Edge and particle embedment effects in low- and high-stress slurry erosion wear of steels and elastomers

Slurry transportation via pumping is an increasingly viable alternative for the conventional fine particle pumping, but there are also many applications involving larger particles. However, most of the published studies on slurry erosion have been conducted with fine particle sizes. In this work, also large particle slurry erosion of commercial wear resistant materials is studied. A high speed slurry-pot wear tester was used with edge protected samples to simulate the wear conditions in industrial slurry applications where edge wear is minimal. Two wear resistant steels together with natural rubber and polyurethane lining materials were tested, and the results were compared with the results of the same materials tested without sample edge protection. The tests were performed using 15 m/s speed, two sample angles, and slurry concentrations with particle size ranging from large 8/10 mm granite to fine 0.1/0.6 mm quartz. In all conditions, the steel samples showed stable wear behavior, whereas the elastomers gave notably inconsistent results in different test conditions. In general, steels exhibited better wear performance with large particles and elastomers with fine particles, and the wear losses were 40-95 % lower when edge wear was inhibited. With increasing abrasive size, the edge wear becomes more dominant and the particle embedment decreases.

General information
State: E-pub ahead of print
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization
Authors: Ojala, N., Valtonen, K., Minkkinen, J., Kuokkala, V.
Keywords: (Wear testing, Steel, Elastomers, Edge effect, Particle embedment, Mining, Mineral processing)
Number of pages: 10
Publication date: 15 Jun 2017
Peer-reviewed: Yes
ASJC Scopus subject areas: Metals and Alloys, Materials Science(all), Polymers and Plastics

Publication information
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ISSN (Print): 0043-1648
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Publication Forum (2017): 1
Scopus rating (2016): 1.558 2.071
Publication Forum (2016): 1
Scopus rating (2015): 1.527 2.017
Web of Science (2015): 2.323 2.395 >10.0 0.37 0.01794 0.645
Publication Forum (2015): 1
Scopus rating (2014): 1.715 2.38
Web of Science (2014): 1.913 2.109 >10.0 0.347 0.01937 0.601
Publication Forum (2014): 2
Scopus rating (2013): 1.319 2.416
Publication Forum (2013): 2
Scopus rating (2012): 1.36 2.178
Publication Forum (2012): 2
Scopus rating (2011): 1.547 2.865
Scopus rating (2009): 1.684 2.07
Scopus rating (2008): 1.597 1.863
Scopus rating (2007): 1.286 1.889
Scopus rating (2006): 1.435 2.036
Scopus rating (2005): 1.473 2.007
Scopus rating (2004): 1.335 1.965
Scopus rating (2003): 1.104 1.788
Scopus rating (2002): 0.958 1.365
Scopus rating (2001): 0.937 1.47
Scopus rating (2000): 1.069 1.149
Scopus rating (1999): 0.848 1.338
Original language: English
Electronic versions:
Ojala_Full_paper_NordTrib2016 to Wear_PRE-PRINT
DOIs:
10.1016/j.wear.2017.06.004
Investigation of the structural anisotropy in a self-assembling glycinate layer on Cu(100) by scanning tunneling microscopy and density functional theory calculations

Self-assembling organic molecule-metal interfaces exhibiting free-electron like (FEL) states offers an attractive bottom-up approach to fabricating materials for molecular electronics. Accomplishing this, however, requires detailed understanding of the fundamental driving mechanisms behind the self-assembly process. For instance, it is still unresolved as to why the adsorption of glycine ([NH2(CH2)COOH]) on isotropic Cu(100) single crystal surface leads, via deprotonation and self-assembly, to a glycinate ([NH2(CH2)COO−]) layer that exhibits anisotropic FEL behavior. Here, we report on bias-dependent scanning tunneling microscopy (STM) experiments and density functional theory (DFT) calculations for glycine adsorption on Cu(100) single crystal surface. We find that after physical vapor deposition (PVD) of glycine on Cu(100), glycinate self-assembles into an overlayer exhibiting c(2x4) and p(2x4) symmetries with non-identical adsorption sites. Our findings underscore the intricacy of electrical conductivity in nanomolecular organic overlayers and the critical role the structural anisotropy at molecule-metal interface plays in the fabrication of materials for molecular electronics.
Improved corrosion properties of Hot Dip Galvanized Steel by nanomolecular silane layers as hybrid interface between zinc and top coatings

Thin organic coatings (TOC) or paints on hot dip galvanized steel (HDGS) improve the corrosion properties and create visually pleasing surfaces. Delamination of these coatings lead to corrosion and peeling of the paints. Hence, a novel method for improved adhesion and corrosion properties for HDGS surfaces is introduced. It is shown how the fabrication of a nanomolecular silane film as an interfacial layer between the HDGS and TOC or paint improves the corrosion properties of HDGS in different pH regimes. Understanding the corrosion behavior of ultra-thin silane layers under differing pH is crucial as subsequent coatings have different pHs. By varying the silanization parameters two different nanomolecular surface structures of aminopropyl trimethoxysilane (APS) on HDGS were fabricated: well-ordered monolayers with approximately 1 nm thickness and highly clustered APS films with a thickness in the range of 5-8 nm. To verify the nanomolecular APS structures, photoelectron spectroscopy (PES) and contact angle (CA) measurements were employed. The corrosion properties of HDGS and silanized HDGS were studied with linear sweep voltammetry (LSV) and electrochemical impedance spectroscopy (EIS). It is shown that at pH 5 and 7 passivation behavior is observed on silanized samples but the most significant improvement in corrosion resistance is found at pH 10 where the corrosion currents of silanized samples are up to two orders of magnitude lower than on uncoated metallic samples. Also, it is demonstrated that the corrosion inhibition of APS is not only dependent on the thickness of the silane film, but also the molecular ordering at the surface. The thin, well-ordered APS monolayer is more resistant towards corrosion in NaCl solution (pH 7) than thicker clustered APS layer. This indicates that the highly ordered nanomolecular surface structure protects the HDGS-silane interface from the Cl⁻ adsorption better than the thicker, but more randomly ordered APS layers. Nanomolecular interfacial silane films for enhanced corrosion and adhesion properties on HDGS are transferrable to industrial production lines providing a low cost and environmentally friendly method for improved HDGS products.
Chlorine-Induced High Temperature Corrosion of Inconel 625 Sprayed Coatings Deposited with Different Thermal Spray Techniques

Ni-based coatings of the type Inconel 625 sprayed with high-kinetic spray processes are applied as protective coatings in many industrial fields where high corrosion resistance is required. Among the high-kinetic spray processes HVOF (High-Velocity Oxygen-Fuel) is an affirmed technology while HVAF (High-Velocity Air-Fuel) and cold spray are promising technologies for the deposition of thick and dense coatings, able to extend the service life of components subjected to harsh corrosive conditions. This study aims to assess the effect of the different high-kinetic spray technologies on the chlorine-induced high temperature corrosion behaviour of the coatings. The coatings were exposed to the test condition of 550°C in the presence of KCl salt deposits under air flow with 12 % of specific humidity for 168 h. The corrosion behaviour of the coatings was evaluated and compared with a reference wrought Inconel 625. Corrosion products and coatings were analysed and characterised in order to define the corrosion/oxidation mechanisms.
Tampere Wear Center have developed several high-stress wear testers that utilize large sized abrasive particles of natural origin and thus are able to simulate demanding applications of the mining industry. In this work, a versatile high speed slurry-pot wear tester was developed. Research questions studied are: 1) How to set up a wear test method for simulating the real applications?, 2) What are the wear mechanisms in high-stress wear?, and 3) What is the role of microstructure and chemical composition on wear performance of wear resistant steels?

The high speed slurry-pot tester was developed for application oriented erosion wear testing of materials used in mineral handling and processing. It enables tests in demanding high-stress abrasive and erosive environments simulating wear, for example, in slurry pumps, tanks and pipes, dredging, mineral crushing and grinding, screening, loader buckets, and rock drilling. The key design features of the test method are the possibility to use up to 10 millimeter sized large abrasives and sample speeds up to 20 m/s in conditions ranging from wet slurry environments to dry sand or gravel.

The work has been done in FIMECC DEMAPP and DIMECC BSA projects, the focus is in the application oriented wear testing of materials intended for demanding wear related applications.

General information
State: Published
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Ojala, N.
Keywords: (Wear testing, Application oriented, Steels, Polymer, Mining, mineral processing, Field test)
Publication date: Nov 2016
Peer-reviewed: Unknown
ASJC Scopus subject areas: Mechanics of Materials, Metals and Alloys, Polymers and Plastics, Industrial and Manufacturing Engineering
Event: Paper presented at DIMECC 9th Annual Seminar, Helsinki, Finland.
Links:
https://www.researchgate.net/publication/310160912_Application_oriented_wear_testing_of_wear_resistant_steels_in_mining_industry
Research output: Scientific › Paper, poster or abstract

Elastic-Plastic Transition in MBE-Grown GaSb Semiconducting Crystal Examined by Nanoindentation

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Univ Helsinki, University of Helsinki, Dept Phys, Aalto University, Department of Materials Science and Engineering, Institute of Materials Science, University of Silesia, 75 Pułku Piechoty 1, 45-500 Chorzów, Poland, Institute of Physics, University of
Improved antifouling properties and selective biofunctionalization of stainless steel by employing heterobifunctional silane-polyethylene glycol overlayers and avidin-biotin technology

A straightforward solution-based method to modify the biofunctionality of stainless steel (SS) using heterobifunctional silane-polyethylene glycol (silane-PEG) overlayers is reported. Reduced nonspecific biofouling of both proteins and bacteria onto SS and further selective biofunctionalization of the modified surface were achieved. According to photoelectron spectroscopy analyses, the silane-PEGs formed less than 10 Å thick overlayers with close to 90% surface coverage and reproducible chemical compositions. Consequently, the surfaces also became more hydrophilic, and the observed non-specific biofouling of proteins was reduced by approximately 70%. In addition, the attachment of E. coli was reduced by more than 65%. Moreover, the potential of the overlayer to be further modified was demonstrated by successfully coupling biotinylated alkaline phosphatase (bAP) to a silane-PEG-biotin overlayer via avidin-biotin bridges. The activity of the immobilized enzyme was shown to be well preserved without compromising the achieved antifouling properties. Overall, the simple solution-based approach enables the tailoring of SS to enhance its activity for biomedical and biotechnological applications.
Development of Magnetic Losses During Accelerated Corrosion Tests for Nd-Fe-B Magnets Used in Permanent Magnet Generators

Sintered Nd-Fe-B magnets are critical components in permanent magnet wind generators. They are the strongest permanent magnets available and thus enable the construction of light and effective devices, but their stability in corrosive environments is limited. In this work, the formation of corrosion losses in two types of Nd-Fe-B alloys was studied. Magnets were in a magnetized state during the corrosion test, enabling monitoring of the development of losses in magnetic flux along with those in weight. Parallel flux and weight loss measurements conducted during corrosion tests showed that percentage weight losses were lower than the total flux losses. Scanning electron microscope studies of corroded specimens disclosed that the magnets first underwent dissolution of the grain-boundary phase, followed by the detachment and movement of the loosened grains in the magnetic field. The degradation was accelerated by oxidation of the matrix phase, which introduced further damage by volume expansion.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland
Authors: Isotahdon, E., Huttunen-Saarivirta, E., Kuokkala, V.
Keywords: (Corrosion, Corrosion losses, Highly accelerated stress test (HAST test), Improved corrosion resistance sintered Nd-Fe-B magnets, Improved stability sintered Nd-Fe-B magnets, Nd-Fe-B, Permanent magnet, Scanning electron microscopy, Thermal losses, Wind power)
Number of pages: 10
Pages: 732-741
Publication date: 1 Jun 2016
Comparison of laboratory wear test results with the in-service performance of cutting edges of loader buckets
The in-service cutting edge of a mining loader bucket was investigated and its wear behavior compared with samples tested in the laboratory to assess how well the wear testing methods correlate with the in-service conditions. The examined in-service cutting edge of a bucket had been run in an underground mine with quarry gravel and it was made of wear resistant steel. The wear behavior of the cutting edge was simulated in the laboratory scale with several application oriented abrasive and impact-abrasive wear testing methods. In addition to the contact mode, high loads, large abrasive size, abrasive type, and the comminution of the abrasive formed the basis for the design of the laboratory experiments. The wear surfaces and cross-sections of the original cutting edge and the test samples were characterized, and the wear behaviors were compared with each other. Work hardening of the steel occurred in all cases, but the amount of plastic deformation and the depth of the wear scars varied.

General information
**Edge effect in high speed slurry erosion wear tests of steels and elastomers**

While the slurry transportation via pumping is an increasingly viable alternative for the conventional fine particle pumping, there are also many applications involving larger particles. However, the published studies on slurry erosion have mainly been conducted with fine particle sizes. In this work, both fine and large particle high speed slurry erosion of commercial wear resistant materials is studied.

