinkage, compressive and flexural strength were used for physical comparison. The results showed that higher densification was achieved at 1200 °C, with a drastic reduction of water absorption below 1%. A compressive strength of 40 MPa was obtained at 1050 °C in the composition made of 50 wt% QFS and 50 wt% kaolin, increasing to 85 MPa at 1100 °C. The strength increase was attributed to better glassy phase formation and mullite growth. The QFS was found to contain no hazardous elements and showed promising sintering results, indicating its high suitability to substitute conventional resources in the production of ceramic materials.

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Publication status: Accepted/In press
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Univ of Oulu
Contributors: Lemougna, P. N., Yliniemi, J., Ismailov, A., Levänen, E., Tanskanen, P., Kinnunen, P., Roning, J., Illikainen, M.
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Ratings:

Scopus rating (2019): CiteScore 5.6 SJR 0.905 SNIP 2.014
Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Chemistry(all), Geotechnical Engineering and Engineering Geology, Mechanical Engineering
Keywords: Feldspars, Mine tailings, Porcelain, Quartz, Structural applications
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Source ID: 85067234637
Research output: Contribution to journal › Article › Scientific › peer-review

Variable speed digital hydraulic transformer–based servo drive
This article studies a digital hydraulic servo drive driven by a variable speed electric servomotor. Digital displacement control is implemented by using a two-port digital hydraulic power management system having six pistons and 18 on/off control valves. The first port of the digital hydraulic power management system controls the cylinder speed, while the second port is connected to a hydraulic accumulator. The peak power is taken from the accumulator, and the electric servomotor supplies only the average power into the system. An experimentally validated simulation model is used, and the results show a combination of adequate controllability and excellent energy efficiency. The estimated reduction in the size of the electric motor is 57%.

General information
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Organisations: Automation Technology and Mechanical Engineering
Contributors: Linjama, M.
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Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Mechanical Engineering
Keywords: DHPMS, Digital hydraulics, variable speed drives
DOIs:

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Source ID: 85071480585
Research output: Contribution to journal › Article › Scientific › peer-review

Variable speed drive with hydraulic boost

This paper studies a variable speed drive with two hydraulic pump motors connected to an actuator. The torque load of the pump motors is reduced by connecting accumulators at different pressures to the inlets of the pump motors. A method for real-time selection of the inlet accumulators is developed. A linearized model is derived, and a robust control approach is used for the controller design of the variable speed drive. Simulation results indicate excellent controllability and robustness together with good energy efficiency. When three accumulators – one being a pressurized tank line – are used, the peak torque is reduced by 52 per cent compared to the traditional solution.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation Technology and Mechanical Engineering, Research group: Innovative Hydraulic Automation
Contributors: Linjama, M.
Number of pages: 25
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Publication information

Journal: International Journal of Fluid Power
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Issue number: 1
ISSN (Print): 1439-9776
Ratings:

Scopus rating (2019): CiteScore 2.8 SJR 0.302 SNIP 1.245
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ASJC Scopus subject areas: Mechanical Engineering, Physics and Astronomy(all)
Keywords: Hydraulics, Robust control, Variable speed drive
DOIs:

10.13052/ijfp1439-9776.2014
Source: Scopus
Source ID: 85087866273
Research output: Contribution to journal › Article › Scientific › peer-review

An Artificial Nocturnal Flower via Humidity-Gated Photoactuation in Liquid Crystal Networks

Beyond their colorful appearances and versatile geometries, flowers can self-shape-morph by adapting to environmental changes. Such responses are often regulated by a delicate interplay between different stimuli such as temperature, light, and humidity, giving rise to the beauty and complexity of the plant kingdom. Nature inspires scientists to realize artificial systems that mimic their natural counterparts in function, flexibility, and adaptation. Yet, many of the artificial systems demonstrated to date fail to mimic the adaptive functions, due to the lack of multi-responsivity and sophisticated control over deformation directionality. Herein, a new class of liquid-crystal-network (LCN) photoactuators whose response is controlled by delicate interplay between light and humidity is presented. Using a novel deformation mechanism in LCNs, humidity-gated photoactuation, an artificial nocturnal flower is devised that is closed under daylight conditions when the humidity level is low and/or the light level is high, while it opens in the dark when the humidity level is high. The humidity-gated photoactuators can be fueled with lower light intensities than conventional photothermal LCN actuators. This, combined with facile control over the speed, geometry, and directionality of movements, renders the “nocturnal actuator” promising for smart and adaptive bioinspired microrobotics.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Eindhoven University of Technology
Contributors: Wani, O. M., Verpaalen, R., Zeng, H., Priimagi, A., Schenning, A. P.
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Keywords: actuator, azobenzene, bioinspired, humidity, light, liquid crystal, multi-responsive
DOIs:

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Source: Scopus
Source ID: 85056318113
Research output: Contribution to journal › Article › Scientific › peer-review

Evaluating retrofit options in a historical city center: Relevance of bio-based insulation and the need to consider complex urban form in decision-making

Historical dwellings make up a significant fraction of the French building stock and require substantial retrofitting to reduce their energy consumption and improve their thermal comfort. In the city center of Cahors, France, the old medieval dwellings are considered as valuable cultural heritage and internal insulation is often the only insulation technique that can be used when the architectural value of the exterior façade is to be preserved. However, internal insulation may have an impact upon the hygrothermal performance of the wall, leading to lowered drying capacity, with possible interstitial condensation and mold growth. Hygrothermal models may be used to assess the risk of failure, but the accuracy of the results depends on how reliable the input data is, including external boundary conditions, which may vary significantly in dense medieval cities such as Cahors. In this study, a Geographical Information System model of Cahors is used to develop EnergyPlus models of individual dwellings. The boundary conditions output by these models are, in turn, used to model the hygrothermal performance of façades with different internal insulations, using the hygrothermal tool Delphin. The Delphin outputs are then analyzed with the VTT model, a mold growth assessment model. Results highlight a quantitative correlation between some urban morphology characteristics and the hygrothermal performance of refurbished walls, with some configurations raising the risk of damage patterns. We find that bio-based insulation presents a better hygrothermal performance than mineral wool in most of the configurations.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: University of Toulouse, INP, LAAS-CNRS, University College London
Contributors: Claude, S., Ginestet, S., Bonhomme, M., Escadeillas, G., Taylor, J., Marincioni, V., Korolija, I., Altamirano, H.
Number of pages: 9
Pages: 196-204
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Original language: English
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering
DOIs:

10.1016/j.enbuild.2018.10.026
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Source: Scopus
Source ID: 85055886229
Research output: Contribution to journal › Article › Scientific › peer-review

Kinetics and thermochemistry of the reaction of 3-methylpropargyl radical with molecular oxygen

We have measured the kinetics and thermochemistry of the reaction of 3-methylpropargyl radical (but-2-yn-1-yl) with molecular oxygen over temperature (223-681 K) and bath gas density ($_{1.2\text{-}15.0\times1016\ cm\text{-}3}$) ranges employing photoionization mass-spectrometry. At low temperatures (223-304 K), the reaction proceeds overwhelmingly by a simple addition reaction to the $_{-CH2}$ end of the radical, and the measured $_{CH3CCCH2\bullet+O2}$ reaction rate coefficient shows

negative temperature dependence and depends on bath gas density. At intermediate temperatures (340-395 K), the addition reaction equilibrates and the equilibrium constant was determined at different temperatures. At high temperatures (465-681 K), the kinetics is governed by O_2 addition to the third carbon atom of the radical, and rate coefficient measurements were again possible. The high temperature $CH3CCCH2•+O2$ rate coefficient is much smaller than at low T, shows positive temperature dependence, and is independent of bath gas density. In the intermediate and high temperature ranges, we observe a formation signal for ketene (ethenone). The reaction was further investigated by combining the experimental results with quantum chemical calculations and master equation modeling. By making small adjustments ($2-3kJmol-1$) to the energies of two key transition states, the model reproduces the experimental results within uncertainties. The experimentally constrained master equation model was used to simulate the $CH3CCCH2•+O2$ reaction system at temperatures and pressures relevant to combustion.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Helsinki, Hungarian Academy of Sciences
Contributors: Pekkanen, T. T., Timonen, R. S., Lendvay, G., Rissanen, M. P., Eskola, A. J.
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Publication date: 1 Jan 2019
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Mechanical Engineering, Physical and Theoretical Chemistry
Keywords: Ab initio quantum chemistry, Combustion chemistry, Experimental gas kinetics, Master equation modeling, Propargyl radical
DOIs:

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Source: Scopus
Source ID: 85049566548
Research output: Contribution to journal › Article › Scientific › peer-review

The potential of electric trucks – An international commodity-level analysis
Development of battery technology is making battery electric heavy duty trucks technically and commercially viable and several manufacturers have introduced battery electric trucks recently. However, the national and sectoral differences in freight transport operations affect the viability of electric trucks. The aim of this paper is to develop a methodology for estimating the potential of electric trucks and demonstrate the results in Switzerland and Finland. Commodity-level analysis of the continuous road freight survey data were carried out in both countries. As much as 71% of Swiss road freight transport tonne-kilometers may be electrified using battery electric trucks but Finland has very limited potential of 35%, due to the use of long and heavy truck-trailer combinations. Within both countries the electrification potential varies considerably between commodities, although in Finland more so than in Switzerland. Commodities which are constrained by payload volume rather than weight and are to large extent carried using medium duty or <26t rigid trucks trucks seem to provide high potential for electrification even with the current technology. Electric trucks increase the annual electricity consumption by only 1–3%, but truck charging is likely to have a large impact on local grids near logistics centres and rest stations along major roads. A spatial analysis by routing the trips reported in the datasets used in this study should be carried out. Future research should also include comparison between the alternate ways of electrifying road freight transport, i.e. batteries with charging, batteries with battery swapping and electrified road systems.