The high speed slurry-pot wear tester was used with edge protected samples to simulate the wear conditions in industrial slurry applications, such as tanks and pipelines. Two quenched wear resistant steels together with natural rubber and polyurethane lining materials were tested, and the results were compared with the results of the same materials tested without sample edge protection. The tests were performed using 15 m/s speed, 45° and 90° sample angles, and 9 wt% and 33 wt% slurry concentrations with particle size ranging from large 8/10 mm granite to fine 0.1/0.6 mm quartz.

With or without edge protection, the steel samples showed stable wear behavior, whereas the elastomers gave notably inconsistent results in different test conditions. Steels exhibited better wear performance with large particles and elastomers with fine particles. In general, the wear losses were 40 – 95 % lower without edge wear, except for elastomers tested with fine quartz at the 45° sample angle, which yielded 25 – 75 % higher weight losses when the sample edges were protected. With increasing abrasive size, the edge wear becomes more dominant.

**General information**

State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Materials Science, Research group: Materials Characterization
Authors: Valtonen, K., Ratia, V., Ojala, N., Kuokkala, V.
Keywords: (Abrasion, Wear testing, Impact wear, Steel, Mining, mineral processing)
Number of pages: 12
Publication date: Jun 2016

**Host publication information**

Title of host publication: The 17th Nordic Symposium on Tribology : NORDTRIB 2016 proceedings
Publisher: VTT Technical Research Centre of Finland
Research output: Professional > Conference contribution

**Erosive and abrasive wear performance of carbide free bainitic steels – comparison of field and laboratory experiments**

Carbide free bainitic (CFB) steels have been tested in two heat treated conditions and compared with currently used quenched and tempered (QT) steel in an industrial mining application subjected to erosive-abrasive wear. A conventional sliding abrasion and a new application oriented high-stress erosion wear tests were performed in laboratory. The results of the erosion and the field tests were compared. The microstructural changes were investigated by optical and scanning electron microscopy. The hardness and hardness profiles of the steels were measured. The results showed that in the laboratory tests, the abrasion and erosion wear rates of the CFB steels were 35 and 45 % lower respectively in comparison to the QT steel. In the field test, the mass losses of the CFB steels were about 80 % lower in comparison with the QT steel. The improved wear resistance of the CFB steel can be explained by its higher hardness and higher work hardening. The erosion wear test was able to simulate the work hardening effect and the wear mechanisms observed in the field test samples.

**General information**

State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Luleå University of Technology, LKAB Mining and Logistics
Authors: Vuorinen, E., Ojala, N., Heino, V., Rau, C., Gahm, C.
Keywords: (Steel, Carbide free bainite, Erosion wear, Abrasive wear, Field test)
Number of pages: 8
Pages: 108-115
Processing and Wear Testing of Novel High-Hardness Wear-Resistant Steel

Novel high-hardness medium carbon martensitic laboratory steel has been produced and tested for wear resistance. Different finish rolling temperatures (FRT) and quenching finish temperatures (QFT) were utilized. Composition was selected based on earlier experiments and carbon content was set to 0.35 % to obtain surface hardness of approximately 600 HB. FRT was varied to investigate the effect of prior austenite deformation on the mechanical properties. Direct quenching was implemented in the laboratory rolling trials. Plates were either quenched to room temperature or quenching was finished at 250 °C. The interrupted quenching was tested in order to improve the toughness of the steel via autotempering and possible austenite retention without drastic loss of hardness. The steel samples were tested for hardness and impact toughness. Material characterization included SEM and optical microscopy for microstructural inspection. Direct quenched steel samples exceeded the desired 600 HB surface hardness, but interrupted quenching to 250 °C resulted in lower hardness values. In contrast, the impact toughness was improved with latter quenching method. Impact-abrasion wear testing was conducted for the experimental steels to understand the effect of rolling and quenching parameters on wear resistance. Impeller-tumbler tests were carried out at Tampere Wear Center using natural granite as the abrasive. The results indicate that surface hardness is the main controlling factor of wear, and samples with the highest surface hardness showed the lowest mass loss.
Corrosion Losses in Sintered (Nd,Dy)-Fe-B Magnets vs. Magnet geometry

Sintered Nd-Fe-B magnets with cube and flat geometries were exposed to pressurized heat-humidity corrosion tests for the durations of 96 and 240 hours. Parallel measurements of weight and flux losses were performed after the corrosion tests. The corroded specimens were further characterized using scanning electron microscopy and optical profilometry. The microcrystalline anisotropy of sintered magnets gave rise to heterogeneous corrosion behavior, where the pole faces degraded preferentially to the side faces. The magnetic field by the magnet itself thus contributed to the amount and location of detached ferromagnetic grains. The magnets with cube geometry suffered greater losses than the flat magnets, even though the flat magnets had a higher relative amount of the pole face. The higher total flux (due to a larger volume) of the cube-shaped magnets led to the higher overall losses. In the flat magnets, the corrosion concentrated heavily on areas near the corners.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Isotahdon, E., Huttunen-Saarivirta, E., Kuokkala, V., Paju, M.
Keywords: (Corrosion, Hard Magnetic Materials, Nd-Fe-B magnets)
Publication date: 2016
Peer-reviewed: Yes
Early online date: 1 Jan 2015

Publication information
Journal: IEEE Magnetics Letters
Volume: 7
Article number: 5500504
ISSN (Print): 1949-307X
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.39 0.454
Publication Forum (2016): 1
Scopus rating (2015): 0.452 0.689
Web of Science (2015): 1.978 1.776 2.8 0.204 0.00115 0.772
Scopus rating (2014): 0.76 0.745
Web of Science (2014): 1.692 1.833 3.0 0.154 9.0E-4 0.789
Scopus rating (2013): 0.68 0.664
Scopus rating (2012): 0.705 0.936
Scopus rating (2011): 0.558 0.399
Original language: English
DOIs:
10.1109/LMAG.2015.2501404
Source: Bibtex
Source-ID: urn:eda200522672923bb11d236d61a3260f
Research output: Scientific - peer-review › Article

Experimental and numerical study of a drill bit drop tests on Kuru Granite

General information
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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Fourmeau, M., Kane, A., Hokka, M.
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Philosophical Transactions of the Royal Society A: Mathematical Physical and Engineering Sciences
ISSN (Print): 1364-503X
Ratings:
Publication Forum (2017): 2
High performance corrosion resistant coatings by novel coaxial cold- and hot-wire laser cladding methods

In the last few years, coaxial laser heads have been developed with centric wire feeding equipment, which enables the laser processing of complex-shaped objects in various applications. These newly developed laser heads are being used particularly in laser brazing experiments in the automotive industry. This study presents experimental results of using a coaxial laser head for cold- and hot-wire cladding application. The coaxial wire cladding method has significant improvements compared with the off-axis wire cladding method such as independence of the travel direction, alignment of the wire to the laser beam, and a reduced number of controlling parameters. These features are important to achieve high quality coatings. Cladding tests were conducted on mild steel with a coaxial laser wire welding head using Ni-based Inconel 625 and Theramanit 2509 super duplex stainless steel solid wires in order to determine the properties of the cladding process and the coatings deposited. The corrosion resistance of the obtained coatings was examined by long-term acetic acid salt spray (AASS) and electrochemical critical pitting temperature tests. The test results showed that by using the coaxial wire cladding method, defect-free high quality and corrosion resistant Inconel 625 and super duplex stainless steel coatings with low dilution were achieved. The average pitting temperature for Theramanit 2509 duplex coating was 75 °C in 1M NaCl solution, which was comparable to wrought 2507 duplex stainless steel. Low diluted Inconel 625 coating survived the AASS test for 2000 h without signs of corrosion.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, Tampere University of Technology, Technology Centre Ketek Ltd.
Authors: Pajukoski, H., Näkki, J., Thieme, S., Tuominen, J., Nowotny, S., Vuoristo, P.
Keywords: (coaxial wire feed, hot-wire laser cladding, Inconel 625, super duplex stainless steel)
Publication date: 2016
Peer-reviewed: Yes
Early online date: 8 Dec 2015
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Biomedical Engineering, Instrumentation
Influence of age-precipitation of Nb-Ti stabilized FeCr alloy on the initial stages of oxide film formation at 650 °C

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Optoelectronics Research Centre, Research group: Surface Science, MAX IV Laboratory, Lund University
Authors: Ali-Löytty, H., Hannula, M., Niu, Y., Zakharov, A., Valden, M.
Publication date: 2016

Publication information
Publisher: Lund University, MAX IV Laboratory
Original language: English
Links:
https://www.maxlab.lu.se/cmis/display?id/workspace%3A%2F%2FSpacesStore%2Fbd7dec7f-b5c5-478a-af1e-8fbe1d875fe7
Influence of temperature-induced copper diffusion on degradation of selective chromium oxy-nitride solar absorber coatings

Temperature-induced copper diffusion process and its influences on optical degradation and long-term stability of solar absorber coatings on copper substrates were investigated at intermediate temperatures of 248-500 °C. The studied absorbers were sputtered chromium oxy-nitride absorbers having tin oxide anti-reflection coatings. The absorbers were aged by means of thermal accelerated ageing studies and short-period heat treatments up to 500 °C for two hours. Ageing mechanisms and degradation of the absorbers were analysed before and after the ageing studies by optical measurements (solar absorptance with a UV/Vis/NIR spectrophotometer and thermal emittance by FTIR spectrophotometry), microstructural analysis using a field-emission scanning electron microscope (FESEM) equipped with an energy dispersive X-ray spectrometer (EDS) and a transmission electron microscope (TEM) with an EDS, composition by time-of-flight elastic recoil detection analysis (TOF-ERDA) and an X-ray photoelectron spectroscope (XPS), and adhesion by tensile test. The relation between optical degradation and diffusion mechanisms was studied using optical modelling and simulation. The results clearly revealed the mechanism of outward copper diffusion: diffusion of copper substrate atoms into the coating and through the coating to the surface, formation of copper oxide islands on the surface of the coating, and formation of voids in the substrate surface. The relation between the diffusion mechanisms and increase in thermal emittance of the absorber surface was demonstrated.

General information

State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, Research group: Materials Characterization, University of Helsinki
Authors: Kotilainen, M., Honkanen, M., Mizohata, K., Vuoristo, P.
Keywords: (Coating, Copper, Diffusion mechanisms, Solar absorber, Thermal diffusion, Void growth)
Number of pages: 10
Pages: 323-332
Publication date: 2016
Peer-reviewed: Yes
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films

Publication information

Journal: Solar Energy Materials and Solar Cells
Volume: 145
ISSN (Print): 0927-0248
Ratings:
Publication Forum (2017): 2
Scopus rating (2016): 1.587 1.71
Publication Forum (2016): 2
Web of Science (2015): 4.732 5.016 5.9 1.476 0.04281 1.16
Publication Forum (2015): 2
Scopus rating (2014): 2.204 2.396
Web of Science (2014): 5.337 5.755 5.6 1.042 0.04651 1.288
Publication Forum (2014): 2
Scopus rating (2013): 2.174 2.582
Publication Forum (2013): 2
Scopus rating (2012): 2.435 2.707
Publication Forum (2012): 2
Scopus rating (2011): 2.175 2.638
Scopus rating (2010): 2.524 2.121
Scopus rating (2009): 1.991 1.977
Scopus rating (2008): 1.654 1.458
Scopus rating (2007): 1.359 1.488
Scopus rating (2005): 1.141 1.619
Modelling and Analysis of Elastic and Thermal Deformations of a Hydrodynamic Radial Journal Bearing

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Tribology and Machine Elements
Authors: Linjamaa, A., Lehtovaara, A., Kallio, M., Söchting, S.
Number of pages: 6
Pages: 127-132
Publication date: 2016
Peer-reviewed: Yes
Early online date: 1 Jan 2015

Publication information
Journal: Key Engineering Materials
Volume: 674
ISSN (Print): 1013-9826
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.163 0.253
Publication Forum (2016): 1
Scopus rating (2015): 0.171 0.228
Publication Forum (2015): 1
Scopus rating (2014): 0.212 0.349
Publication Forum (2014): 1
Scopus rating (2013): 0.19 0.308
Publication Forum (2013): 1
Scopus rating (2012): 0.172 0.377
Publication Forum (2012): 1
Scopus rating (2011): 0.176 0.441
Scopus rating (2010): 0.183 0.295
Scopus rating (2009): 0.211 0.246
Scopus rating (2008): 0.192 0.285
Scopus rating (2007): 0.191 0.36
Scopus rating (2006): 0.221 0.411
Scopus rating (2005): 0.222 0.369
Scopus rating (2004): 0.214 0.414
Scopus rating (2003): 0.206 0.289
Scopus rating (2002): 0.202 0.223
Scopus rating (2001): 0.24 0.326
Scopus rating (2000): 0.295 0.325
Scopus rating (1999): 0.262 0.301
Original language: English
DOIs:
10.4028/www.scientific.net/KEM.674.127
Optimizing iron alloy catalyst materials for photoelectrochemical water splitting: Passivation of FeCr alloy surface by water vapour using near-ambient-pressure photoelectron spectroscopy

**General information**

State: Published

Ministry of Education publication type: D4 Published development or research report or study

Organisations: Optoelectronics Research Centre, Research group: Surface Science, MAX IV Laboratory, Lund University

Authors: Lahtonen, K., Hannula, M., Ali-Löytty, H., Hirsimäki, M., Urpelainen, S., Valden, M.