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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Transport Research Centre Verne, Civil Engineering, HCI e 486.1
Contributors: Liimatainen, H., van Vliet, O., Aplyn, D.
Number of pages: 11
Pages: 804-814
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Early online date: 14 Dec 2018

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Original language: English
ASJC Scopus subject areas: Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law
Keywords: Charging infrastructure, Electric trucks, Logistics, Road freight transport
Electronic versions:

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http://urn.fi/URN:NBN:fi:tty-201901081024
Source: Scopus
Source ID: 85058374379
Research output: Contribution to journal › Article › Scientific › peer-review

Nonlinear model predictive energy management of hydrostatic drive transmissions

In this article, we devise a nonlinear model predictive control framework for the energy management of nonhybrid hydrostatic drive transmissions. The controller determines the optimal control commands of the actuators by minimising a cost function over a receding horizon. With our approach, the velocity-tracking error is minimised while keeping the fuel economy of the system high. The hydrostatic drive transmission system studied in this article is a typical commercial work machine, that is, there is no energy storage or alternative power source in the system (a nonhybrid hydrostatic drive transmission). We evaluate success with a validated simulation model of the hydrostatic drive transmission of a municipal tractor. In our experiments, a detailed system model is used both in the system simulation and in the prediction phase of the nonlinear model predictive control. The use of a detailed model in the nonlinear model predictive control framework places our design as a benchmark for controlling nonhybrid hydrostatic drive transmissions, when compared to solutions using simplified models or computationally less intensive control methods as in earlier work by the authors. Our nonlinear model predictive control approach enables numerically robust optimisation convergence with the utilised complex nonlinear model. Above all, this is accomplished with stabilising terminal constraints and distinctive terminal cost, both based on an optimal steady-state solution. In addition, a simple method to generate initial guesses for optimisation is introduced. When compared with the performance of a controller based on quasi-static models, our results show notable improvement in velocity tracking while maintaining high fuel economy. Furthermore, our experiments demonstrate that framing energy management as a nonlinear model predictive control provides a flexible and rigorous framework for fast velocity tracking and high energy efficiency. We also compare the results with those of an industrial baseline controller.

General information
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Organisations: Automation and Hydraulic Engineering
Contributors: Backas, J., Ghabcheloo, R.
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Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Mechanical Engineering
Keywords: energy efficiency, fluid power, hydraulic systems, power management, Power transmission
DOIs:

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Source: Scopus
Source ID: 85053336733

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

Stable and unstable friction in fretting contacts

Designing contacts susceptible to fretting is a challenging task due to uncertainties related to friction. For example, coefficient of friction has shown to vary as a function of load cycles and so-called non-Coulomb friction can exist during individual load cycles. Concepts of stable and unstable friction are presented in this manuscript. Based on experiments, no fretting is to be expected if the utilization of friction is kept below unstable friction threshold. If contact is subjected to tangential load above this threshold, reciprocating slippage, fretting, is to be expected even if the contact was initially in stick. Experimental evidence for existence of such threshold is presented in form of friction data, slip data and fretting scars.

General information

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Organisations: Research group: Tribology and Machine Elements, Materials Science, Wärtsilä, Univ of Oulu
Contributors: Hintikka, J., Mäntylä, A., Vaara, J., Frondelius, T., Lehtovaara, A.
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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Fretting, Friction, Stick-slip, Wear
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Source: Scopus
Source ID: 85055737240
Research output: Contribution to journal › Article › Scientific › peer-review

The formation and characterization of fretting-induced degradation layers using quenched and tempered steel

Fretting movement is dangerous for machines, because it can cause cracking and surface degradation. The aim of this work was to characterize fretting-induced material degradation in large flat-on-flat contacts without edge effects in a sliding direction using quenched and tempered steel 34CrNiMo6. The focus was on the adhesive contact spots, which were formed under a wide variety of operating conditions. Characterization methods were optical microscopy, Vickers hardness tests and scanning electron microscopy. Three different degradation areas were observed: a general deformation layer, a tribologically transformed structure and a third body layer. All the degradation phases have high hardness and low ductility compared to the base material. The formation and behavior of the degradation layers in different operating conditions were discussed.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Tribology and Machine Elements, Research group: Materials Characterization, Wärtsilä
Contributors: Nurmi, V., Hintikka, J., Juoksukangas, J., Honkanen, M., Vippola, M., Lehtovaara, A., Mäntylä, A., Vaara, J., Frondelius, T.
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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Adhesion, Fretting, Friction, Microscopy
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URLs:

http://urn.fi/URN:NBN:fi:tty-201812202882

Bibliographical note
INT=mol,"Nurmi, Verner"
EXT="Hintikka, Jouko"
Source: Scopus
Source ID: 85056207084
Research output: Contribution to journal › Article › Scientific › peer-review

Employing Knowledge on Causal Relationship to Assist Multidisciplinary Design Optimization
With the increasing design dimensionality, it is more difficult to solve multidisciplinary design optimization (MDO) problems. Many MDO decomposition strategies have been developed to reduce the dimensionality. Those strategies consider the design problem as a black-box function. However, practitioners usually have certain knowledge of their problem. In this paper, a method leveraging causal graph and qualitative analysis is developed to reduce the dimensionality of the MDO problem by systematically modeling and incorporating the knowledge about the design problem into optimization. Causal graph is created to show the input-output relationships between variables. A qualitative analysis algorithm using design structure matrix (DSM) is developed to automatically find the variables whose values can be determined without resorting to optimization. According to the impact of variables, an MDO problem is divided into two subproblems, the optimization problem with respect to the most important variables, and the other with variables of lower importance. The novel method is used to solve a power converter design problem and an aircraft concept design problem, and the results show that by incorporating knowledge in form of causal relationship, the optimization efficiency is significantly improved.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Automation Technology and Mechanical Engineering, Research area: Manufacturing and Automation, Simon Fraser University
Contributors: Wu, D., Coatanea, E., Wang, G. G.
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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Computer Science Applications, Computer Graphics and Computer-Aided Design
Keywords: causal graph, dimension reduction, dimensional analysis, multidisciplinary design optimization
DOIs:

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Source: Scopus
Source ID: 85059942742
Research output: Contribution to journal › Article › Scientific › peer-review

Mass balance control of crushing circuits

This paper describes a novel circuit-wide control scheme that addresses the challenging problem of mass balance control of crushing circuits. The control objective is to ensure 100% utilization at the circuit bottleneck and hence push the realized performance towards the theoretical maximum. The present control problem is challenging due to long transport delays, complex circuit layout, under-actuated process, several uncontrolled disturbance flows, varying number of active equipment, varying downstream demand, and changing bottleneck location. The proposed mass balance control scheme involves feeding the circuit according to actual demand and realized circuit throughput, whilst maintaining the amount of material accumulated into the circuit and ensuring the physical integrity of the circuit. Therefore, the circuit feeding is based on the realized processing capacity, rather than an individual bin level or an operator decision. To ensure the efficient use of available surge capacity, a limiting control structure is proposed to simultaneously realize the in-circuit multi-objective limit violation control and loose bin level control strategy. The proposed scheme offers a simple solution for the otherwise complex control problem, which can be easily and efficiently implemented using classic control methods. The paper details an entire design procedure, from the fundamental theory, through dynamic modeling and controller tuning, to the complete circuit control system design and implementation. The proposed scheme is evaluated under extensive full-scale and simulated experiments at various production scenarios and equipment combinations. The rigorous control experiments revealed that the proposed scheme delivered the desired behavior in every possible scenario. This enables the circuit to reach its true potential.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Automation Technology and Mechanical Engineering, Research group: Automation and Systems Theory, Chalmers University of Technology, University of Queensland
Contributors: Itävuo, P., Hulthén, E., Yahyaei, M., Vilkko, M.
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Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Chemistry(all), Geotechnical Engineering and Engineering Geology, Mechanical Engineering
Keywords: Crushing, Dynamic modeling, Limiting control, Mass balance control, Sensor fusion
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Source: Scopus
Source ID: 85062035841
Research output: Contribution to journal › Article › Scientific › peer-review

Assessing population vulnerability towards summer energy poverty: Case studies of Madrid and London

Climate change is expected to increase the frequency and duration of hot weather and its associated adverse health effects. In dense urban areas, these phenomena will be exacerbated by the Urban Heat Island (UHI) effect and indoor overheating. This paper assesses population exposure and vulnerability to high summer temperatures by exploring the geospatial connection between the UHI, housing energy efficiency and overheating risk, and social vulnerability indicators, such as income and the elderly population. Focusing on Madrid and London, two European cities with strong UHIs but contrasting drivers of indoor heat risk, the spatial distribution of selected indicators were analysed by means of Geographical Information Systems, and areas with the highest vulnerability towards summer energy poverty were identified. It was found that while ‘hot and vulnerable’ areas are present in both Madrid and London, there are significant differences in climate, socioeconomic distribution and housing between the two cities. In warmer climates such as Madrid, energy poverty—traditionally defined by wintertime heating—requires its definition to be broadened to include summertime cooling needs; in the context of climate change and urban warming trends, this may soon also be the case in northern cities such as London.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: University College London, Universidad Politecnica de Madrid
Contributors: Sanchez-Guevara, C., Núñez Peiró, M., Taylor, J., Mavrogianni, A., Neila González, J.
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Research output: Contribution to journal › Article › Scientific › peer-review

Direct model predictive power control of a series-connected modular rectifier
This paper presents a direct model predictive power control for a series-connected modular rectifier. The topology combines a diode rectifier and an active-front-end (AFE) converter to achieve a medium voltage target. A voltage control loop regulates the total dc voltage, providing the power references to the inner direct model predictive control. Operation under the desired real and reactive power is achieved, while minimizing the converter switching frequency. Moreover, successful operation and control of the AFE converter is guaranteed thanks to a hard constraint included in the optimization problem.

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MoE publication type: A4 Article in a conference publication
Organisations: Electrical Engineering, Politecnico di Milano, Technische Universitat Munchen
Contributors: Rossi, M., Liegmann, E., Karamanakos, P., Castelli-Dezza, F., Kennel, R.
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ASJC Scopus subject areas: Electrical and Electronic Engineering, Mechanical Engineering, Control and Optimization
Electronic versions:

Direct Model Predictive Power Control of a Series-Connected Modular Rectifier
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Operating point dependent variable switching point predictive current control for PMSM drives
This contribution presents a direct model predictive current control approach that achieves favorable performance during transients while minimizing the torque and current ripples at steady-state operation by increasing the granularity at which switching can be performed. To meet the control goals, an optimization problem is solved in real-time that decides whether only one discrete voltage space vector or a combination of two is selected. In the latter case, a variable switching point, i.e., a time instant within the control interval at which the converter switches change state, is computed. The proposed

method is advantageous, e.g., for electric drives in machine tools, in which, depending on the operating point, fast dynamics and a low torque ripple are important. The approach is evaluated at the example of a two-level voltage source inverter driving a permanent magnet synchronous machine.