Keywords: (Synchrotron, Steel, photoelectrochemical water splitting, Passivation, near-ambient-pressure photoelectron spectroscopy, APXPS)

Number of pages: 2

Publication date: 2016

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Site-controlled InAs Quantum Dots for Plasmonics

We present site-controlled epitaxy of InAs quantum dots (QD) for plasmonics and report QD-plasmon coupling in a hybrid structure consisting of site-controlled InAs/GaAs QD chains in the proximity of an Ag film.

**General information**

State: Published

Ministry of Education publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Laboratory for Future Electronics, Department of Physics, Research group: Nanophotonics

Authors: Hakkarainen, T., Tommila, J., Schramm, A., Simonen, J., Niemi, T., Strelow, C., Kipp, T., Kontio, J., Guina, M.

Keywords: ((250.5403) Plasmonics, (160.4236) Nanomaterials, (160.6000) Semiconductor materials)

Publication date: 2016

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Reiänlaajennustesti - voidaanko sen tulos ennustaa vetokokeen perusteella?

**General information**

State: Published

Ministry of Education publication type: D1 Article in a trade journal

Organisations: Department of Materials Science, Research group: Metals Technology, Research group: Materials Characterization

Authors: Peura, P., Chufan, S., Hokka, M., Minkkinen, A.

Number of pages: 6

Pages: 28-33

Publication date: 2016

Peer-reviewed: Unknown

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Site-controlled InAs Quantum Dots for Plasmonics

We present site-controlled epitaxy of InAs quantum dots (QD) for plasmonics and report QD-plasmon coupling in a hybrid structure consisting of site-controlled InAs/GaAs QD chains in the proximity of an Ag film.

**General information**

State: Published

Ministry of Education publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Laboratory for Future Electronics, Department of Physics, Research group: Nanophotonics

Authors: Hakkarainen, T., Tommila, J., Schramm, A., Simonen, J., Niemi, T., Strelow, C., Kipp, T., Kontio, J., Guina, M.

Keywords: ((250.5403) Plasmonics, (160.4236) Nanomaterials, (160.6000) Semiconductor materials)

Publication date: 2016

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Site-controlled InAs Quantum Dots for Plasmonics

We present site-controlled epitaxy of InAs quantum dots (QD) for plasmonics and report QD-plasmon coupling in a hybrid structure consisting of site-controlled InAs/GaAs QD chains in the proximity of an Ag film.

**General information**

State: Published

Ministry of Education publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Laboratory for Future Electronics, Department of Physics, Research group: Nanophotonics

Authors: Hakkarainen, T., Tommila, J., Schramm, A., Simonen, J., Niemi, T., Strelow, C., Kipp, T., Kontio, J., Guina, M.

Keywords: ((250.5403) Plasmonics, (160.4236) Nanomaterials, (160.6000) Semiconductor materials)

Publication date: 2016

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Site-controlled InAs Quantum Dots for Plasmonics

We present site-controlled epitaxy of InAs quantum dots (QD) for plasmonics and report QD-plasmon coupling in a hybrid structure consisting of site-controlled InAs/GaAs QD chains in the proximity of an Ag film.

**General information**

State: Published

Ministry of Education publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Laboratory for Future Electronics, Department of Physics, Research group: Nanophotonics

Authors: Hakkarainen, T., Tommila, J., Schramm, A., Simonen, J., Niemi, T., Strelow, C., Kipp, T., Kontio, J., Guina, M.

Keywords: ((250.5403) Plasmonics, (160.4236) Nanomaterials, (160.6000) Semiconductor materials)

Publication date: 2016

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**General information**

State: Published

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Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Laboratory for Future Electronics, Department of Physics, Research group: Nanophotonics

Authors: Hakkarainen, T., Tommila, J., Schramm, A., Simonen, J., Niemi, T., Strelow, C., Kipp, T., Kontio, J., Guina, M.

Keywords: ((250.5403) Plasmonics, (160.4236) Nanomaterials, (160.6000) Semiconductor materials)

Publication date: 2016

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**General information**

State: Published

Ministry of Education publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Laboratory for Future Electronics, Department of Physics, Research group: Nanophotonics

Authors: Hakkarainen, T., Tommila, J., Schramm, A., Simonen, J., Niemi, T., Strelow, C., Kipp, T., Kontio, J., Guina, M.

Keywords: ((250.5403) Plasmonics, (160.4236) Nanomaterials, (160.6000) Semiconductor materials)

Publication date: 2016
The Characterization of Flame Cut Heavy Steel – The Residual Profiling of Heat Affected Surface Layer

Flame cutting is commonly used thermal cutting method in metal industry when processing thick steel plates. Cutting is performed with controlled flame and oxygen jet, which burns steel and forms cutting edge. Flame cutting process is based on controlled chemical reaction between steel and oxygen at elevated temperature. Flame cutting of thick wear-resistant steels is challenging while it can result in cracks on and under the cut edge. Flame cutting causes uneven temperature distribution in the plate, which can introduce residual stresses. In addition, heat affected zone (HAZ) is formed and there both volume and microstructural changes as well as hardness variations are taking place. Therefore flame cutting always causes thermal stress, shape changes and consequently residual stresses to the material. Material behaviour under thermal and mechanical loading depends on the residual stress state of the material. Due to this, it is important to be able to measure the residual stresses. The aim of this study was to examine residual stresses on the cutting edge as a function of flame cutting parameters. Also resulting microstructures and hardness values were verified. Varying parameters were the cutting speed, preheating and post heating procedures. Flame cut samples were investigated with X-ray diffraction method to produce residual stress profiles of the heat affected surface layer. Results indicated that different cutting parameters provide different residual stress profiles and that these profiles can be modified by changing the cutting speed and pre- or post-treatment procedures. Cutting parameters also affect the depth of the reaustenized region in the surface. The results correlate well with the actual industrial flame cutting and thus they provide an effective tool for optimizing the flame cutting process parameters.
The effects of microstructure on erosive-abrasive wear behavior of carbide free bainitic and boron steels

The wear resistance of carbide free bainitic (CFB) microstructures have shown to be excellent in sliding, sliding-rolling and erosive-abrasive wear. Whereas, boron steels are often an economically favorable alternative used in applications subjected to erosive and abrasive wear. In this study the erosive-abrasive wear resistance of CFB and boron steels with different heat treatments were compared and the effect of microstructure on wear was investigated. An application oriented dry-pot laboratory test method with 8-10 mm granite gravel was used to produce erosive-abrasive wear environment. The tested materials were CFB and boron steels. The CFB steels had hardness values of 500 and 600 HV. The boron steels, both quenched and quenched and tempered, had a hardness of 500 HV. The influence of the microstructures on wear was studied by wear test results as well as by optical and scanning electron microscopy. The phase compositions were determined by XRD. The effect of wear, in addition to weight loss was also characterized by surface profilometry, hardness and hardness profile determinations. The wear resistance of the steels was compared with results achieved in a field test in an industrial mining application. Moreover, the effect of the different microstructures on wear behavior is discussed. The carbide free bainitic steels showed better wear performance than the martensitic boron steels. The boron steels were subjected to microcutting and microploughing, whereas the CFB steels exhibited more shallow impact craters with thin platelets.

The role of microstructure in high stress abrasion of white cast irons

The abrasion wear resistance of white cast irons can be controlled primarily by adjusting the size, size distribution, and volume fraction of the carbide phase. The main physical property of white cast irons correlating with abrasion resistance is hardness. This study concentrates on the evaluation of hardened and stress relieved, normalized, self-hardened, and as-cast states of high chromium white cast irons in high stress abrasion. The correct size and orientation of the carbides were found to be crucial for the wear resistance of white cast irons in high stress abrasive conditions. The different annealing procedures affected the formation of the carbide structure and its distribution, as well as the microstructure of the matrix. The austenite-to-martensite ratio together with a beneficial carbide structure was found to have a strong effect on the abrasion wear resistance of WCI specimens.
Towards material excellence: Evaluation of Tekes' programmes on materials

**General information**
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Virebit Oy
Authors: Timonen, J., Antikainen, M., Das, A., Sarlin, E., Vuorinen, J.
Number of pages: 61
Publication date: 2016

**Publication information**
Publisher: Tekes
Original language: English
Links: http://www.tekes.fi/tekes/julkaisut1/towards-material-excellence--42016/
Research output: Professional › Commissioned report

Transformation of ALD grown TiO2 film to topographically microstructured titanium silicide for photonics applications

**General information**
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Research group: Nanophotonics
Keywords: (titanium silicide, Synchrotron, photoemission electron microscopy)
Number of pages: 2
Publication date: 2016

**Publication information**
Place of publication: Lund
Publisher: Lund University, MAX IV Laboratory
Original language: English
Links: https://www.maxlab.lu.se/cmis/display?id=workspace%3A%2F%2FSpacesStore%2F80e2da54-8373-4d0c-a4af-8b53b81b0ca3
Links: https://www.maxlab.lu.se/node/2032#I311-PEEM_ (Reports 2015 - Syncrotron Radiation)
Research output: Professional › Commissioned report

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 Al2O3 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**
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, University of Modena and Reggio Emilia
Authors: Bolelli, G., Milanti, A., Lusvarghi, L., Trombi, L., Koivuluoto, H., Vuoristo, P.
Keywords: (Cavitation damage, Impact wear, Sliding contact, Thermally-sprayed coating)
Pages: 372-390
Publication date: 2016
Peer-reviewed: Yes
Early online date: 30 Nov 2015
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces
Wear performance of quenched wear resistant steels in abrasive slurry erosion

Three commercially available quenched wear resistant steel grades were compared with a structural steel and four elastomer materials to reveal the differences in their behavior in slurry erosion conditions and to find the best solutions for demanding applications. A slurry-pot tester, allowing simulation of various wear conditions with different minerals, particle sizes (up to 10 mm), abrasive concentrations, and sample angles were used to simulate different industrial slurry applications. In this study, granite and quartz with concentrations of 9 and 33 wt% were used as abrasives in tests conducted at 45° and 90° sample angles. The performance of the studied steels was evaluated with respect to their material properties such as hardness and microstructure. Furthermore, the cross-sections and wear surfaces of the test samples were analyzed to reveal the possible differences in the mechanical behavior of the materials during slurry erosion. The wear surface analyses show that abrasion is the dominating wear mechanism already for the smallest particle size of 0.1/0.6 mm. In low-stress abrasive slurry erosion with the smallest particles, the elastomers showed better wear resistance than the steels, whereas in demanding high-stress abrasive slurry erosion conditions the quenched wear resistant steels can well compete with elastomers in wear resistance. The relative wear performance of the steels increased with increasing abrasive size, while for the elastomers it decreased.
ZnFe Coated 22MnB5 Steels in Direct Press Hardening: the Relationships between Coating Structure and Process Parameters

Abstract. Two types of press hardening experiments were carried out to investigate the behavior of ZnFe coated 22MnB5 steel in direct press hardening process. The coating properties were studied using variable process temperatures and times with a flat-die and a forming tool. Coatings were analyzed with optical and scanning electron microscopes. The results indicated that steels that have low coating weights (40/40 and 50/50 g/m²) may be processed successfully with short dwell times. For high coating weights (70/70 and 80/80 g/m²) a significantly longer dwell time is needed. The behavior of ZnFe coating in hot press forming experiments was in line with literature and the findings of the flat-die experiments. Thus, the feasibility of the experimental press hardening equipment was confirmed.
Behavior of Martensitic Wear Resistant Steels in Abrasion and Impact Wear Testing Conditions

Wear is a complex phenomenon present in both small and large scale in the industry, but also in our everyday life. The ability of a material to resist wear is not an intrinsic mechanical property, as it depends on the tribosystem as a whole, including all the environmental and operational factors. One of the aims of this work is to analyze the wear testing methods used for abrasive, impact, and impact-abrasive wear performance assessment of materials and thus to add to the current understanding of the wear testing in such conditions.

In this work, wear tests with various test devices were conducted on wear resistant martensitic steels. The tests include high-stress abrasive wear tests with crushing pin-on-disc and uniaxial crusher, impact-abrasive tests with impeller-tumbler, and impact tests with single and continuous impact testers. The impeller-tumbler method was analyzed in more detail by examining the effects of sample angle and test duration as well as the effects of testing procedures on the test results. In high-stress wear tests, the amount of wear was determined through mass loss measurements, while in the impact tests measurements of the impact scars were made. The wear surfaces were characterized with optical and electron microscopy, optical profilometry and residual stress measurements. Moreover, the behavior and changes in the subsurface and microstructure of the materials were studied from prepared cross sections with optical and electron microscopy, microhardness measurements and electron backscatter diffraction.
In wear testing, selection of correct parameters is important, as they affect the wear mechanisms present on the sample surfaces. In abrasive wear, abrasive properties and even indirect counterparts have an influence on the forming wear mechanisms, which finally govern the severity of material removal. On the other hand, some similarities in the wear behavior of wear resistant steels in different abrasive contact conditions of sliding, gouging and impacting could be observed: the harder steels presented more scratching, which can be correlated to their lower ability of plastic deformation and higher amount of cutting. To ensure reaching the correct (steady) state of wear, tests should be of adequate duration, as the response of materials to many contact conditions may be nonlinear and reveal certain evolution of microstructures only after longer exposure.

Wear tests enable the comparison of materials in controlled conditions, but close attention on the test procedures must be paid also when conducting seemingly robust wear tests, especially when the differences to be detected are small. As the tests themselves constitute a tribosystem, local changes in the conditions due to the test procedures, such as sample placement, must be properly understood in order to obtain reliable results. Understanding the concept of a tribosystem and the major interdependencies involved is essential for all wear testing methods and proper analysis of the experimental test results.

General information
State: Published
Ministry of Education publication type: G5 Doctoral dissertation (article)
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Ratia, V.
Number of pages: 86
Publication date: 6 Nov 2015

Publication information
Publisher: Tampere University of Technology
Original language: English

Publication series
Name: Tampere University of Technology. Publication
Publisher: Tampere University of Technology
Volume: 1342
ISSN (Print): 1459-2045
Electronic versions:
ratia_1342
Links:

Bibliographical note
Awarding institution:Tampere University of Technology
Research output: Collection of articles › Doctoral Thesis

Influence of application method and sintering temperature on porosity and thermal conductivity of two commercial silicon carbide based castables
Information about thermal conductivity of refractory castables is crucial in heat conducting structures. Two commercial castables were studied to find out the effect of silicon carbide content (58-67 %) and installation method on thermal conductivity. One castable was designed to be installed by casting and the other one was shotcrete castable. The shotcrete castable was casted and shotcreted in to metal mold sized 200x200x50 mm. The other castable was casted in laboratory conditions and on site. Porosities and thermal conductivities were measured from samples after heat treatment at 400, 600, 800 and 1000 °C. Thermal conductivities were measured by transient plane source method, porosities were measured by Archimedes’ method and microstructures were characterized by scanning electron microscopy. Thermal conductivities varied from 6.8-16.3 W/mK and porosities 12.74-21.92 %. Thermal conductivity of measured samples increased with SiC content and higher heat treatment temperature as expected. Porosities and thermal conductivities in castables casted in laboratory and on site varied only slightly. In shotcrete castable applied by casting the porosity and thermal conductivity were higher than
in shotcreted sample. So the interconnection between low porosity and high thermal conductivity was not as clear as expected.

**General information**
State: Published
Ministry of Education publication type: B3 Non-refered article in conference proceedings
Organisations: Department of Materials Science, Research group: Ceramic materials, Research group: Tribology and Machine Elements, Valmet Technologies Oy
Authors: Silvonen, J., Ruusila, V., Levänen, E., Uusitalo, M.
Publication date: 18 Sep 2015

**Host publication information**
Title of host publication: UNITECR2015 – 14th Biennial Worldwide Congress
Article number: Proceeding 224
ISBN (Print): 978-3-9815813-1-7
Research output: Scientific › Conference contribution

**Effect of spraying parameters on the microstructural and corrosion properties of HVAF-sprayed Fe-Cr-Ni-B-C coatings**
Thermally sprayed Fe-based coatings have been extensively studied as future solution in order to replace more expensive, harmful and environmentally dangerous Ni- and WC-based coatings for several industrial applications where high corrosion and wear resistance are required. The aim of the present study is to investigate the effect of spraying parameters on the microstructure and the corrosion resistance of Fe-based coatings manufactured with the High Velocity Air Fuel (HVAF) thermal spray process. Six sets of thermal spraying parameters have been chosen and their effect on the overall quality of coatings was investigated. All HVAF coatings showed comparably dense microstructure with near-zero oxidation, proving the high quality of the deposition process. However, higher anti-corrosion and mechanical properties were achieved by increasing the spraying air pressure and decreasing the particle feeding rate without altering the thickness and the overall deposition rate. Powder feeding rate was reported to have a remarkable effect on microstructure and corrosion properties. Coatings with beneficial compressive residual stresses were successfully obtained by increasing air pressure during spraying which resulted in improved microstructural and corrosion properties.

**General information**
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, Engineering materials science and solutions (EMASS), University of Modena and Reggio Emilia, Department of Engineering Enzo Ferrari
Authors: Milanti, A., Matikainen, V., Koivuluoto, H., Bolelli, G., Lusvarghi, L., Vuoristo, P.
Keywords: (Corrosion behaviour, Fe-based coating, HVAF, Structure)
Number of pages: 10
Pages: 81-90
Publication date: 15 Sep 2015
Peer-reviewed: Yes
ASJC Scopus subject areas: Chemistry(all), Condensed Matter Physics, Materials Chemistry, Surfaces, Coatings and Films, Surfaces and Interfaces

**Publication information**
Journal: Surface and Coatings Technology
Volume: 277
ISSN (Print): 0257-8972
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.874 1.359
Publication Forum (2016): 1
Scopus rating (2015): 0.871 1.415
Web of Science (2015): 2.139 2.417 8.5 0.402 0.0356 0.527
Publication Forum (2015): 1
Scopus rating (2014): 0.998 1.681
Web of Science (2014): 1.998 2.374 8.2 0.307 0.03477 0.517
Publication Forum (2014): 2
Scopus rating (2013): 1.057 1.859
Publication Forum (2013): 2
Scopus rating (2012): 1.049 1.658
Publication Forum (2012): 2
Enhanced photoactive and photoelectrochemical properties of TiO$_2$ sol-gel coated steel by the application of SiO$_2$ intermediate layer

Photocatalysis is a promising solution for purifying air and water from pollutants, yet more efficient photocatalytic materials are needed. A new approach is proposed in this paper for enhancing the photoactive and photoelectrical properties of anatase TiO$_2$ films by applying an intermediate SiO$_2$ film between the TiO$_2$ film and the stainless steel substrate. TiO$_2$ and SiO$_2$ coatings are synthesized by a sol-gel method and the thickness of TiO$_2$ film is varied in order to obtain improved understanding on the role of thickness in photocatalytic and electrochemical performance. The obtained coatings are systematically characterized in terms of microstructure using such techniques as field-emission scanning electron microscopy (FE-SEM), Raman spectroscopy and X-ray diffraction (XRD), that demonstrate, e.g., the anatase phase structure of the TiO$_2$ films. The enhanced photocatalytic properties of SiO$_2$/TiO$_2$ coatings as compared to TiO$_2$ films are verified using methylene blue (MB) discoloration tests, while the improved photoelectrochemical properties are shown by potentiodynmic i-V scans, open circuit potential (OCP) monitoring and electrochemical impedance spectroscopy (EIS). We attribute the beneficial effect of the intermediate SiO$_2$ film on the photocatalytic and photoelectrochemical performance to the high electrical resistance of the SiO$_2$, that imposes a high-energy barrier for electron transfer and, therefore, (partly) insulates the TiO$_2$ film from the substrate and acts as a capacitor for photo-generated electrons under illumination. The presented results show an effective way of enhancing the photocatalytic performance of anatase TiO$_2$ films.
Scopus rating (2016): 2.583 2.12
Publication Forum (2016): 3
Scopus rating (2015): 2.26 2.081
Web of Science (2015): 8.328 8.142 5.2 3.377 0.05722 1.508
Scopus rating (2014): 2.232 2.164
Web of Science (2014): 7.435 7.49 5.3 2.539 0.05334 1.477
Publication Forum (2014): 3
Scopus rating (2013): 2.345 2.134
Publication Forum (2013): 3
Scopus rating (2012): 2.629 2.236
Publication Forum (2012): 3
Scopus rating (2011): 2.585 2.345
Scopus rating (2010): 2.461 1.895
Scopus rating (2009): 2.301 2.232
Scopus rating (2008): 2.455 2.275
Scopus rating (2007): 2.493 2.5
Scopus rating (2006): 2.284 2.229
Scopus rating (2005): 2.095 2.233
Scopus rating (2004): 2.393 2.41
Scopus rating (2003): 1.979 2.259
Scopus rating (2002): 2.304 1.847
Scopus rating (2001): 2.781 2.441
Scopus rating (2000): 2.687 2.13
Scopus rating (1999): 2.18 1.874
Original language: English
DOI:
10.1016/j.apcatb.2015.03.014
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http://www.scopus.com/inward/record.url?scp=84937762118&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
ORG=mol,0.5
ORG=orc,0.5
Source: Scopus
Source-ID: 84925799672
Research output: Scientific - peer-review › Article

IDDRG, ohutlevyn muovauksen tutkimusta 50-luvulta lähtien

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science, Research group: Metals Technology
Authors: Peura, P.
Number of pages: 3
Pages: 10-12
Publication date: Sep 2015
Peer-reviewed: Unknown

Publication information
Journal: Ohutlevy-lehti
Issue number: 2/2015
ISSN (Print): 1239-4122
Original language: Finnish
Research output: Professional › Article
Evaluation of crushing strength of spray-dried MgAl<sub>2</sub>O<sub>4</sub> granule beds

The crushing strengths of four different experimental magnesium aluminate spinel (MgAl<sub>2</sub>O<sub>4</sub>) granule beds were monitored with the axial die pressing test after heat treatments. Precursor, magnesium hydroxide (Mg(OH)<sub>2</sub>) and magnesium oxide (MgO) as Mg precursor and aluminium oxide hydroxide Al(OH) and α-Al<sub>2</sub>O<sub>3</sub> as Al precursor, were used for experimental granules, which were manufactured via a dispersion manufacturing and spray-drying process. After spray-drying, granules were heat treated in air at 1000, 1100, 1200, 1300 and 1400 °C. In order to understand the potential effect of precursor, phase structure, morphology, particle size distribution and density of granules on crushing strength behaviour, scanning X-ray diffraction (XRD) was used together with electron microscopy (SEM) and laser diffraction (LDPA) for characterisation. All precursor mixtures formed spherical granules during the spray-drying process and pure spinel phase structure during heat treatment. The crushing strength test results indicated that the Al precursor clearly affected the crushing strength behaviour of experimental granule beds. The highest strength was observed for granule beds with Al(OH) as Al and Mg(OH)<sub>2</sub> as Mg precursor.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland
Authors: Kanerva, U., Suhonen, T., Lagerbom, J., Levänen, E.
Keywords: (Axial pressing, Granule, MgAl<sub>2</sub>O<sub>4</sub> spinel, The crushing strength)
Number of pages: 7
Pages: 8494-8500
Publication date: 1 Aug 2015
Peer-reviewed: Yes
ASJC Scopus subject areas: Ceramics and Composites, Process Chemistry and Technology, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Materials Chemistry

Publication information
Journal: Ceramics International
Volume: 41
Issue number: 7
ISSN (Print): 0272-8842
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.853 1.304
Publication Forum (2016): 1
Scopus rating (2015): 0.846 1.299
Web of Science (2015): 2.758 2.661 2.8 0.647 0.03925 0.465
Publication Forum (2015): 1
Scopus rating (2014): 0.871 1.668
Web of Science (2014): 2.605 2.54 3.1 0.416 0.02829 0.452
Publication Forum (2014): 1
Scopus rating (2013): 0.812 1.563
Publication Forum (2013): 1
Scopus rating (2012): 0.816 1.766
Publication Forum (2012): 1
Scopus rating (2011): 0.922 1.758
Scopus rating (2010): 0.86 1.299
Scopus rating (2009): 0.937 1.478
Scopus rating (2008): 0.872 1.658
Scopus rating (2007): 0.91 1.436
Scopus rating (2006): 0.802 1.218
Scopus rating (2005): 0.522 0.998
Scopus rating (2004): 0.671 1.495
Scopus rating (2003): 0.692 0.997
Scopus rating (2002): 0.628 0.872
Scopus rating (2001): 0.558 0.836
Scopus rating (2000): 0.471 0.799
Scopus rating (1999): 0.501 0.769
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
State: Published
Ministry of Education 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
Authors: Hintikka, J., Lehtovaara, A., Mäntylä, A.
Keywords: (Fretting, Friction, Steel, Wear)
Number of pages: 12
Pages: 191-202
Publication date: 2 Jul 2015
Peer-reviewed: Yes
ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces

Publication information
Journal: Tribology International
Volume: 92
ISSN (Print): 0301-679X
Ratings:
Publication Forum (2017): 2
Scopus rating (2016): 1.382 2.094
Publication Forum (2016): 2
Scopus rating (2015): 1.437 2.04
Web of Science (2015): 2.259 2.352 6.8 0.542 0.0138 0.688
Publication Forum (2015): 2
Scopus rating (2014): 1.545 2.5
Web of Science (2014): 1.936 2.094 7.1 0.456 0.01304 0.635
Publication Forum (2014): 2
Scopus rating (2013): 1.473 2.793
Publication Forum (2013): 2
Scopus rating (2012): 1.406 2.331
Publication Forum (2012): 2
Scopus rating (2011): 1.247 2.209
Scopus rating (2010): 1.394 2.159
Scopus rating (2009): 1.294 2.09
Scopus rating (2008): 1.365 1.823
Scopus rating (2007): 1.195 1.766
Scopus rating (2006): 1.082 1.744
Scopus rating (2005): 0.916 1.809
Scopus rating (2004): 1.062 1.541
Scopus rating (2003): 1.256 1.567
Scopus rating (2002): 0.68 1.137
Education and Materials Joining Research methods at Tampere University of Technology

At Tampere University of Technology (TUT), education and research related to joining technologies are performed by two university departments, the Department of Materials Science (DMS) and the Department of Mechanical Engineering and Industrial Systems (MEI). Many of the research activities are conducted via close collaboration between these two units.