General information

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MoE publication type: A4 Article in a conference publication
Organisations: Electrical Engineering, Institute ELSYS, Technische Universitat Munchen
Contributors: Wendel, S., Karamanakos, P., Dietz, A., Kennel, R.
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ASJC Scopus subject areas: Electrical and Electronic Engineering, Mechanical Engineering, Control and Optimization
Keywords: Direct model predictive control (DMPC), Finite control set model predictive control (FCS-MPC), SoC FPGA, Variable switching point predictive current control (VSP2CC)
Electronic versions:

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http://urn.fi/URN:NBN:fi:tuni-202001151296
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Fabrication of soft devices with buried fluid channels by using sacrificial 3D printed molds

Casting silicone elastomers into 3D printed molds has seen a surge of applications in soft robots, soft manipulators, microfluidics, wearable technologies and stretchable sensors. In such devices, buried fluid channels are used to transport fluids, as fluidic actuators and as sensors with liquid metal. However, it is difficult to demold structures with buried channels or overhangs. As a solution, using sacrificial molds made of dissolvable materials has been proposed. In this paper, we evaluate different commercially available 3D printing materials as dissolvable mold materials. We tested dissolving prints made of high-impact polystyrene (HIPS), acrylonitrile butadiene styrene (ABS), polyvinyl butyral (PVB) and polyvinyl alcohol (PVA) in limonene, acetone, isopropanol/ethanol and water, respectively. We further studied the effect of magnetic stirring and ultrasonic bath on the dissolution times. Finally, we fabricated buried channels using different mold materials and silicone elastomers. The results show that at least ABS, PVB and PVA can be used as mold materials. In particular, PVA is a promising material as it is soluble in water. The studied method simplifies the fabrication of soft devices, allowing the fabrication of overhangs and buried channels in a single casting step.

General information

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MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Research group: Bioinspired Materials and Robotics (BMR)
Contributors: Koivikko, A., Sariola, V.
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Bioactive glass ions induce efficient osteogenic differentiation of human adipose stem cells encapsulated in gellan gum and collagen type I hydrogels

Background: Due to unmet need for bone augmentation, our aim was to promote osteogenic differentiation of human adipose stem cells (hASCs) encapsulated in gellan gum (GG) or collagen type I (COL) hydrogels with bioactive glass (experimental glass 2-06 of composition [wt-%]: Na_2O 12.1, K_2O 14.0, CaO 19.8, P_2O5 2.5, B_2O_3 1.6, SiO_2 50.0) extract based osteogenic medium (BaG OM) for bone construct development. GG hydrogels were crosslinked with spermidine (GG-SPD) or BaG extract (GG-BaG). Methods: Mechanical properties of cell-free GG-SPD, GG-BaG, and COL hydrogels were tested in osteogenic medium (OM) or BaG OM at 0, 14, and 21 d. Hydrogel embedded hASCs were cultured in OM or BaG OM for 3, 14, and 21 d, and analyzed for viability, cell number, osteogenic gene expression, osteocalcin production, and mineralization. Hydroxyapatite-stained GG-SPD samples were imaged with Optical Projection Tomography (OPT) and Selective Plane Illumination Microscopy (SPIM) in OM and BaG OM at 21 d. Furthermore, Raman spectroscopy was used to study the calcium phosphate (CaP) content of hASC-secreted ECM in GG-SPD, GG-BaG, and COL at 21 d in BaG OM. Results: The results showed viable rounded cells in GG whereas hASCs were elongated in COL. Importantly, BaG OM induced significantly higher cell number and higher osteogenic gene expression in COL. In both hydrogels, BaG OM induced strong mineralization confirmed as CaP by Raman spectroscopy and significantly improved mechanical properties. GG-BaG hydrogels rescued hASC mineralization in OM. OPT and SPIM showed homogeneous 3D cell distribution with strong mineralization in BaG OM. Also, strong osteocalcin production was visible in COL. Conclusions: Overall, we showed efficacious osteogenesis of hASCs in 3D hydrogels with BaG OM with potential for bone-like grafts.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Research group: Computational Biophysics and Imaging Group, Tampere University Hospital, Research, University of Jyvaskyla, Abo Akad Univ, Abo Akademi University, Dept Phys, Tampere University of Applied Sciences
Contributors: Vuornos, K., Ojansivu, M., Koivisto, J. T., Häkkänen, H., Belay, B., Montonen, T., Huhtala, H., Kääriäinen, M. , Hupa, L., Kellomäki, M., Hyttinen, J., Ihalainen, J. A., Miettinen, S.
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Tailoring Second-Harmonic Emission from (111)-GaAs Nanoantennas

Second-harmonic generation (SHG) in resonant dielectric Mie-scattering nanoparticles has been hailed as a powerful platform for nonlinear light sources. While bulk-SHG is suppressed in elemental semiconductors, for example, silicon and germanium due to their centrosymmetry, the group of zincblende III-V compound semiconductors, especially (100)-grown AlGaAs and GaAs, have recently been presented as promising alternatives. However, major obstacles to push the technology toward practical applications are the limited control over directionality of the SH emission and especially zero forward/backward radiation, resulting from the peculiar nature of the second-order nonlinear susceptibility of this otherwise highly promising group of semiconductors. Furthermore, the generated SH signal for (100)-GaAs nanoparticles depends strongly on the polarization of the pump. In this work, we provide both theoretically and experimentally a solution to these problems by presenting the first SHG nanoantennas made from (111)-GaAs embedded in a low index material. These nanoantennas show superior forward directionality compared to their (100)-counterparts. Most importantly, based on the special symmetry of the crystalline structure, it is possible to manipulate the SHG radiation pattern of the nanoantennas by

changing the pump polarization without affecting the linear properties and the total nonlinear conversion efficiency, hence paving the way for efficient and flexible nonlinear beam-shaping devices.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Nonlinear Optics, Physics, Australian National University, Friedrich-Schiller-University Jena, School of Engineering and Information Technology, University of New South Wales (UNSW) Australia, Russian Academy of Sciences
Contributors: Sautter, J. D., Xu, L., Miroshnichenko, A. E., Lysevych, M., Volkovskaya, I., Smirnova, D. A., Camacho-Morales, R., Zangeneh Kamali, K., Karouta, F., Vora, K., Tan, H. H., Kauranen, M., Staude, I., Jagadish, C., Neshev, D. N. , Rahmani, M.
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ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: Dielectric nanoantennas, directional emission, III-V semiconductors, Mie resonance, multipolar interference, second harmonic generation
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Source ID: 85067057047
Research output: Contribution to journal › Article › Scientific › peer-review

Characterization of cracks formed in large flat-on-flat fretting contact
Fretting fatigue may lead to severe damage in machines. Adhesive material transfer spots in millimeter scale have previously been observed on fretted surfaces, which have been related to cracking. In this study, fretting-induced cracks formed in a large annular flat-on-flat contact are characterized. Optical and scanning electron microscopy of the fretting scar cross-section samples of self-mated quenched and tempered steel specimens revealed severe cracking and deformed microstructure. Two major cracks typically formed around an adhesion spot, which propagated at an oblique angle, regardless of the test parameters used. Millimeter-scale cracks were observed already within a few thousand loading cycles.

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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Tribology and Machine Elements, Materials Science and Environmental Engineering, Research group: Materials Characterization, Wärtsilä, University of Oulu, Tampere University
Contributors: Juoksukangas, J., Nurmi, V., Hintikka, J., Vippola, M., Lehtovaara, A., Mäntylä, A., Vaara, J., Frondelius, T.
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering, Surfaces, Coatings and Films, Surfaces and Interfaces
Keywords: Crack formation, Cracks, Damage, Fretting fatigue, Microscopy

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EXT="Hintikka, Jouko"
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Observation of Coexistence of Yu-Shiba-Rusinov States and Spin-Flip Excitations
We investigate the spectral evolution in different metal phthalocyanine molecules on NbSe2 surface using scanning tunnelling microscopy (STM) as a function of the coupling with the substrate. For manganese phthalocyanine (MnPc), we demonstrate a smooth spectral crossover from Yu-Shiba-Rusinov (YSR) bound states to spin-flip excitations. This has not been observed previously and it is in contrast to simple theoretical expectations. We corroborate the experimental findings using numerical renormalization group calculations. Our results provide fundamental new insight on the behavior of atomic scale magnetic/SC hybrid systems, which is important, for example, for engineered topological superconductors and spin logic devices.