Effect of Strain Rate on the Martensitic Transformation During Plastic Deformation of an Austenitic Stainless Steel

The effect of strain rate on the plastic deformation and phase transformation behavior of metastable austenitic stainless steel EN 1.4318 was studied. Strain rate jump tests were used to distinguish the direct effects of strain rate from the effects of adiabatic heating. Test results are analyzed from the viewpoint of both stress- and strain-induced martensitic transformation.

Effect of Strain Rate on the Martensitic Transformation During Plastic Deformation of an Austenitic Stainless Steel

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High temperature oxidation tests for the high velocity solution precursor flame sprayed manganese-cobalt oxide spinel protective coatings on SOFC interconnector steel

High velocity solution precursor flame spray process was used to deposit MnCo1.9Fe0.1O4 and Mn1.5Co1.5O4 coatings on Crofer 22 APU ferritic stainless steel samples. The solution precursors were manufactured by diluting metal nitrates into deionized water. The as-sprayed coatings were oxidized at 850 degrees C for 500 h to evaluate Cr-barrier and electrical properties.

The post-mortem studies were performed with various qualitative and quantitative elemental analysis methods and a four-point measurement was used for the area specific resistance studies. The as-sprayed coatings were formed of single crystallite nanoparticles (10-20 nm) and polycrystalline sub-micron particles (100-500 nm). The small particle and crystallite size showed strong sintering behavior during the oxidation cycle. Cr-migration was fully prevented thought the oxidized coatings. The surface topography and grain growth dominated the electrical properties during the test cycle.

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State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, Research group: Materials Characterization, Research group: Ceramic materials, Engineering materials science and solutions (EMASS), Univ Toronto, University of Toronto, Dept Mat Sci & Engr, Univ Toronto, University of Toronto, Dept Mech & Ind Engr
Authors: Puranen, J., Laakso, J., Honkanen, M., Heinonen, S., Kylmälähti, M., Lugowski, S., Coyle, T. W., Kesler, O., Vuoristo, P.
Erosive wear of various stainless steel grades used as impeller blade materials in high temperature aqueous slurry

Two austenitic stainless steel grades, 316L and 904L, and three duplex stainless steel grades, LDX 2101, 2205, and 2507, were erosion tested as impeller blade materials for hydrometallurgical applications. Samples were attached to the pressure and suction sides of an impeller and were tested for 72 h at 80 °C and 95 °C in a small-scale reactor using quartz sand slurry. Based on the mass losses measured, the steel grades could be ranked into two distinct categories; LDX 2101 and 2507 comprising the category with the better erosion resistance. The categories were the same for the pressure and suction side tests even though the erosion mechanism differed. In most cases, erosion was more severe in the suction side samples, which has practical implications for wear protection design. In the pressure side samples, the variation in the erosion mass loss with different experimental parameters was in line with earlier reported findings. In contrast, in the suction side samples, under some experimental conditions, increasing tip speed and increasing particle size were found to reduce erosion mass loss. This emphasizes the fact that the erosivity of particles for the impeller suction side cannot be deduced solely based on particle size. The reasons for the observed behavior are discussed.
The effect of impact conditions on the wear and deformation behavior of wear resistant steels

The deformation and wear behavior of four high strength wear resistant steels were studied in various impact conditions to evaluate their performance in applications involving heavy impacts and impact-abrasion. In the normal direction impacts, the studies were conducted with single and repeated (multiple) drop tests. To better simulate the actual application conditions, the samples were positioned at an angle relative to the impact direction in the tests with the high velocity particle impactor (HVPI) device. The effect of strain rate was investigated using constant size projectiles made from
materials with different density but keeping the impact energy constant by varying the incident projectile velocity. The effect of surface hardening on the wear resistance of the high strength steels was determined by impacting the same surface area multiple times at a constant velocity using spherical high velocity projectiles. Regardless of the rather similar hardness of the studied three martensitic steel grades, the impact behavior showed differences in wear rate and damage mechanisms in each case due to the microstructural characteristics of the materials. The adiabatic shear bands forming in the martensitic steels at higher loading rates were found to increase the wear rate. Moreover, the carbide reinforced steel performed in general better than the martensitic grades but showed more brittle behavior and generation of crack networks that can affect the wear performance of the material.

General information
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Ministry of Education 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), AC2T Research GmbH, VTT Technical Research Centre of Finland
Authors: Lindroos, M., Ratia, V., Apostol, M., Valtonen, K., Laukkanen, A., Molnar, W., Holmberg, K., Kuokkala, V. T.
Keywords: (Adiabatic shear bands (ASB), High strength steel, High velocity impact, Wear testing)
Number of pages: 9
Pages: 197-205
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ASJC Scopus subject areas: Condensed Matter Physics, Surfaces and Interfaces, Materials Chemistry, Surfaces, Coatings and Films, Mechanics of Materials

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Publication Forum (2017): 1
Scopus rating (2016): 1.558 2.071
Publication Forum (2016): 1
Scopus rating (2015): 1.527 2.017
Web of Science (2015): 2.323 2.395 >10.0 0.37 0.01794 0.645
Publication Forum (2015): 1
Scopus rating (2014): 1.715 2.38
Web of Science (2014): 1.913 2.109 >10.0 0.347 0.01937 0.601
Publication Forum (2014): 2
Scopus rating (2013): 1.319 2.416
Publication Forum (2013): 2
Scopus rating (2012): 1.36 2.178
Publication Forum (2012): 2
Scopus rating (2011): 1.547 2.865
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Scopus rating (2008): 1.597 1.863
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Scopus rating (2005): 1.473 2.007
Scopus rating (2004): 1.335 1.965
Scopus rating (2003): 1.104 1.788
Scopus rating (2002): 0.958 1.365
Scopus rating (2001): 0.937 1.47
Scopus rating (2000): 1.069 1.149
Scopus rating (1999): 0.848 1.338
Original language: English
Electronic versions:
The effect of impact conditions on the wear and deformation behavior of wear resistant steels. Embargo ended: 19/02/17
DOIs:
10.1016/j.wear.2015.02.032
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.
Tribology of HVOF- and HVAF-sprayed WC-10Co4Cr hardmetal coatings: A comparative assessment

This paper provides a comprehensive assessment of the sliding and abrasive wear behaviour of WC-10Co4Cr hardmetal coatings, representative of the existing state-of-the-art. A commercial feedstock powder with two different particle size distributions was sprayed onto carbon steel substrates using two HVOF and two HVAF spray processes. Mild wear rates of $<10^{-7}$ mm$^3/(Nm)$ and friction coefficients of $≈0.5$ were obtained for all samples in ball-on-disk sliding wear tests at room temperature against Al$_2$O$_3$ counterparts. WC-10Co4Cr coatings definitely outperform a reference electrolytic hard chromium coating under these test conditions. Their wear mechanisms include extrusion and removal of the binder matrix, with the formation of a wavy surface morphology, and brittle cracking. The balance of such phenomena is closely related to intra-lamellar features, and rather independent of those properties (e.g. indentation fracture toughness, elastic modulus) which mainly reflect large-scale inter-lamellar cohesion, as quantitatively confirmed by a principal component analysis. Intra-lamellar dissolution of WC into the matrix indeed increases the incidence of brittle cracking, resulting in slightly higher wear rates. At 400°C, some of the hardmetal coatings fail because of the superposition between tensile residual stresses and thermal expansion mismatch stresses (due to the difference between the thermal expansion coefficients of the steel substrate and of the hardmetal coating). Those which do not fail, on account of lower residual stresses, exhibit higher wear rates than at room temperature, due to oxidation of the WC grains. The resistance of the coatings against abrasive wear, assessed by dry sand-rubber wheel testing, is related to inter-lamellar cohesion, as proven by a principal component analysis of the collected dataset. Therefore, coatings deposited from coarse feedstock powders suffer higher wear loss than those obtained from fine powders, as brittle inter-lamellar detachment is caused by their weaker interparticle cohesion, witnessed by their systematically lower fracture toughness as well.

General information

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Ministry of Education publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Surface Engineering, Engineering materials science and solutions (EMASS), University West, Dipartimento di Ingegneria Enzo Ferrari, University of Modena and Reggio Emilia, Fraunhofer-Institut für Werkstoff- und Strahltechnik (IWS), Fraunhofer-Institut für Keramische Technologien und Systeme (IKTS), Institut für Korrosionsschutz Dresden GmbH
High speed slurry-pot erosion wear testing with large abrasive particles

One of the testing methods used to simulate slurry erosion in laboratory conditions is the slurry-pot method. In this work, a novel high speed slurry-pot type erosion wear tester was constructed for testing of materials used in mining and other mineral handling applications. In the tester, the samples are attached to a vertical rotating shaft on four levels in a pin mill configuration. High speeds up to 20 m/s at the sample tip can be achieved also with large abrasive size up to 10 mm. In the tests, the equipment proved to be functional and durable even with the high loads created by the high speeds and large abrasive sizes. There are, however, variations in the slurry concentrations inside the pot during testing, leading to different wear rates at the different sample levels. Therefore, a sample rotation test method was developed. By rotating the samples evenly through all sample levels, the overall deviations between samples will be minimized. Furthermore, with the
sample rotation method up to eight materials can be tested simultaneously. The slurry-pot is suitable for testing various materials, such as steels and rubbers.

**General information**

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Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Ojala, N., Valtosen, K., Kivikytö-Reponen, P., Vuorinen, P., Kuokkala, V.
Keywords: (Wear testing, Slurry erosion, Slurry-pot, Mining, mineral processing, Steel, Rubber)
Number of pages: 9
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Scopus rating (2016): 0.141 0.076
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Scopus rating (2015): 0.101 0.0
Publication Forum (2015): 1
Scopus rating (2014): 0.316 0.126
Publication Forum (2014): 1
Scopus rating (2013): 0.118 0.019
Publication Forum (2013): 1
Scopus rating (2012): 0.24 0.312
Publication Forum (2012): 1
Scopus rating (2011): 0.237 0.103
Scopus rating (2010): 0.125 0.055
Scopus rating (2009): 0.459 0.37
Scopus rating (2008): 0.13 0.228
Scopus rating (2007): 0.126 0.186
Scopus rating (2006): 0.159 0.438
Scopus rating (2005): 0.181 0.429
Scopus rating (2004): 0.104 0.479
Scopus rating (2003): 0.227 0.277
Scopus rating (2002): 0.101 0.0
Scopus rating (2001): 0.221 0.0
Scopus rating (2000): 0.238
Scopus rating (1999): 0.119
Original language: English
Electronic versions:
Tribologia 2015 Ojala et al
Links:
http://urn.fi/URN:NBN:fi:tty-201606134239

**Bibliographical note**

xoa ei tarkistettu
Research output: Scientific - peer-review › Article

**Temperature-induced ageing of solar absorbers on plain and anodized aluminium substrates**

The temperature-induced ageing mechanisms and long-term stability of solar thermal absorbers having aluminium substrate with and without anodized aluminium oxide layer were investigated. A thin Al layer was used to act as an IR reflector on anodized aluminium oxide layer. The absorbers studied were industrial, sputtered chromium-based absorber coatings. The absorbers were aged by means of prolonged and extended thermal accelerated ageing studies at 248-308
degrees C.
The ageing mechanisms and degradation of the absorbers were analysed by optical measurements (solar absorbance with a UV/Vis/NIR spectrophotometer and thermal emittance by FTIR spectrophotometry), microstructural analysis using transmission electron microscope (TEM) equipped with an energy dispersive X-ray spectrometer (EDS), composition by time-of-flight elastic recoil detection analysis (TOF-ERDA), and crystal structure by grazing incidence X-ray diffraction (XRD) before and after the ageing studies. The relation between optical degradation and ageing mechanisms was studied using optical modelling and simulation with CODE Coating Designer. The results clearly demonstrated the effect of substrate material on the long-term stability of the absorber at intermediate temperatures. (C) 2014 Elsevier B.V. All rights reserved.
Hydrofluoric-nitric-sulphuric-acid surface treatment of tungsten for carbon fibre-reinforced composite hybrids in space applications

Hybrid material systems, such as combinations of tungsten foils and carbon fibre-reinforced plastic (CFRP), are replacing metal alloy concepts in spacecraft enclosures. However, a good adhesion between the tungsten oxide scale and the epoxy resin used is required. Here, the effects of a hydrofluoric-nitric-sulphuric-acid (HFNS) treatment on tungsten oxides and subsequent adhesion to CFRP are analysed using atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS) and fracture testing. The work shows that HFNS treatment results in decreased oxygen content, over 50% thinner tungsten trioxide (WO3) layer and increased nano-roughness on thin tungsten foils. Fracture testing established a 39% increase in the average critical strain for tungsten-CFRP specimens after HFNS treatment was carried out on tungsten. The effect of the oxide scale modification regarding the critical strain energy release rate was Delta Gc approximate to 8.4 J/m(2). (C) 2014 Elsevier By. All rights reserved.
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
State: Published
Organisations: Department of Materials Science, Research group: Materials Characterization, Engineering materials science and solutions (EMASS), AC2T Research GmbH
Authors: Ratia, V., Rojacz, H., Terva, J., Valtonen, K., Badisch, E., Kuokkala, V. T.
Keywords: (Deformation, EBSD, Impact, Martensite, Residual stresses, Steel)
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ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Surfaces, Coatings and Films, Surfaces and Interfaces

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Scopus rating (2016): 1.016 1.278
Publication Forum (2016): 1
Scopus rating (2015): 1.03 1.202
Web of Science (2015): 1.758 1.997 6.0 0.318 0.00859 0.615
Publication Forum (2015): 1
Scopus rating (2014): 1.306 1.639
Web of Science (2014): 1.739 2.088 6.1 0.457 0.00876 0.666
Publication Forum (2014): 2
Scopus rating (2013): 1.404 1.727
Publication Forum (2013): 2
Scopus rating (2012): 1.33 1.569
Publication Forum (2012): 2
Scopus rating (2011): 1.199 1.581
Scopus rating (2010): 1.139 1.389
Scopus rating (2009): 0.982 1.348
Scopus rating (2008): 1.218 1.248
Scopus rating (2007): 1.228 1.353
Scopus rating (2006): 1.019 1.135
Fatigue behaviour of nickel- and cobalt-based laser cladded coatings on steel bars

Laser cladding allows the manufacturing of thick, dense and fusion bonded low diluted coatings, permitting its application in industry fields that require wear and corrosion protection. On the other hand, large residual stresses on the coating layer and noticeable changes in the substrate material may affect mechanical properties and fatigue strength. In this study, high load four-point bending fatigue tests were conducted, comparing the results to those of the substrate material alone and post-weld heat treated components. The fatigue test results were displayed with Wöhler curves. Two different substrate/coating couples are studied in this work: mild steel S355-J2 coated with Stellite21 cobalt based hard-facing alloy, and low-alloy steel 42CrMo4 coated with Inconel625 nickel based super alloy. In order to better define how the features of the materials change with the cladding direction and the post weld heat treatment, the specimens were analysed by SEM/EDS; verifying the presence of defects, and how dilution changes along the cladding direction. Chemical etched samples were observed by optical microscope to assess the effect of the laser treatment on materials microstructures. Hardness measurements and depth sensing nanoindentations are performed to evaluate mechanical properties of coatings, HAZ and substrate. After fatigue failure, every fractured surface was separated from the fatigue specimen and analysed by stereo microscope, SEM and EDS in order to identify the reasons and the mechanisms of the failure.

General information
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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Surface Engineering
Authors: Fantozzi, D., Tuominen, J., Bolelli, G., Lusvarghi, L., Vuoristo, P.
Keywords: (Laser cladding, Fatigue, Ni-based superalloy, Co-based hardfacing alloy)
Number of pages: 10
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Editors: Sudarshan, T., Vuoristo, P., Koivuluoto, H.
ISBN (Electronic): 978-81-926196-1-3

Bibliographical note
xoa ei tarkistettu
Research output: Scientific - peer-review › Conference contribution

High performance wear and corrosion resistant coatings by novel cladding techniques

In the field of surface engineering, cladding or overlay welding is a group of coating methods used in manufacturing fusion-bonded thick metallic and metal matrix composite (MMC) coatings on a wide variety of metallic base materials with varying degree of deposition rate, dilution and heat input. Growing demands for more material-, energy- and cost-effective overlay welding processes as well as sustainable solutions for performance-critical applications have boosted to develop methods that are capable of producing low diluted and fusion-bonded single layer coatings with high deposition rates. Such novel cladding methods include for instance laser-based high power laser cladding, coaxial hot-wire laser cladding, laser-arc hybrid cladding, non-laser-based Cold Metal Transfer (CMT) cladding and methods that utilize high intensity infrared (IR) light. This paper introduces some of such highly innovative cladding techniques and highlights some microstructural and geometrical features, abrasion and sliding wear, and wet corrosion properties of Fe-, Ni- and Co-based metallic coatings manufactured by novel laser and CMT cladding methods. The research results evidence that with the choice of optimal processing parameters, novel cladding techniques are capable of manufacturing high performance...
weld overlays with the properties equivalent or near to corresponding wrought alloys and reference overlays with net deposition rates of approximately 5 kg/h and more. Overall, the presented work suggests that discussed methods have high potential in surfacing of new and remanufacturing of service-damaged surfaces in high value components, in building up complex features on existing components and also in near net shape additive manufacturing of functional 3D objects.

Microstructural and abrasion wear characteristics of tool steel coatings manufactured by laser cladding

Tool steels are a class of complex carbon and alloy steels that are widely available as powders over a wide compositional range. In this work, several different tool steel grades were deposited on mild steel by the laser cladding process using a continuous wave 4.4 kW Nd:YAG laser in combination with a coaxial powder feeding technique. With bidirectional scanning pattern, most of the grades were deposited crack-free with hardness up to 1000 HV without additional preheating. A comparative study of 3-body abrasion and single point scratch wear behaviour was conducted on the obtained coatings. In a 3-body abrasion wear study, the laser clad Ralloy WR6 with significant portion of retained austenite exhibited superior abrasive wear resistance compared with the fully martensitic tool steel coatings (M2, M4, H13, HS-23, HS-30) and the reference material, Raex Ar500 wear resistant steel. The abrasion wear resistance of austenitic-martensitic WR6 tool steel was further enhanced by the external addition of 20% volume percentage of relatively large (45-106 µm) vanadium carbides. In single point scratch tests, fully martensitic tool steels outperformed austenitic-martensitic tool steels and Raex Ar500 wear resistant steel. The differences in wear performances were explained by different wear mechanisms and types of contact between the abrasive and the surface. These results show the potential of laser cladding in depositing hard and wear resistant tool steel coatings on easier to fabricate and less expensive base materials or remanufacturing of wear resistant steel grades for enhancing the service life of various components. Examples of such components are, for instance, rock and ground drilling bits in mining and construction and various blades and knives in pulp & paper industries.
Study of worn weld deposit with added tungsten carbide particles

Nowadays we can see the application of special protective surface layers, which perform many different functions. These protective layers are applied and used to protect components against wear that occurs in various forms in the construction, mining and metal industries. Among these so-called protective layers we can include special hard-facing, using metal matrix (in the context of this article alloyed iron matrix) in combination with tungsten carbide particles that can be assigned to a group of composite materials. High hardness of the carbides combined with the use of relatively tough matrix allows us to get high wear resistance. This resistance then considerably increases the service life of machine parts and significantly contributes to reducing the expenses of industrial companies to repair or replacement of the worn parts. The main focus of this article is to study characteristics of generated weld deposit with tungsten carbide reinforced iron matrix on common structural steel S235JR substrate. This includes the evaluation of hardness of formed layer and its resistance to the abrasive wear. Lower wear resistance of high boron A864 M layer with externally incorporated tungsten carbide particles was observed compared to standard F-Durit G iron based layer with microscopic tungsten carbide particles included in cored wire. This is the result of the fact that most of big tungsten carbide particles were placed on the bottom of the weld deposit and do not protect the surface of the weld deposit effectively.

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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Surface Engineering, VSB-Technical University Ostrava, Czech Republic
Authors: Hlavaty, I., Kozak, J., Tuominen, J.
Number of pages: 10
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Publisher: Valardocs
Editors: Sudarshan, T., Vuoristo, P., Koivuluoto, H.
ISBN (Electronic): 978-81-926196-1-3
Research output: Scientific - peer-review > Conference contribution

Applying the digital image correlation method to fretting contact for slip measurement
Fretting is a consequence of small relative oscillatory movement between contacting parts and can cause serious damage to machine components. This paper describes the implementation of digital image correlation method to a fretting test device to measure the relative movement, i.e. slip, between the contacting parts. A complete contact fretting test device is used, in which two flat fretting pads are clamped against a cyclically loaded flat fretting specimen. The material used is quenched and tempered steel. Digital image correlation, equipped with a microscope, is employed to measure the local displacement field at the contact edge. The micrometer-level slip amplitude and the length of the slip region are determined at specific time intervals during a fretting fatigue test. Both of these quantities appear to decrease and stabilize during fretting fatigue testing. The slip decreases markedly during the initial cycles.

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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Tribology and Machine Elements, Research and Development, Wärtsilä Finland
Authors: Juoksukangas, J., Lehtovaara, A., Mäntylä, A.
Number of pages: 11
Publication date: 2015
Peer-reviewed: Yes
Early online date: 20 Aug 2015

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Barkhausen Noise Measurements for Detecting Surface Changes during Grinding Process

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Organisations: Department of Materials Science, Research group: Materials Characterization, University of Oulu
Authors: Santa-aho, S., Sorsa, A., Hakanen, M., Leiviskä, K., Lepistö, T. K., Vippola, M. S.
Number of pages: 15
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ISBN (Print): 978-81-926196-1-3
Research output: Scientific - peer-review › Conference contribution

Debonding and impact damage in stainless steel fibre metal laminates prior to metal fracture
An experimental drop-weight impact investigation was performed for stainless steel fibre metal laminates (FMLs) containing carbon-fibre and glass-fibre-reinforced epoxy layers. The purpose was to study the dependence of metal-composite debonding on the metal's surface morphology, as well as the interaction between debonding and internal damage caused to a composite. Three different steel surface morphologies were studied for the steel-carbon FMLs. Force-contact time and deflection profile measuring, as well as ultrasonic scanning and scanning electron microscopy imaging, were used for impact damage evaluation. Debonding was found to proceed either at the metal and adhesive film interface or cohesively inside the adhesive film. The steel's surface condition did not significantly influence impact response. The research also revealed that debonding between the lower metal sheet and composite part proceeded as mixed mode (I/II) fracture. Debonding was connected to the composite damages by several shear cracks located in the
uppermost composite layer.