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MoE publication type: A1 Journal article-refereed
Organisations: Physics, Aalto University, Jozef Stefan Institute, University of Ljubljana
Contributors: Kezilebieke, S., Žitko, R., Dvorak, M., Ojanen, T., Liljeroth, P.
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Original language: English
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Keywords: Magnetic impurity, scanning tunneling microscopy (STM), spin-flip excitation, superconductor, Yu-Shiba-Rusinov state
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Source ID: 85069329661
Research output: Contribution to journal › Article › Scientific › peer-review

Elevated and cryogenic temperature micropillar compression of magnesium–niobium multilayer films
The mechanical properties of multilayer films consisting of alternating layers of magnesium and niobium are investigated through micropillar compression experiments across a broad range of temperatures. The data collected from the variable temperature micropillar compression tests and strain rate jump tests are used to gain insight into the operative deformation mechanisms within the material. At higher temperatures, diffusion-based deformation mechanisms are shown to determine the plastic behavior of the multilayers. Diffusion occurs more readily along the magnesium–niobium interface than within the bulk, acting as pathway for magnesium diffusion. When individual layer thicknesses are sufficiently small,

diffusion can remain the dominant deformation mechanism down to room temperature. Multilayer strengthening models historically rely solely on dislocation-based arguments; therefore, consideration of diffusion-based deformation in nanolaminates with low melting temperature components offers improved understanding of multilayer behavior.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Swiss Federal Laboratories for Materials Science and Technology, HCI e 486.1, University of California, Santa Barbara, University of Nevada, Reno, University of Minnesota Twin Cities
Contributors: Thomas, K., Mohanty, G., Wehrs, J., Taylor, A. A., Pathak, S., Casari, D., Schwiedrzik, J., Mara, N., Spolenak, R., Michler, J.
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Original language: English
ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
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Source: Scopus
Source ID: 85065435834
Research output: Contribution to journal › Article › Scientific › peer-review

Fluorine losses in Er^{3+} oxyfluoride phosphate glasses and glass-ceramics

Er^{3+} doped phosphate glasses with the composition $75NaPO_3$-$25CaF_2$ (mol%) were prepared at different melting temperatures to demonstrate the importance to quantify the fluorine content when preparing oxyfluoride glasses. Indeed, increasing the melting temperature from 900 to 1000 °C leads to a small reduction in the fluorine content from 9.4 at % to 8.8 at % as quantified using EPMA. Whereas this loss of fluorine can be suspected from small changes in the thermal properties of the glass, it increases significantly the glass crystallization tendency in this glass system. This means that a heat treatment of the as-prepared glass should be performed when evaporation of fluorine during the glass melting is suspected. Sample preparation for the characterization of the spectroscopic properties of the glasses is discussed here as well; bulk glasses should be used when measuring the spectroscopic properties of oxyfluoride glasses, which are known to be hygroscopic. It is shown, in this work, that a heat treatment of the glass within the investigated glass system leads to transparent glass-ceramics with volume precipitation of Er^{3+} doped CaF_2 crystals with strong upconversion.

General information

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Organisations: Research group: Materials Characterization, Materials Science and Environmental Engineering, Physics, Tampere University of Applied Sciences, Fondazione LINKS – Leading Innovation & Knowledge for Society
Contributors: Szczodra, A., Mardoukhi, A., Hokka, M., Boetti, N. G., Petit, L.
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Keywords: Crystal, Erbium, Fluorine, Glass, Glass-ceramic, Luminescence
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Source ID: 85065824926
Research output: Contribution to journal › Article › Scientific › peer-review

Pneumatic unidirectional cell stretching device for mechanobiological studies of cardiomyocytes

In this paper, we present a transparent mechanical stimulation device capable of uniaxial stimulation, which is compatible with standard bioanalytical methods used in cellular mechanobiology. We validate the functionality of the uniaxial stimulation system using human-induced pluripotent stem cells-derived cardiomyocytes (hiPSC-CMs). The pneumatically controlled device is fabricated from polydimethylsiloxane (PDMS) and provides uniaxial strain and superior optical performance compatible with standard inverted microscopy techniques used for bioanalytics (e.g., fluorescence microscopy and calcium imaging). Therefore, it allows for a continuous investigation of the cell state during stretching experiments. The paper introduces design and fabrication of the device, characterizes the mechanical performance of the device and demonstrates the compatibility with standard bioanalytical analysis tools. Imaging modalities, such as high-resolution live cell phase contrast imaging and video recordings, fluorescent imaging and calcium imaging are possible to perform in the device. Utilizing the different imaging modalities and proposed stretching device, we demonstrate the capability of the device for extensive further studies of hiPSC-CMs. We also demonstrate that sarcomere structures of hiPSC-CMs organize and orient perpendicular to uniaxial strain axis and thus express more maturated nature of cardiomyocytes.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Micro and Nanosystems Research Group, BioMediTech, Risø Campus, Tampere University of Applied Sciences, Eindhoven University of Technology, Tampere University Hospital
Contributors: Kreutzer, J., Viehrig, M., Pölönen, R. P., Zhao, F., Ojala, M., Aalto-Setälä, K., Kallio, P.
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ASJC Scopus subject areas: Biotechnology, Modelling and Simulation, Mechanical Engineering
Keywords: Cardiomyocytes, hiPSC, Mechanical stimulation, PDMS
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EXT="Zhao, Feihu"
Source: Scopus
Source ID: 85070939275
Research output: Contribution to journal › Article › Scientific › peer-review

Detection of gaseous species during KCl-induced high-temperature corrosion by the means of CPFAAS and CI-APi-TOF

Two different analytical approaches—collinear photofragmentation and atomic absorption spectroscopy (CPFAAS) and chemical ionization atmospheric pressure interface time-of-flight mass spectrometer (CI-APi-TOF)—were applied to detect and identify the online gaseous KOH and HCl formed in the addressed high-temperature reactions. Samples of pure KCl, KCl+Cr, KCl+Fe, and KCl+316 L were studied at 550°C under dry and humid conditions with varying oxygen concentrations. The goal was to shed more light on the gas-phase chemistry during KCl-induced corrosion under conditions relevant to biomass combustion. CI-APi-TOF proved to be a valuable tool for high-temperature corrosion studies: HCl was identified to have formed during the reactions under humid conditions. On the contrary, despite the known sensitivity of CPFAAS, the formation of KOH could not be verified in any of the performed measurements.

General information

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Organisations: Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Physics, Research group: Applied Optics, Åbo Akademi University

Contributors: Lehmusto, J., Olin, M., Viljanen, J., Kalliokoski, J., Mylläri, F., Toivonen, J., Dal Maso, M., Hupa, L.
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Shedding frequency in cavitation erosion evolution tracking
Cavitation erosion is a concern for most hydraulic machinery. An especially damaging type of cavitation is cloud cavitation. This type of cavitation is characterized by a growth-collapse cycle in which a group of vapor bubbles first grows together in a low-pressure region and then collapses almost simultaneously when the pressure recovers. Measuring the frequency of these collapse events is possible by acoustic emission (AE), as demonstrated in this study, in which a cavitation tunnel is utilized to create cloud cavitation in the vicinity of a sample surface. These samples were equipped with AE sensors, and the initially high frequency AE signal was demodulated to detect the relatively low frequency cloud cavitation shedding. It was found that when the cavitation number is increased, AE successfully detects the changes in this frequency, confirmed by comparing the results to video analysis and to simulations from literature. Additionally, the frequency increases when cavitation erosion progresses, thus providing means to track the erosion stage. It is concluded that the presented method is suitable for both detecting the transition from cloud to sheet cavitation and the erosion evolution in the experimental cavitation tunnel. The method could probably be extended to non-intrusive hydraulic machine monitoring, as this type of cloud cavitation is common in hydrofoils.

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Organisations: Automation Technology and Mechanical Engineering, Materials Science and Environmental Engineering, Université Grenoble Alpes
Contributors: Ylönen, M., Franc, J. P., Miettinen, J., Saarenrinne, P., Fivel, M.
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Original language: English
ASJC Scopus subject areas: Mechanical Engineering, Physics and Astronomy(all), Fluid Flow and Transfer Processes
Keywords: Acoustic emission, Cavitation erosion, Cloud cavitation, Shedding frequency
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Source: Scopus
Source ID: 85067547906
Research output: Contribution to journal › Article › Scientific › peer-review

Multiresonant High-Q Plasmonic Metasurfaces
Resonant metasurfaces are devices composed of nanostructured subwavelength scatterers that generate narrow optical resonances, enabling applications in filtering, nonlinear optics, and molecular fingerprinting. It is highly desirable for these applications to incorporate such devices with multiple high-quality-factor resonances; however, it can be challenging to obtain more than a pair of narrow resonances in a single plasmonic surface. Here, we demonstrate a multiresonant

metasurface that operates by extending the functionality of surface lattice resonances, which are the collective responses of arrays of metallic nanoparticles. This device features a series of resonances with high-quality factors (Q ~ 40), an order of magnitude larger than what is typically achievable with plasmonic nanoparticles, as well as a narrow free spectral range. This design methodology can be used to better tailor the transmission spectrum of resonant metasurfaces and represents an important step toward the miniaturization of optical devices.

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Organisations: Physics, Research group: Nonlinear Optics, Iridian Spectral Technologies, University of Rochester Institute of Optics
Contributors: Reshef, O., Saad-Bin-Alam, M., Huttunen, M. J., Carlow, G., Sullivan, B. T., Ménard, J. M., Dolgaleva, K., Boyd, R. W.
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Tribocorrosion behaviour of two low-alloy steel grades in simulated waste solution

The tribocorrosion behaviour of two low-alloy steels not previously investigated, was examined in a Pin-on-Disc test device, both in the presence and absence of mechanical wear and/or corrosion in simulated waste solution. Volume losses through wear, corrosion and synergy processes were calculated and changes in the material surfaces investigated. The tribocorrosion behaviour and the volume losses caused by the synergy processes were found to be dependent on the steel grade, instead of applied potential. For both steel grades, material losses were caused by two main degradation mechanisms: wear and wear-induced corrosion. Total material losses and the percentage of wear-corrosion synergy were higher for the ferritic grade than for the martensitic grade. These results are presented and discussed in this paper.

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Organisations: Physics, VTT Technical Research Centre of Finland, Microscopy Center
Contributors: Mäntyranta, A., Heino, V., Isotahdon, E., Salminen, T., Huttunen-Saarivirta, E.
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Peer-reviewed: Yes

Publication information
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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Contact: sliding, Synergism: tribochemistry, Wear: corrosive
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Bibliographical note
EXT="Heino, Vuokko"
EXT="Isotahdon, Elisa"
Source: Scopus
Source ID: 85066497579
Research output: Contribution to journal › Article › Scientific › peer-review

Vehicle type detection and passenger satisfaction analysis using smartphone sensors and digital surveys
Detailed knowledge of passenger context is essential for developing intelligent transportation systems. For example, automated ticket sales and personal routing require more information about used means of transportation than traditional time tables can offer. Here, the authors contribute to this topic by using measurements from smartphone sensors to predict (i) whether a person is inside a bus, (ii) if the person is travelling in a diesel or an electric bus, and (iii) how the person is rating the quality of the bus ride. All three tasks are worked out by using a selection of machine learning (ML) algorithms. In tandem with sensor data, collecting a digital passenger survey was conducted to add passengers' own evaluation of the quality of their bus ride. The tests showed that the context of a passenger can be predicted relatively well. However, the prediction of passenger satisfaction is a complex task that requires further research. This research aims to give a good premise for such efforts.