**General information**

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Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Engineering materials science and solutions (EMASS), Department of Applied Mechanics, Aalto University
Authors: Pärnänen, T., Kanerva, M., Sarlin, E., Saarelä, O.
Keywords: (Debonding, Fibre metal laminates, Fracture, Impact, Interface)
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ASJC Scopus subject areas: Civil and Structural Engineering, Ceramics and Composites

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Publication Forum (2016): 2
Scopus rating (2015): 2.247 2.236
Web of Science (2015): 3.853 3.874 5.5 0.738 0.02985 0.909
Publication Forum (2015): 2
Scopus rating (2014): 2.331 2.524
Web of Science (2014): 3.318 3.5 5.7 0.825 0.02625 0.884
Publication Forum (2014): 2
Scopus rating (2013): 2.017 2.937
Publication Forum (2013): 2
Scopus rating (2012): 1.867 2.838
Publication Forum (2012): 2
Scopus rating (2011): 1.683 2.581
Scopus rating (2010): 1.583 2.367
Scopus rating (2009): 1.652 2.076
Scopus rating (2008): 1.447 1.761
Scopus rating (2006): 1.08 1.894
Scopus rating (2005): 1.233 1.647
Scopus rating (2004): 1.022 1.484
Scopus rating (2003): 0.977 1.101
Scopus rating (2002): 1.347 0.958
Scopus rating (2001): 0.695 1.151
Scopus rating (2000): 0.896 0.879
Scopus rating (1999): 0.864 0.868
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**Bibliographical note**

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Source-ID: 25
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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

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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.
Authors: Lindroos, M., Apostol, M., Kuokkala, V. T., Laukkanen, A., Valtosen, K., Holmberg, K., Oja, O.
Keywords: (Adiabatic shear band, High strain rate, High strength steel, Impact wear)
Number of pages: 14
Pages: 114-127
Publication date: 2015
Peer-reviewed: Yes

ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Civil and Structural Engineering, Aerospace Engineering, Automotive Engineering, Ocean Engineering, Safety, Risk, Reliability and Quality

Publication information

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Scopus rating (2016): 1.509 2.137
Publication Forum (2016): 1
Scopus rating (2015): 1.878 3.054
Web of Science (2015): 2.646 2.937 8.5 0.749 0.00747 0.884
Publication Forum (2015): 1
Scopus rating (2014): 2.015 3.653
Web of Science (2014): 2.201 2.572 8.4 0.455 0.00759 0.842
Publication Forum (2014): 2
Scopus rating (2013): 2.21 3.744
Publication Forum (2013): 2
Scopus rating (2012): 1.751 3.687
Publication Forum (2012): 2
Scopus rating (2011): 1.593 3.124
Scopus rating (2010): 1.409 2.453
Scopus rating (2009): 1.412 2.031
Scopus rating (2008): 1.507 2.47
Scopus rating (2007): 1.11 2.021
Scopus rating (2006): 0.92 2.704
Scopus rating (2005): 1.069 1.629
Scopus rating (2004): 0.693 1.325
Scopus rating (2003): 0.775 1.763
Scopus rating (2002): 0.889 1.075
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. © The Society for Experimental Mechanics, Inc. 2015.

High Temperature Tension HSB Device Based on Direct Electrical Heating

State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Materials Characterization, Engineering materials science and solutions (EMASS)
Authors: Hokka, M., Östman, K., Rämö, J., Kuokkala, V. T.
Keywords: (High strain rate, High temperature, Hopkinson split bar, Stainless steels, Tension testing)
Number of pages: 7
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General information

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ISBN (Print): 978-3-319-06994-4
ISBN (Electronic): 978-3-319-06995-1
ASJC Scopus subject areas: Engineering(all), Computational Mechanics, Mechanical Engineering

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Links: http://www.scopus.com/inward/record.url?scp=84906319239&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
siirretään 2015<br/>Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2015-01-13<br>publication_forum:72540
Influence of Diffusion Barriers on Thermal Ageing Behaviour of Solar Absorber Coatings on Copper

The thermal stability of magnetron sputtered and electroplated solar absorber coatings were investigated at elevated temperatures of 200-500°C. Diffusion barriers of aluminium and nickel were studied towards thermal diffusion of copper substrate atoms.

The diffusion barriers studied were experimental magnetron sputtered Al layers and an industrial electroplated Ni layer between a Cu substrate and an absorber coating. The thicknesses of Al barriers were 0.1 µm and 0.5 µm, and a Ni barrier was 3 µm thick. As absorber coatings, magnetron sputtered chromium-based coatings and industrially electroplated black chromium coatings, were studied. The sputtered absorbers were a 3-layer stack of CrOx/Cr/CrOx with layer thicknesses of 0.05/0.03/0.05 µm, respectively. The electroplated black chromium coating had a thickness of 0.2 µm. Copper was used as a substrate for all of the absorbers studied.

The degradation of the absorber surfaces and influence of diffusion barriers were analysed by optical measurements (solar absorbance with a UV/Vis/NIR spectrophotometer and thermal emittance with a FTIR spectrophotometer), microstructural analyses were performed using a field-emission scanning electron microscope (FESEM). The absorbers were aged by means of heat treatments in a circulating air furnace at 200, 300, 400 and 500°C for two hours. The experimental analyses were performed before and after the ageing studies.

The results showed that without a barrier coating copper substrate atoms can diffuse into the absorber coating and through the coating to the surface of the coating and form CuO islands on the surface. These phenomena degraded optical selectivity of the absorber surface. The diffusion can be prevented or retarded with a diffusion barrier layer between the Cu substrate and the absorber coating. The 3-µm-thick Ni barrier prevented Cu diffusion and retained optical selectivity up to 500°C for two hours and the 0.5-µm-thick Al layer up to 400°C.

Influence of the Spray Gun Type on Microstructure and Properties of HVAF Sprayed Fe-Based Corrosion Resistant Coatings

The aim of this study is to evaluate the microstructural details and corrosion properties of novel Fe-based coatings prepared using two different generations of HVAF spray guns. These two generations of HVAF guns are Activated Combustion HVAF (AC-HVAF, 2nd generation) M2 gun and Supersonic Air Fuel HVAF (SAF, 3rd generation) M3 gun. Structural details were analysed using x-ray diffractometry and field-emission scanning electron microscope. Higher denseness with homogeneous microstructure was achieved for Fe-based coating deposited by the M3 process. Such coatings exhibit higher particle deformation and lower oxide content compared to coatings manufactured with M2 gun. Corrosion properties were studied by open-cell potential measurements and electrochemical impedance spectroscopy. The lower porosity and higher interlamellar cohesion of coating manufactured with M3 gun prevent the electrolyte from penetrating through the coating and arriving to the substrate, enhancing the overall corrosion resistance. This can be explained by the improved microstructures and coating performance.
Microstructural analysis of high-pressure cold-sprayed Ni, NiCu and NiCu + Al2O3 coatings

Cold spraying has shown its potential to produce metallic and composite coatings with high quality and performance. For instance, the impermeability of the coatings is the criterion for the corrosion resistance and thus, fully dense coatings can act as real corrosion barrier coatings. Our previous study has demonstrated the good corrosion properties of high-pressure cold-sprayed (HPCS) Ni and NiCu coatings whereas the present study focuses on the analysis of structural characteristics behind the dense coatings. Microstructures of as-sprayed and heat-treated HPCS Ni, Ni20Cu and Ni20Cu+Al2O3 coatings have been evaluated with FESEM from top-view direction. This revealed clearly particle deformation and particle boundaries whereas particle bonding was evaluated with cavitation-erosion test. Density was proven with Corrodkote test and impermeable HPCS NiCu+Al2O3 coating structures were achieved. Furthermore, cavitation-erosion resistance of NiCu coating was improved by heat treatment.
Modelling of Material Properties Using Frequency Domain Information from Barkhausen Noise Signal

Frequency spectrum, bispectrum and bicoherence which are computed from Barkhausen noise (BN) signal are used to model material properties. The use of frequency domain information can be a significant addition to the more common time domain data analysis of the BN signals. The frequency spectrum shows the magnitude of the spectral components present in the signal. These components can also have interaction which is revealed only by the higher-order spectra. Third order spectrum can be used to detect the quadratic phase coupling phenomenon, which is a result of nonlinearity in the signal. In this study, a special attention is paid on the segment biphase to distinguish the quadratic phase coupling from constant non-zero biphase. Partial least squares regression models are made to model the surface hardness and residual stress properties from a set of carburizing case-hardened steel samples.
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.
The deformation, strain hardening and wear behavior of chromium alloyed Hadfield steel in abrasive and impact conditions

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10.1007/s11249-015-0477-6

**Links:**
http://urn.fi/URN:NBN:fi:itty-201603223737

**Source:** Scopus

**Source-ID:** 84921751364

**Research output:** Scientific - peer-review › Article

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**Wear behavior and work hardening of high strength steels in high stress abrasion**

**General information**

State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Computational Science X (CompX), Engineering materials science and solutions (EMASS)
Authors: Lindroos, M., Valtonen, K., Kemppainen, A., Laukkanen, A., Holmberg, K., Kuokkala, V.
Number of pages: 9
Pages: 32-40
Publication date: 2015
Peer-reviewed: Yes

**Publication information**

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**Publication Forum (2017):** 1
**Scopus rating (2017):** 1

**Publication Forum (2016):** 1
**Scopus rating (2016):** 1.016 1.278

**Publication Forum (2015):** 1
**Scopus rating (2015):** 1.03 1.202

**Web of Science (2015):** 1.758 1.997 6.0 0.318 0.00859 0.615
**Publication Forum (2015):** 1
**Scopus rating (2014):** 1.306 1.639

**Web of Science (2014):** 1.739 2.088 6.1 0.457 0.00876 0.666
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**Scopus rating (2012):** 1.33 1.569
**Publication Forum (2012):** 2
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**Scopus rating (2008):** 1.218 1.248
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**Scopus rating (2003):** 1.093 1.44
**Scopus rating (2002):** 0.874 0.983
**Scopus rating (2001):** 0.993 1.173
**Scopus rating (2000):** 0.87 0.945
**Scopus rating (1999):** 1.101 0.915

Original language: English
Electronic versions:

The deformation, strain hardening and wear behavior of chromium alloyed Hadfield steel in abrasive and impact conditions
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**Bibliographical note**

Online 5 November 2014; vol. 322-323 (2015), s.32-40<br>Contribution: organisation=mol,FACT1=1<br>Portfolio EDEND: 2015-01-09<br>Publisher name: Elsevier<br>Source: researchoutputwizard<br>Source-ID: 951

Research output: Scientific - peer-review › Article

**X-ray Diffraction based Residual Stress Profiling of Heat Affected Surface Layer in Flame Cut Heavy Steels**

**General information**

State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Materials Characterization, Research group: Metals Technology
Authors: Saarinen, T., Jokiaho, T., Santa-aho, S., Vippola, M., Peura, P.
Number of pages: 13
Pages: 595-607
Publication date: 2015

**Host publication information**

Title of host publication: Proceedings of the Twenty Eighth International Conference on Surface Modification Technologies
Publisher: Valardocs
Edition: 1st edition
ISBN (Print): 978-81-926196-1-3
Research output: Scientific - peer-review › Conference contribution

**Nanofabrication and Adsorption Studies of Organic Molecules on Metal and Metal Alloy Surfaces as Templates for Biofunctional Applications**
The nanofabrication of organic layers on metal and metal alloy surfaces was studied in this thesis by employing photoelectron spectroscopy (PES) as the main analysis method. The motivation for this research is to introduce new properties to metal and metal alloy surfaces via self-assembly driven adsorption processes of organic molecules. Trimesic acid (TMA) and glycine adsorption on single crystal Cu(100) surface was investigated with PES and scanning tunnelling microscopy (STM). TMA on Cu(100) exhibits coverage dependent surface phases with drastic changes in the molecular orientation. The mobile TMA molecules at low coverage transform into Cu atom coordinated TMA networks and finally into carboxyl (COOH) functionalized, densely packed TMA monolayers. This is enabled due to three equivalent COOH groups symmetrically around a rigid benzene ring. Homo- and heterochiral surface phases of achiral glycine on Cu(100) were observed, and a new structural model for glycine bonding on Cu(100) based on STM and density functional theory calculations is presented. The coadsorption of aminopropyl trimethoxysilane (APS) and mercaptopropyl trimethoxysilane (MPS) on stainless steel was studied with an aim to incorporate MPS in APS matrix with tuneable distribution. In addition to the determination of elemental and chemical states at the surface, PES data was also used to determine the surface morphology by employing inelastic electron energy-loss background analysis. Synchrotron radiation mediated PES enabled the study of the in-depth distribution of the chemical states in non-destructive manner. The functionality of the APS/MPS overlayers on stainless steel was studied with chemical derivatization. The studies of TMA and glycine on Cu(100) provide important knowledge of the adsorption behaviour of small molecules on surfaces, which is crucial for understanding the adsorption phenomena of larger molecules, such as proteins on more complex substrates. The fabricated surface structures may also be applicable to molecular electronics or catalytic surfaces. The bifunctional silanization of stainless steel, on the other hand, is directly transferrable to industrial scale processes. The bifunctional APS/MPS nanomolecular layer on stainless steel works as a template, to which biomolecules can be covalently coupled with tuneable distribution. Hence, the stainless steel surface can be biofunctionalized for a range of applications, depending on the properties of the biomolecules.

General information
State: Published
Ministry of Education publication type: G5 Doctoral dissertation (article)
Organisations: Optoelectronics Research Centre
Authors: Vuori, L.
Number of pages: 70
Publication date: 21 Nov 2014

Publication information
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Publisher: Tampere University of Technology
Original language: English

Publication series
Name: Tampere University of Technology. Publication
Publisher: Tampere University of Technology
Volume: 1267
ISSN (Print): 1459-2045
Electronic versions:
vuori.pdf
Links:

Bibliographical note
Awarding institution:Tampere University of Technology
Source: researchoutputwizard
Source-ID: 1770
Research output: Collection of articles › Doctoral Thesis

Versatile erosion wear testing with the high speed slurry-pot
The high speed slurry-pot tester was developed for application oriented erosion wear testing of materials used in mineral handling and processing. It enables tests in demanding high stress abrasive and erosive environments simulating wear, for example in slurry pumps, tanks and pipes, mineral crushing and grinding, loader buckets, dredging, and drilling. The key design features of the test method are the possibility to use up to 10 millimeter sized particles and sample speeds up to 20 m/s in conditions ranging from wet slurry environments to dry sand or gravel.