General information
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Organisations: Computing Sciences, Research area: Computer engineering, Department of Computer Science, Aalto University
Contributors: Perttula, A., Nguyen, N., Collin, J., Jokinen, J.
Number of pages: 8
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Publication date: 1 Oct 2019
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ASJC Scopus subject areas: Transportation, Environmental Science(all), Mechanical Engineering, Law
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Research output: Contribution to journal › Article › Scientific › peer-review

Running-in in fretting, transition from near-stable friction regime to gross sliding
It has been shown that quenched and tempered steel in gross-sliding fretting conditions, with tens of microns of slip amplitude, leads to fretting induced cracking and high and non-Coulomb friction. At low tangential load levels, there was only insignificant cracking. However, the running condition tends to change from stick to gross-sliding with a slip amplitude of a few micrometres. In this study, novel two-phase fretting experiments were done where quenched and tempered steel contact is run first at low loads that are initially in stick (running-in phase), followed by a gross-sliding phase with a slip amplitude of 35μm. The results show that gross-sliding phase friction was reduced and the fretting induced cracks were shorter when the running-in phase was done at high enough load level and lasted more than 10^6 load cycles. At the highest running-in load levels, the resulting crack lengths were approximately halved in comparison to experiments without running-in, and it was possible to achieve nearly ideal Coulomb friction in the gross-sliding phase when the running-in duration was 10.2×10^6 load cycles. It is concluded that it is possible to control fretting-induced friction and cracking by carefully controlled running-in.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Tribology and Machine Elements, Materials Science and Environmental Engineering, University of Oulu, Research and Development, Wärtsilä Finland

Contributors: Hintikka, J., Mäntylä, A., Vaara, J., Frondelius, T., Juoksukangas, J., Lehtovaara, A.
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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Fretting, Friction, Running-in, Wear
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Source: Scopus
Source ID: 85075897578
Research output: Contribution to journal › Article › Scientific › peer-review

FORMI: A Fast Holonomic Path Planning and Obstacle Representation Method Based on Interval Analysis
This paper presents a path planning approach for mobile robots in 2D spaces. The algorithm uses a quadtree decomposition where the discretization precision is improved until a path to the goal is found if one exists. The algorithm uses interval analysis-based methods to categorize the quadtree decomposition to occupied, free and partly occupied cells. The proposed algorithm is compared against other concurrent path planning algorithms, A on an ordinary quadtree, A for shortest path on a binary occupancy grid, and a Dijkstra's algorithm for lowest collision probability in a continuous-valued occupancy grid, in five different scenarios.Compared to the other methods, the main advantage of our method is achieving a compromise between driving distance, safety, and computation time. The proposed algorithm was found to require significantly fewer collision checks in all scenarios while providing sub-optimum results, based on the obstacle distance and path length criteria. The algorithm is suitable for further extension to include non-euclidean measures and for higher dimensions of configuration spaces. The proposed algorithm will be publicly available on GitHub repository.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Automation Technology and Mechanical Engineering, Research group: Innovative Hydraulic Automation
Contributors: Mäenpää, P., Aref, M. M., Mattila, J.
Number of pages: 6
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ASJC Scopus subject areas: Artificial Intelligence, Mechanical Engineering, Control and Optimization
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Source ID: 85085860783
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Position Estimation for Drones based on Visual SLAM and IMU in GPS-denied Environment

Due to the increased rate of drone usage in various commercial and industrial fields, the need for their autonomous operation is rapidly increasing. One major aspect of autonomous movement is the ability to operate safely in an unknown environment. The majority of current works are persistently using a global positioning system (GPS) to directly find the absolute position of the drone. However, GPS accuracy might be not suitable in some applications and this solution is not applicable to all situations. In this paper, a positioning system based on monocular SLAM and inertial measurement unit (IMU) is presented. The position is calculated through the semi-direct visual odometry (SVO) method alongside IMU data, and is integrated with an extended Kalman filter (EKF) to enhance the efficiency of the algorithm. The data is then employed to control the drone without any requirement to any source of external input. The experiment results for long-distance flying paths is very promising.

General information

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MoE publication type: A4 Article in a conference publication
Organisations: Computing Sciences, K. N. Toosi University of Technology
Contributors: Motlagh, H. D. K., Lotfi, F., Taghirad, H. D., Germi, S. B.
Number of pages: 5
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ASJC Scopus subject areas: Artificial Intelligence, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Control and Optimization, Instrumentation
Keywords: Kalman filtering, monocular camera, Position estimation, SLAM, UAV
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Prediction of contact condition and surface damage by simulating variable friction coefficient and wear

A simulation method to predict the reliability of clamped metal contacts under cyclic loading is presented. The main idea is to predict the development of contact condition of a joint by simulating a spatially variable coefficient of friction (COF) and wear. Frictional energy dissipation drives the COF evolution rule, and classic Archard's equation is employed as the evolution rule for wear depth. As both the COF and wear evolution are considered, the presented approach is capable of predicting changes in the contact condition over time. The approach is based on the Finite Element Method (FEM) and is generally applicable to industrial cases. The method is implemented as a subroutine to a FEM solver Abaqus to define a contact formulation in both normal and tangential directions. The subroutine allows full coupling between normal and tangential contact variables, which makes the approach robust also in complex industrial applications. As the effect of wear is described in the contact pressure calculation, there is no need for mesh modification. The presented approach was validated by simulating cylinder-on-plane configuration. The presented method provides similar results obtained with a simulation where geometry is updated due to wear. The results of the case study were qualitatively verified against a bolted joint type fretting experiment. The area of slip after stabilized COF distribution corresponds well with the experimental fretting scars. However, Archard's wear law seems to be limited, at least in partial slip cases, as it overestimates the amount of wear without considering entrapment of wear debris in the contact. A case study of medium speed combustion engine component is presented to show how the simulation method can be used in engine development to ensure reliable contact interfaces.

General information

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Organisations: Research group: Tribology and Machine Elements, Materials Science and Environmental Engineering, University of Oulu, Research and Development, Wärtsilä Finland
Contributors: Mäntylä, A., Hintikka, J., Frondelius, T., Vaara, J., Lehtovaara, A., Juoksukangas, J.
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ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Contact, Fatigue, Finite element method, Fretting, Friction, Wear
DOIs:
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Source: Scopus
Source ID: 85075347573
Research output: Contribution to journal › Article › Scientific › peer-review

Potential of renewable fuel to reduce diesel exhaust particle emissions

The use of fossil fuels in traffic is a significant source of air pollutants and greenhouse gases in rapidly growing and densely populated cities. Diesel exhaust emissions including particle number concentration and size distribution along with the particles' chemical composition and NOx were investigated from a Euro 4 passenger car with a comprehensive set of high time-resolution instruments. The emissions were compared with three fuel standards – European diesel (EN590), Indian diesel (BS IV) and Finnish renewable diesel (Neste MY) – over the New European Driving Cycle (NEDC) and the Worldwide harmonized Light vehicles Test Cycle (WLTC). Fuel properties and driving conditions strongly affected exhaust emissions. The exhaust particulate mass emissions for all fuels consisted of BC (81–88%) with some contribution from organics (11–18%) and sulfate (0–3%). As aromatic-free fuel, the MY diesel produced around 20% lower black carbon (BC) emissions compared to the EN590 and 29–40% lower compared to the BS IV. High volatile nanoparticle concentrations at high WLTC speed conditions were observed with the BS IV and EN590 diesel, but not with the sulfur-free MY diesel. These nanoparticles were linked to sulfur-driven nucleation of new particles in cooling dilution of the exhaust. For all the fuels non-volatile nanoparticles in sub-10 nm particle sizes were observed during engine braking, and they were most likely formed from lubricant-oil-originated compounds. With all the fuels, the measured particulate and NOx emissions were significantly higher during the WLTC cycle compared to the NEDC cycle. This study demonstrated that renewable diesel fuels enable mitigations of particulate and climate-warming BC emissions of traffic, and will simultaneously help tackle urban air quality problems.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Physics, Department of Automotive and Mechanical Engineering, Metropolia University of Applied Sciences, Finnish Meteorological Institute, The Energy and Resources Institute India, Neste Oyj
Contributors: Pirjola, L., Kuuluvainen, H., Timonen, H., Saarikoski, S., Teinilä, K., Salo, L., Datta, A., Simonen, P., Karjalainen, P., Kulmala, K., Rönkkö, T.
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Original language: English
ASJC Scopus subject areas: Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law
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Bibliographical note

EXT="Pirjola, Liisa"
Source: Scopus
Source ID: 85070211798

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

Barkhausen Noise Probes and Modelling: A Review

This review looks at the main types of magnetic Barkhausen noise (BN) probes that have been developed. The aim of this review is to summarize the existing knowledge of magnetic Barkhausen noise probes and the magnetic modelling of them. The BN probes have been the focus of many previous studies, but no sufficient review or conclusions have been made so far. This review focuses on combining information regarding the different types of BN probes and their modelling. The review is divided into two sections; in the first part the different designs and types of Barkhausen noise probes are introduced. The second part of the review deals with the BN probe modelling with various modelling software. Finally, a comparison of the experimental measurements is made and BN sensitivity is discussed.

General information

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Organisations: Materials Science and Environmental Engineering, University of Oulu
Contributors: Santa-aho, S., Laitinen, A., Sorsa, A., Vippola, M.
Publication date: 1 Dec 2019
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Original language: English
ASJC Scopus subject areas: Mechanics of Materials, Mechanical Engineering
Keywords: FEM modelling, Magnetic Barkhausen noise, Non-destructive testing, Probes
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URLs:

http://urn.fi/URN:NBN:fi:tuni-201910213970
Source: Scopus
Source ID: 85073207400
Research output: Contribution to journal › Review Article › Scientific › peer-review

An exploratory study on strengthening and thermal stability of magnetron sputtered W nanoparticles at the interface of Cu/Ni multilayer films

An initial study to investigate the effect of controlled deposition of nanoparticles at multilayer interfaces was conducted to explore the mechanical effect of particles on laminate structures. Nanoparticles with diameter of about 4.5 nm were specifically deposited at the interface between Cu and Ni laminates by forced agglomeration of magnetron sputtered ions using a Mantis Ltd. Nanogen50 nanoparticle generator and the hardness of these films were measured using the nanoindentation technique. Cu/Ni laminates without W nanoparticles have an average modulus value of approximately 120 ± 3.7 GPa and hardness value of 2.23 ± 0.07 GPa, while the hardness values of the particle-containing films are greater, regardless of particle density. The areas with the lowest particle density at the interfaces (0.9 at.% W) show the greatest increase in hardness, with an increase of about 1.3 GPa greater than the particle-free sample. However, as the particle density increases, there is a corresponding decrease in hardness. In-situ x-ray diffraction of these films was also conducted to observe the annealing behavior of these films. For all samples, the Cu and Ni layered structure remained intact; however, there is evidence of Ni diffusion along grain boundaries and interaction with the oxygen, likely creating NiO. After annealing, a significant number of the W nanoparticles dissolved into the Ni matrix to create NiW solid-solution. The ability to deposit particles with such precise control has the potential to open up an exciting new field of research.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Materials Characterization, University of California, Santa Barbara, Swiss Federal Laboratories for Materials Science and Technology
Contributors: Schoeppner, R., Mohanty, G., Polyakov, M., Petho, L., Maeder, X., Michler, J.
Number of pages: 9
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
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Electronic versions:

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Source: Scopus
Source ID: 85089233725
Research output: Contribution to journal › Article › Scientific › peer-review

Assessment of pitting corrosion in bare and passivated (wet scCO$_2$-induced patination and chemical passivation) hot-dip galvanized steel samples with SVET, FTIR, and SEM (EDS)
In this study, the local electrochemical activity of untreated and passivated (natural or chemical passivation) zinc specimens was observed during immersion in a 0.1-M NaCl solution. The localized anodic activity during the exposure, measured with the scanning vibrating electrode technique, was linked to zinc dissolution by the pitting corrosion mechanism. It was correlated to specific corrosion products characterized by Fourier transmission infrared (FTIR) microscopy. FTIR molecule maps were produced from individual pitting corrosion sites (100–200 µm in width). With argon ion beam milling and latest energy-dispersive X-ray spectroscopy (EDS) technology, element maps with a high spatial resolution (≪100 nm) were recorded from abrasion- and beam-sensitive corrosion products, showing a residual layer structure. This study demonstrates the capability of FTIR mapping, cross-section polishing, and state-of-the-art scanning electron microscopy imaging, and EDS element mapping to produce high-resolution elemental, molecular, and visual information about pitting corrosion mechanisms on a hot-dip galvanized steel sample.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Ceramic materials, Top Analytica Oy, Swerim AB, RISE, SSAB
Contributors: Saarimaa, V., Fuertes, N., Persson, D., Zavalis, T., Kaleva, A., Nikkanen, J., Levänen, E., Heydari, G.
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ASJC Scopus subject areas: Environmental Chemistry, Mechanics of Materials, Mechanical Engineering, Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry
Keywords: anodic dissolution, FTIR microscopy, passivation, pitting corrosion, scanning electron microscopy, zinc
DOIs:

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Source: Scopus
Source ID: 85084611702
Research output: Contribution to journal › Article › Scientific › peer-review

Asymptotics and approximation of large systems of ordinary differential equations
In this paper we continue our earlier investigations into the asymptotic behaviour of infinite systems of coupled differential equations. Under the mild assumption that the so-called characteristic function of our system is completely monotonic we obtain a drastically simplified condition which ensures boundedness of the associates semigroup. If the characteristic function satisfies certain additional conditions we deduce sharp rates of convergence to equilibrium. We moreover address the important and delicate issue of the role of the infinite system in understanding the asymptotic behaviour of large but finite systems, and we provide a precise way of obtaining size-independent rates of convergence for families of finite-dimensional systems. Finally, we illustrate our abstract results in the setting of the well-known platoon problem.

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Contributors: Paunonen, L., Seifert, D.
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Avoiding the high friction peak in fretting contact
Fretting fatigue and wear may exist if two parts have small amplitude relative rubbing between the contacting surfaces. A peak in the coefficient of friction typically occurs during the first thousands of loading cycles in dry fretting contact with quenched and tempered steel. This peak is related to adhesive friction and wear causing non-Coulomb friction and high local contact stresses possibly leading to cracking. The focus of the study is the effect of different experimental methods on the frictional behavior of the fretting contact between the steel surfaces. The use of pre-corroded specimens and contact lubrication delayed and reduced the initial peak. However, a pre-added third body layer removed the peak completely.

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Contributors: Juoksukangas, J., Hintikka, J., Lehtovaara, A., Mäntylä, A., Vaara, J., Frondelius, T.
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Research output: Contribution to journal › Article › Scientific › peer-review

CFD modeling the diffusional losses of nanocluster-sized particles and condensing vapors in 90° bends of circular tubes

Particle and vapor measurements typically include sampling tubing causing sampling losses therein. Correcting measured concentrations from the sampling losses using the calculated penetration efficiencies of straight tubes is a satisfactory approximation if sub-micrometer particles are of interest. However, in addition to inertial impaction of larger particles, bends in the tubing can cause a significant increase in diffusional losses of particles smaller than 5 nm or of condensing vapor, such as sulfuric acid. Here, the effects of 90° bends with various curvatures (dimensionless curvatures of 1.3−67) on the diffusional losses in a wide range of Reynolds (25−10000) and Schmidt (0.48−1400) numbers were simulated using computational fluid dynamics. The results were parametrized to output the functions for the penetration efficiencies of a bend.

General information

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Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group
Contributors: Olin, M., Dal Maso, M.
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Keywords: Bend, Diffusion, Nanocluster, Sulfuric acid
Electronic versions:

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DOIs:

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http://urn.fi/URN:NBN:fi:tuni-202008256644
Source: Scopus
Source ID: 85087771556
Research output: Contribution to journal › Article › Scientific › peer-review

Conductivity control via minimally invasive anti-Frenkel defects in a functional oxide

Utilizing quantum effects in complex oxides, such as magnetism, multiferroicity and superconductivity, requires atomic-level control of the material's structure and composition. In contrast, the continuous conductivity changes that enable artificial oxide-based synapses and multiconfigurational devices are driven by redox reactions and domain reconfigurations, which entail long-range ionic migration and changes in stoichiometry or structure. Although both concepts hold great technological potential, combined applications seem difficult due to the mutually exclusive requirements. Here we demonstrate a route to overcome this limitation by controlling the conductivity in the functional oxide hexagonal $Er(Mn,Ti)O_3$ by using conductive atomic force microscopy to generate electric-field induced anti-Frenkel defects, that is, charge-neutral interstitial–vacancy pairs. These defects are generated with nanoscale spatial precision to locally enhance the electronic hopping conductivity by orders of magnitude without disturbing the ferroelectric order. We explain the non-volatile effects using density functional theory and discuss its universality, suggesting an alternative dimension to functional oxides and the development of multifunctional devices for next-generation nanotechnology.

General information

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Contributors: Evans, D. M., Holstad, T. S., Mosberg, A. B., Småbråten, D. R., Vullum, P. E., Dadlani, A. L., Shapovalov, K. , Yan, Z., Bourret, E., Gao, D., Akola, J., Torgersen, J., van Helvoort, A. T., Selbach, S. M., Meier, D.
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Source: Scopus
Source ID: 85089493457
Research output: Contribution to journal › Article › Scientific › peer-review

Deformability analysis and improvement in stretchable electronics systems through finite element analysis

Stretchable electronic systems employ a combination of extremely deformable substrates with electrically conductive inks printed on their surface, on which components are connected. The absence of solid metal as conductive material greatly enhances the deformability of these systems. However, although being able to sustain high deformation, the presence of rigid components heavily affects the achievable deformation levels due to strain concentrations near the interconnection area. In order to improve stretchability under these conditions, a combination of research on materials for conductive inks and optimization of the employed layout is needed. Especially for the latter, the use of Finite Element (FE) modeling is very useful, since it allows to locate critical regions for deformation behavior and to perform design optimization and instability analyses. In this work, the authors show the application of this strategy to improve mechano-electrical performance of the system under uniaxial tension by modelling and then modifying the overall stiffness of specific sample regions. Depending on the specific need, different strategies can be adopted to intervene on stiffness changes, such as material addition to specific regions. This work shows that, in particular, a simple technique such as laser cutting can be used to tailor the local material parameters at a deeper level, thus allowing decrease in stiffness gradients and a general enhancement of electrical performances under high levels of uniaxial deformation of the sample, as also predicted in the FE analyses.

General information

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Organisations: Electrical Engineering, Research group: Plastics and Elastomer Technology, Research group: Laboratory for Future Electronics, Materials Science and Environmental Engineering
Contributors: Di Vito, D., Mosallaei, M., Vahed, B. K., Kanerva, M., Mäntysalo, M.
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Keywords: FEM, Optimization, Stretchable electronics
DOIs:
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URLs:
http://urn.fi/URN:NBN:fi:tuni-202008046388. Embargo ends: 31/03/21

Bibliographical note

jufoid=79273
Source: Scopus
Source ID: 85083958324
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

FEM-based wear simulation for fretting contacts

This article presents a robust Finite-Element-Method-based wear simulation method, particularly suitable for fretting contacts. This method utilizes the contact subroutine in a commercial finite element solver Abaqus. It is based on a user-

defined contact formulation for both normal and tangential directions. For the normal contact direction, a nodal gap field is calculated by using a simple Archard's wear equation to describe the depth of material removal due to wear. The wear field is included in the contact pressure calculation to allow simulation of wear and contact stress evolution during the loading cycles. The main advantage of this approach is that all contact variables are accessible inside the routine, which allows full coupling between normal and tangential contact variables. Also, there is no need for mesh modifications during the solution. This makes the implementation flexible, robust and particularly suitable for fretting cases where friction and tangential contact stiffness play an essential role. The method is applied to the bolted joint type fretting test case. The methodology is also fully applicable to complex real component simulations.

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Organisations: Materials Science and Environmental Engineering, Research group: Tribology and Machine Elements, University of Oulu, Wärtsilä
Contributors: Mäntylä, A., Juoksukangas, J., Hintikka, J., Frondelius, T., Lehtovaara, A.
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Research output: Contribution to journal › Article › Scientific › peer-review

From Responsive Molecules to Interactive Materials

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Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, DWI – Leibniz Institute for Interactive Materials, RWTH Aachen University
Contributors: Priimägi, A. (ed.), Hecht, S. (ed.)
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
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Source ID: 85084867954
Research output: Contribution to journal › Editorial › Scientific

Introducing Multi-Convexity in Path Constrained Trajectory Optimization for Mobile Manipulators

Mobile manipulators have a highly non-linear and non-convex mapping between the end-effector path and the manipulator's joints and position and orientation of the mobile base. As a result, trajectory optimization with end-effector path constraints takes the form of a difficult non-linear optimization problem. In this paper, we present the first multi-convex approximation to this difficult optimization problem that eventually reduces to solving a sequence of globally valid convex quadratic programs (QPs). The proposed optimizer rests on two novel building blocks. First, we introduce a set of auxiliary variables in which the non-linear constraints that arise out of manipulator kinematics and its coupling with the mobile base have a multi-affine form. Projecting the auxiliary variables to the space of actual configuration variables of the mobile manipulator involves a non-convex optimization. Thus, the second building block involves computing a convex surrogate for this non-convex projection. We show how large parts of the proposed optimizer can be solved in parallel providing the possibility of exploiting multi-core CPUs. We validate our trajectory optimization on different benchmark examples. Specifically, we highlight how it solves the cyclicity problem and provides a holistic approach where a diverse set of trajectories can be obtained by trading-off different aspects of manipulator and mobile base motion.

General information

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Organisations: Automation Technology and Mechanical Engineering, Research group: Robotics and Automation, University of Tartu, Johannes Kepler University
Contributors: Singh, A. K., Ahonen, A., Ghabcheloo, R., Mueller, A.
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ASJC Scopus subject areas: Artificial Intelligence, Decision Sciences (miscellaneous), Control and Systems Engineering, Mechanical Engineering, Computational Mathematics, Control and Optimization

Bibliographical note

EXT="Singh, Arun Kumar"
Source: Scopus
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Käyräviivaiset koordinaatistot kontinuumimekaniikassa

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Civil Engineering, Research group: Structural Mechanics
Contributors: Holopainen, S.
Number of pages: 14
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Low temperature afterglow from $SrAl_2O_4$: Eu, Dy, B containing glass

$SrAl_2O_4$: Eu, Dy, B particles were added in a phosphate glass ($90NaPO_3$-10NaF (in mol%)) using the direct doping method. For the first time, the composition of the particles prior to and after embedding them in the glass was analysed using EPMA analysis. Boron was found to be incorporated in already distorted surroundings creating new trapping centers in the particles which are thought to be favourable for the tunnelling process and so for the afterglow at 10K. Despite the partial decomposition of the particles, the glass exhibit afterglow at low temperature confirming to be promising materials for low temperature applications.

General information

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Organisations: Physics, Research group: Photonics Glasses, Institute of Solid State Physics University of Latvia, Tampere University, University of Turku
Contributors: Vitola, V., Lahti, V., Bite, I., Spustaka, A., Millers, D., Lastusaari, M., Petit, L., Smits, K.
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ASJC Scopus subject areas: Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Mechanical Engineering, Metals and Alloys
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Source ID: 85090044971
Research output: Contribution to journal › Article › Scientific › peer-review

Multi-sensor next-best-view planning as matroid-constrained submodular maximization

3D scene models are useful in robotics for tasks such as path planning, object manipulation, and structural inspection. We consider the problem of creating a 3D model using depth images captured by a team of multiple robots. Each robot selects a viewpoint and captures a depth image from it, and the images are fused to update the scene model. The process is repeated until a scene model of desired quality is obtained. Next-best-view planning uses the current scene model to select the next viewpoints. The objective is to select viewpoints so that the images captured using them improve the quality of the scene model the most. In this letter, we address next-best-view planning for multiple depth cameras. We propose a utility function that scores sets of viewpoints and avoids overlap between multiple sensors. We show that multi-sensor next-best-view planning with this utility function is an instance of submodular maximization under a matroid constraint. This allows the planning problem to be solved by a polynomial-Time greedy algorithm that yields a solution within a constant factor from the optimal. We evaluate the performance of our planning algorithm in simulated experiments with up to 8 sensors, and in real-world experiments using two robot arms equipped with depth cameras.

General information

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Organisations: Computing Sciences, Technical University Darmstadt, Max Planck Institute for Intelligent Systems, University of Hamburg
Contributors: Lauri, M., Pajarinen, J., Peters, J., Frintrop, S.
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Keywords: multi-robot systems, Reactive and sensor-based planning, RGB-D perception
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EXT="Lauri, Mikko"
Source: Scopus
Source ID: 85090245712
Research output: Contribution to journal › Article › Scientific › peer-review

Phosphate/oxyfluorophosphate glass crystallization and its impact on dissolution and cytotoxicity
The role of fluorine in bioactive glasses is of interest due to the potential of precipitating fluorapatite, a phase with higher chemical resistance than the typical hydroxyapatite precipitated from oxide bioactive glasses. However, the introduction of fluorine in silicate bioactive glasses was found deleterious to the bioactivity of the glass. Here, phosphate glasses with the composition $75NaPO_3$-(25-x) CaO-xCaF_2 (in mol%), with x = 0–20 and glass-ceramics were investigated to evaluate their potential as substitutes to the traditional silicate bioactive glass. An increase in CaF_2 substitution for CaO led to an increase in the glass solubility, due to an increase in highly soluble F(M)n species (where M is a cation) and to an increased polymerization of the phosphate network. Structural analysis reveals the formation of F[sbnd]P bonds, in addition to the F(M)n species, in the glass with the higher CaF_2 content. Furthermore, with heat treatment, CaF_2 crystals precipitate within the bulk in the newly developed glass, when x = 20. This bulk crystallization reduces the glass dissolution without compromising the precipitation of a reactive layer at the glass surface. Finally, in vitro cell tests were performed using MC3T3 pre-osteoblastic cells. While the substitution of CaF_2 for CaO led to an increased cytotoxicity, the controlled crystallization of the fluorine containing glasses decreased such cytotoxicity to similar values than traditional bioactive phosphate glass (x0). This study reports on new oxyfluorophosphate glass and glass-ceramics able, not only, to precipitate a Ca-P reactive layer but also to be processed into glass-ceramics with controlled crystal size, density and cellular activity. Statement of significance: Uncontrolled crystallization of bioactive glasses has negative effect on the materials' bioactivity. While in silicate glass the bioactivity is solely reduced, in phosphate glasses it is often completely suppressed. Furthermore, the need for fluorine containing bioactive glasses, not only for use in bone reconstruction but also in toothpaste as emerged. The addition of F in both silicate and phosphate has led to challenges due the lack of Si-F or P-F bonds, generally leading to a decrease in bioactivity. Here, we developed a bioactive invert phosphate glass where up to 20 mol% of CaO was replaced with CaF_2. In the new developed glasses, NMR demonstrated formation of P-F bonds. The content of fluorine was tailored to induce CaF_2 bulk crystallization. Overall an increase in F was associated with an increase network connectivity. In turns it led to an increased dissolution rate which was linked to a higher cytotoxicity. Upon (partial to full) surface crystallization of the F-free glass, the bioactivity (ability to form a reactive layer) was loss and the cytotoxicity again increased due to the rapid dissolution of one crystal phase and of the remaining amorphous phase. On another hand, the controlled bulk precipitation of CaF_2 crystals, in the F-containing glass, was associated with a reduced cytotoxicity. The new oxyfluorophosphate glass-ceramic developed is promising for application in the biomedical field.

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Organisations: Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group, Research group: Tribology and Machine Elements, Materials Science and Environmental Engineering, Physics, Research group: Photonics Glasses, CY Cergy Paris University, Central South University China, Queen Mary University of London
Contributors: Nommeots-Nomm, A., Houaoui, A., Pradeepan Packiyanathar, A., Chen, X., Hokka, M., Hill, R., Pauthe, E., Petit, L., Boissière, M., Massera, J.
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Research output: Contribution to journal › Article › Scientific › peer-review

Probabilistic approach to physical object disentangling

Physically disentangling entangled objects from each other is a problem encountered in waste segregation or in any task that requires disassembly of structures. Often there are no object models, and especially with cluttered irregularly shaped objects, the robot cannot create a model of the scene due to occlusion. One of our key insights is that based on previous sensory input we are only interested in moving an object out of the disentanglement around obstacles. That is, we only need to know where the robot can successfully move in order to plan the disentangling. Due to the uncertainty we integrate information about blocked movements into a probability map. The map defines the probability of the robot successfully moving to a specific configuration. Using as cost the failure probability of a sequence of movements we can then plan and execute disentangling iteratively. Since our approach circumvents only previously encountered obstacles, new movements will yield information about unknown obstacles that block movement until the robot has learned to circumvent all obstacles and disentangling succeeds. In the experiments, we use a special probabilistic version of the Rapidly exploring Random Tree (RRT) algorithm for planning and demonstrate successful disentanglement of objects both in 2-D and 3-D simulation, and, on a KUKA LBR 7-DOF robot. Moreover, our approach outperforms baseline methods.

General information

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Contributors: Pajarinen, J., Arenz, O., Peters, J., Neumann, G.
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Keywords: Autonomous systems, collision avoidance, intelligent robots, path planning, probabilistic computing, waste recovery
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Source ID: 85090290264
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Resilient Cooperative Voltage Control for Distribution Network with High Penetration Distributed Energy Resources

This paper considers the problem of designing a resilient distributed voltage control algorithm for distribution systems with high penetration of distributed energy resources in the presence of an unknown cyber-attack. The purpose of the attack is to force the system to violate the operating voltage limit by intercepting its communication channels and inserting exogenous signals to perturb and/or modify the information being exchanged. We first review the cooperative voltage control proposed in our previous work and provide a new stability analysis for it. Next, we present a resilient cooperative voltage control algorithm by introducing a virtual system interconnected with the original system such that the voltage can be maintained within the operational limit under unknown attacks. The resiliency of the proposed algorithm is demonstrated via simulations on the IEEE 8500-node system when subjected to an attack which consists of corrupting the data being exchanged in the communication network between two generation units.

General information

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MoE publication type: A4 Article in a conference publication
Organisations: Automation Technology and Mechanical Engineering, University of Central Florida
Contributors: Gusrialdi, A., Xu, Y., Qu, Z., Simaan, M. A.
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ASJC Scopus subject areas: Artificial Intelligence, Decision Sciences (miscellaneous), Control and Systems Engineering, Mechanical Engineering, Computational Mathematics, Control and Optimization
Keywords: cooperative control, cyber attacks, distribution network, resilient control, Voltage control
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Special Issue: From Responsive Materials to Interactive Materials

General information
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MoE publication type: C2 Edited books
Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, DWI – Leibniz Institute for Interactive Materials, RWTH Aachen University
Contributors: Priimägi, A. (ed.), Hecht, S. (ed.)
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ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Mechanical Engineering
Research output: Contribution to journal › Special issue › Scientific › peer-review

Syndecan-4 tunes cell mechanics by activating the kindlin-integrin-RhoA pathway
Extensive research over the past decades has identified integrins to be the primary transmembrane receptors that enable cells to respond to external mechanical cues. We reveal here a mechanism whereby syndecan-4 tunes cell mechanics in response to localized tension via a coordinated mechanochemical signalling response that involves activation of two other receptors: epidermal growth factor receptor and β1 integrin. Tension on syndecan-4 induces cell-wide activation of the kindlin-2/β1 integrin/RhoA axis in a PI3K-dependent manner. Furthermore, syndecan-4-mediated tension at the cell–extracellular matrix interface is required for yes-associated protein activation. Extracellular tension on syndecan-4 triggers a conformational change in the cytoplasmic domain, the variable region of which is indispensable for the mechanical adaptation to force, facilitating the assembly of a syndecan-4/α-actinin/F-actin molecular scaffold at the bead adhesion. This mechanotransduction pathway for syndecan-4 should have immediate implications for the broader field of mechanobiology.

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MoE publication type: A1 Journal article-refereed
Organisations: Imperial College London, Queen Mary University of London, Fimlab Laboratories, University of Helsinki, Tampere University
Contributors: Chronopoulos, A., Thorpe, S. D., Cortes, E., Lachowski, D., Rice, A. J., Mykuliak, V. V., Rog, T., Lee, D. A., Hytönen, V. P., del Río Hernández, A. E.
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Peer-reviewed: Yes

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Bibliographical note
EXT="Rog, Tomasz"
INT=bmte,"Mykuliak, Vasyl V."
INT=bmte,"Hytonen, Vesa P."
dupl=51711393
Source: Scopus
Source ID: 85077339980
Research output: Contribution to journal › Article › Scientific › peer-review

Viewpoint: Pavlovian Materials—Functional Biomimetics Inspired by Classical Conditioning
Herein, it is discussed whether the complex biological concepts of (associative) learning can inspire responsive artificial materials. It is argued that classical conditioning, being one of the most elementary forms of learning, inspires algorithmic realizations in synthetic materials, to allow stimuli-responsive materials that learn to respond to a new stimulus, to which they are originally insensitive. Two synthetic model systems coined as “Pavlovian materials” are described, whose stimuli-responsiveness algorithmically mimics programmable associative learning, inspired by classical conditioning. The concepts minimally need a stimulus-triggerable memory, in addition to two stimuli, i.e., the unconditioned and the originally neutral stimuli. Importantly, the concept differs conceptually from the classic stimuli-responsive and shape-memory materials, as, upon association, Pavlovian materials obtain a given response using a new stimulus (the originally neutral one); i.e., the system evolves to a new state. This also enables the functionality to be described by a logic diagram. Ample room for generalization to different stimuli and memory combinations is foreseen, and opportunities to develop future adaptive materials with ever-more intelligent functions are expected.

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, Aalto University
Contributors: Zhang, H., Zeng, H., Priimägi, A., Ikkala, O.
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Circular dichroism in the second harmonic field evidenced by asymmetric AU coated gaas nanowires
Optical circular dichroism (CD) is an important phenomenon in nanophotonics, that addresses top level applications such as circular polarized photon generation in optics, enantiomeric recognition in biophotonics and so on. Chiral nanostructures can lead to high CD, but the fabrication process usually requires a large effort, and extrinsic chiral samples can be produced by simpler techniques. Glancing angle deposition of gold on GaAs nanowires can (NWs) induces a symmetry breaking that leads to an optical CD response that mimics chiral behavior. The GaAs NWs have been fabricated by a self-catalyzed, bottom-up approach, leading to large surfaces and high-quality samples at a relatively low cost. Here, we investigate the second harmonic generation circular dichroism (SHG-CD) signal on GaAs nanowires partially covered with Au. SHG is a nonlinear process of even order, and thus extremely sensitive to symmetry breaking. Therefore, the visibility of the signal is very high when the fabricated samples present resonances at first and second harmonic frequencies (i.e., 800 and 400 nm, in our case).

General information

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Organisations: Physics, Sapienza University, Department of Chemistry and Bioengineering
Contributors: Belardini, A., Leahu, G., Petronijevic, E., Hakkarainen, T., Koivusalo, E., Piton, M. R., Talmila, S., Guina, M., Sibilia, C.
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Source: Scopus
Source ID: 85081162306
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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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.
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ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Mechanical Engineering, Electrical and Electronic Engineering
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URLs:

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Source ID: 85076060273
Research output: Contribution to journal › Article › Scientific › peer-review

Transparent microelectrode arrays fabricated by ion beam assisted deposition for neuronal cell in vitro recordings

Microelectrode array (MEA) is a tool used for recording bioelectric signals from electrically active cells in vitro. In this paper, ion beam assisted electron beam deposition (IBAD) has been used for depositing indium tin oxide (ITO) and titanium nitride (TiN) thin films which are applied as transparent track and electrode materials in MEAs. In the first version, both tracks and electrodes were made of ITOto guarantee full transparency and thus optimal imaging capability. In the second version, very thin (20 nm) ITO electrodes were coated with a thin (40 nm) TiN layer to decrease the impedance of O30 μm electrodes to one third (1200 kΩ → 320 kΩ) while maintaining (partial) transparency. The third version was also composed of transparent ITO tracks, but the measurement properties were optimized by using thick (200 nm) opaque TiN electrodes. In addition to the impedance, the optical transmission and electric noise levels of all three versions were characterized and the functionality of the MEAs was successfully demonstrated using human pluripotent stem cell-derived neuronal cells. To understand more thoroughly the factors contributing to the impedance, MEAs with higher IBAD ITO thickness as well as commercial sputter-deposited and highly conductive ITO were fabricated for comparison. Even if the sheet-resistance of our IBAD ITO thin films is very high compared to the sputtered one, the impedances of the MEAs of each ITO grade were found to be practically equal (e.g., 300-370 kΩ for O30 μm electrodes with 40 nm TiN coating). This implies that the increased resistance of the tracks, either caused by lower thickness or lower conductivity, has hardly any contribution to the impedance of the MEA electrodes. The impedance is almost completely defined by the double-layer interface between the electrode top layer and the medium including cells.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Micro and Nanosystems Research Group, BioMediTech, Tampere University
Contributors: Ryynänen, T., Mzezewa, R., Meriläinen, E., Hyvärinen, T., Lekkala, J., Narkilahti, S., Kallio, P.
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ASJC Scopus subject areas: Control and Systems Engineering, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: Indium tin oxide (ITO), Ion beam assisted electron beam deposition (IBAD), Microelectrode array (MEA), Neurons, Titanium nitride (TiN), Transparent
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Source: Scopus
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Research output: Contribution to journal › Article › Scientific › peer-review

Hot-box measurements to investigate the internal convection of highly insulated loose-fill insulation roof structures

The purpose of this study was to investigate how internal convection in loose-fill insulations affects the insulation properties of highly insulated roof structures. This study consists of laboratory measurements of roof structures insulated by two different blown-in insulations. The measurements are repeated with two temperature differences and air velocities for 300 mm and 600 mm thick insulation layers both with and without trusses, making a total of 24 case studies. The measurements were conducted with equipment using the calibrated hot-box method. The results of the tests show that internal convection can reduce insulation capacity significantly, especially with low-density loose-fill insulations, such as blown-in glass wool. A critical evaluation should be performed as to whether international standards and national building regulations take internal convection into account adequately. According to this study, 5 should be used as a critical modified Rayleigh number for horizontal roof structures with an open upper surface when used insulation material is loose-fill glass wool or wood fibre insulation as in this study.

General information

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Contributors: Kivioja, H., Vinha, J.
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Peer-reviewed: Yes

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Tribocorrosion behaviour of tin bronze CuSn12 under a sliding motion in NaCl containing environment: Contact to inert vs. reactive counterbody
Tribocorrosion behaviour of tin bronze was examined in NaCl environments using two counterbodies: inert alumina and reactive bearing steel. The results with inert counterbody disclosed growing alloy losses with increasing potential, due to wear-influenced corrosion. Degradation progressed through the development, modification and removal of corrosion products, exposing fresh surface for the environment. With reactive counterbody, galvanic coupling between the two metals played an important role in the behaviour of the tribopair. At the lowest potential, where counterbody corrosion progressed slowly, the metals were in a direct mechanical contact, introducing wear in the ploughing mode in tin bronze. At anodic potentials, counterbody provided cathodic protection to tin bronze, with most material losses occurring in the counterbody by corrosion and wear-influenced corrosion.

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Estimation of the largest expected photovoltaic power ramp rates
Photovoltaic (PV) systems are prone to irradiance variation caused by cloud shadows leading to fluctuations in generated power. Since these fluctuations can be harmful to the operation of power grids, there is a need to restrict the largest PV

power ramp rates (RR). This article proposes a method to estimate the largest expected PV power RRs. The only inputs of the method are the minimum PV system dimension and the measurements of point irradiance and cloud shadow velocity. Since cloud shadows cause the largest power RRs for well-designed large-scale PV power plants, the relation between the largest RRs in irradiance and power during partial cloud shading events was studied based on irradiance measurements. The largest RRs in PV power are estimated from RRs in the average irradiance across the PV system. The proposed method was validated using measured data of 57 days from two PV systems. It showed superior performance compared to an existing method enveloping the RR in the measured power over 99.99% of the time. The method can be used in design and component sizing of PV power plants.

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