The tester has been used to test many different material types, including conventional steels, surface treated steels, cast irons, thick and thin coatings, ceramics, hybrid materials, polymers and elastomers. With the high speed slurry-pot tester, samples of various types and sizes can be tested.

In the FIMECC BSA/P2/SP3 project, the focus is in the testing of materials intended for demanding wear related
applications. Moreover, the test system is further developed for various wear conditions, including slurry-erosion, grinding abrasion, and sub-zero temperatures.

**General information**
- **State**: Published
- **Organisations**: Department of Materials Science, Research group: Materials Characterization
- **Authors**: Ojala, N., Heino, V., Valtonen, K., Kuokkala, V.
- **Keywords**: (Wear testing, Wear resistant steel, Application oriented, Materials, Material characterization, Wear, Polymer, Ceramic, Coatings, mining)
- **Publication date**: Nov 2014
- **Peer-reviewed**: Unknown
- **ASJC Scopus subject areas**: Materials Science(all)
- **Electronic versions**: TWC 2014 poster_Niko Ojala
- **Research output**: Scientific > Paper, poster or abstract

**Effects of composition and microstructure on the abrasive wear performance of quenched wear resistant steels**

Wear resistant steels are commonly categorized by their hardness, and in the case of quenched wear resistant steels, their Brinell hardness grades are widely considered almost as standards. In this study, the abrasive wear performance of 15 commercially available 400 HB grade quenched wear resistant steels from all over the world were tested with granite gravel in high stress conditions. The aim was to evaluate the real wear performance of nominally similar steels. Also properties such as hardness, hardness profiles, microstructures and chemical compositions of the steels were studied and reasons for the differences in their wear performance further discussed. In terms of mass loss, over 50% differences were recorded in the abrasive wear performance of the studied steels. Variations in the chemical compositions were linked to the auto-tempered microstructures of the steels, and the microstructural characteristics were further linked to their ultimate wear behavior. © 2014 Elsevier B.V.

**General information**
- **State**: Published
- **Ministry of Education publication type**: A1 Journal article-refereed
- **Organisations**: Department of Materials Science, Research group: Materials Characterization, Tampere University of Technology, Metso Minerals, Inc.
- **Authors**: Ojala, N., Valtonen, K., Heino, V., Kallio, M., Aaltonen, J., Siitonen, P., Kuokkala, V. T.
- **Keywords**: (Abrasion, Hardness, Microstructure, Mineral processing, Steel, Wear testing)
- **Number of pages**: 8
- **Pages**: 225-232
- **Publication date**: 15 Sep 2014
- **Peer-reviewed**: Yes
- **ASJC Scopus subject areas**: Condensed Matter Physics, Surfaces and Interfaces, Materials Chemistry, Surfaces, Coatings and Films, Mechanics of Materials

**Publication information**
- **Journal**: Wear
- **Volume**: 317
- **Issue number**: 1-2
- **ISSN (Print)**: 0043-1648
- **Ratings**:
  - Publication Forum (2017): 1
  - Scopus rating (2016): 1.558 2.071
  - Publication Forum (2016): 1
  - Scopus rating (2015): 1.527 2.017
  - Web of Science (2015): 2.323 2.395 >10.0 0.37 0.01794 0.645
  - Publication Forum (2015): 1
  - Scopus rating (2014): 1.715 2.38
  - Web of Science (2014): 1.913 2.109 >10.0 0.347 0.01937 0.601
  - Publication Forum (2014): 2
  - Scopus rating (2013): 1.319 2.416
  - Publication Forum (2013): 2
  - Scopus rating (2012): 1.36 2.178
  - Publication Forum (2012): 2
University-Industry Co-operation Using a Practice-based Innovation Tool: Case Advisory Professorship Programme in Materials Technology

In the thesis the usability and effectiveness of a practice-based innovation tool for university–industry co-operation, the advisory professorship model, is evaluated. The research material was collected by applying the tool with a materials technological emphasis in the regional co-operation network in 2008–2012. The inputs, functions and internal dynamics of the innovation environment, as well as the results and effects of innovation activities in the materials technology advisory professorship programme (MTAP) network, are analysed qualitatively using a conceptual framework for the evaluation of regional innovative capability and the Network-Based Innovative Capability (NBIC) matrix. In the network of the MTAP programme, new practice-based innovation processes, concentrated in practice-based problems and development targets in companies products, operational environment or markets were created. The role of the university was especially in producing of information in the front-end phases of innovation processes, related mostly to properties and processing knowledge of materials, the feasibility of development ideas and in searching of new R&D opportunities. The nature of university based research inputs was typically fast and short-termed. Some innovation processes ended up as new products or product improvements. New knowledge, information and knowledge networks were created. The advisory professorship model can be considered a useful practice-based innovation tool for regional university–industry cooperation with some limitations. In the thesis the materials technology related regional resources, infrastructure and needs from both private and public sectors are also studied and levels of regional availability, access and delivery options for materials technological research are analysed in the Lahti region. Based on this information, it is suggested how the knowledge, network and innovation system related to materials technology should be developed further by public policies and strategies in the region.

General information
State: Published
Ministry of Education publication type: G4 Doctoral dissertation (monograph)
Organisations: Department of Materials Science
Authors: Eerola, S.
Number of pages: 208
Publication date: 6 Jun 2014

Publication information
Place of publication: Tampere
Publisher: Tampere University of Technology
Original language: English
Characterisation of Novel Corrosion Resistant Stainless Steel/Rubber/Composite Hybrid Structures

Last decade has shown an increasing interest in hybrid materials and structures. With hybrids there is not only potential to create high strength low weight structures, but also to tailor the properties of the final product in a way that is unattainable by any single material alone. Simpler manufacturing process, increased functional integration, improved sound and vibration damping properties, enhanced crack propagation resistance and protection against collapse in a crash are just some examples of possible advantages of hybrid materials. However, before implementation in industrial application, adequate adhesion between the material components of a hybrid must be ensured. Also, from industrial point of view the required manufacturing method should not increase substantially the costs of the product. Although many established adhesion procedures exist, there is still lack of functioning joining methods for certain material combinations. Especially, the adhesive joining of polymeric materials to stainless steel is demanding, as the conventional methods require laborious manufacturing steps. In this study, the possibility to bond stainless steel to fibre reinforced epoxy composite with an ethylene propylene diene terpolymer (EPDM) based rubber is studied. Two different rubber compounds are used to create stainless steel/rubber/composite hybrids and a mild steel/rubber/composite structure is used as a reference. Both geometry-dependent peel tests together with environmental testing and geometry-independent single cantilever beam test are used to study the adhesion of the structure's interfaces. Scanning electron microscopy and transmission electron microscopy are used to characterise the nature of the interfaces of the hybrids. In addition, the effect of the rubber on the energy absorption properties of the hybrid structure was of interest. This was studied by non-destructive vibration damping test and by high velocity impact test. In these tests, both sample geometry (rubber thickness) and test parameters were varied to investigate their effect on the hybrid's behaviour. It was found that the studied method to bond stainless steel and epoxy composite by EPDM rubber enables the use of a simple manufacturing process and it furthermore results in well-bonded hybrid structure. The stainless steel/composite bond strength is defined by the cohesive strength of the rubber and the bond maintains its strength in harsh environments. This enables the evaluation of the stainless steel/composite bond's strength by using the rubber's bulk properties instead of the substrate/rubber interfacial properties, which are difficult to define in a reliable manner. The stainless steel/rubber/composite structure has significantly better vibration damping properties than an all-metal structure. In addition, the rubber improves significantly the damage tolerance of the structure when compared to a corresponding structure which has been conventionally bonded. Thus, the approach of joining stainless steel to fibre reinforced epoxy composite with rubber has potential for industrial applications and the hybrid structure would offer a lighter and better damping solution when compared to all-metallic ones.
Abstracts of the 28th International Conference on Surface Modification Technologies, SMT28, Tampere University of Technology, Tampere, Finland, June 16-18, 2014
Apparent Fracture Toughness Versus Micro-Scale Fracture Toughness of Interfaces-The Challenge of Critical Values

Application of DIC technique for studies of Kuru Granite rock under static and dynamic loading
Atomistic investigation on the structure-property relationship during thermal spray nanoparticle impact

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science
Authors: Goel, S., Faisal, N. H., Ratia, V., Agrawal, A., Stukowski, A.
Number of pages: 12
Pages: 163-174
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: COMPUTATIONAL MATERIALS SCIENCE
ISSN (Print): 0927-0256
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.926 1.259
Publication Forum (2016): 1
Scopus rating (2015): 0.993 1.348
Web of Science (2015): 2.086 2.182 6.4 0.587 0.02786 0.659
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Scopus rating (2014): 1.129 1.677
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Publication Forum (2014): 2
Scopus rating (2013): 0.965 1.337
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Scopus rating (2006): 0.852 1.474
Scopus rating (2005): 1.161 1.327
Scopus rating (2004): 0.915 1.06
Scopus rating (2003): 0.61 0.775
Scopus rating (2002): 0.576 0.705
Barkhausen noise-magnetizing voltage sweep measurement in evaluation of residual stress in hardened components

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Santa-aho, S., Sorsa, A., Hakanen, M., Leiviskä, K., Vippola, M., Lepistö, T.
Number of pages: 6
Pages: 1-6
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Measurement Science and Technology
Volume: 25
Issue number: 8
ISSN (Print): 0957-0233
Ratings:
Publication Forum (2017): 2
Scopus rating (2016): 0.668 1.173
Publication Forum (2016): 2
Scopus rating (2015): 0.687 1.303
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Scopus rating (2014): 0.657 1.319
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Scopus rating (2013): 0.555 1.244
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Scopus rating (2012): 0.716 1.529
Publication Forum (2012): 2
Scopus rating (2011): 0.844 1.703
Scopus rating (2010): 0.679 1.462
Scopus rating (2009): 0.919 1.573
Scopus rating (2008): 0.881 1.494
Scopus rating (2007): 0.823 1.492
Scopus rating (2006): 0.744 1.58
Scopus rating (2005): 0.82 1.584
Scopus rating (2004): 0.828 1.64
Scopus rating (2003): 0.666 1.199
Scopus rating (2002): 0.589 1.2
Scopus rating (2001): 0.616 1.548
Scopus rating (2000): 0.79 1.204
Scopus rating (1999): 1.484 0.905
Original language: English
Behaviour of ferritic-martensitic steel and aluminium base coatings under demanding elevated temperature conditions

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Huttunen-Saarivirta, E., Metsäjoki, J., Kuokkala, V.
Number of pages: 8
Pages: 57-64
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Tribology: Materials, Surfaces and Interfaces
Volume: 8
Issue number: 2
ISSN (Print): 1751-5831
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.297 0.464
Publication Forum (2016): 1
Scopus rating (2015): 0.305 0.476
Publication Forum (2015): 1
Scopus rating (2014): 0.362 0.38
Publication Forum (2014): 1
Scopus rating (2013): 0.247 0.312
Publication Forum (2013): 1
Scopus rating (2012): 0.333 0.376
Publication Forum (2012): 1
Scopus rating (2011): 0.276 0.363
Scopus rating (2010): 0.353 0.261
Scopus rating (2009): 0.155 0.114
Scopus rating (2008): 0.122 0.0
Original language: English
DOIs:
10.1179/1751584X13Y.0000000055

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27
Source: researchoutputwizard
Source-ID: 520
Research output: Scientific - peer-review › Article

Biofunctional hybrid materials: bimolecular organosilane monolayers on FeCr alloys

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Frontier Photonics, Multi-scaled biodata analysis and modelling (MultiBAM)
Authors: Vuori, L., Leppiniemi, J., Hannula, M., Lahtonen, K., Hirsimäki, M., Nömmiste, E., Costelle, L., Hytönen, V. P., Vaiden, M.
Case-Depth Verification of Hardened Samples with Barkhausen Noise Sweeps

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Santa-aho, S., Vippola, M., Lepistö, T., Sorsa, A., Leiviskä, K., Hakanen, M.
Number of pages: 8
Pages: 1307-1314
Publication date: 2014

Publication information
Journal: Nanotechnology
Volume: 25
Issue number: 43
Article number: 435603
ISSN (Print): 0957-4484
Ratings:
Publication Forum (2017): 2
Scopus rating (2016): 1.096 0.814
Publication Forum (2016): 2
Scopus rating (2015): 1.18 0.966
Web of Science (2015): 3.573 3.611 6.1 0.819 0.07276 0.961
Publication Forum (2015): 2
Scopus rating (2014): 1.465 1.258
Web of Science (2014): 3.821 3.885 5.5 0.678 0.09114 1.041
Publication Forum (2014): 3
Scopus rating (2013): 1.585 1.244
Publication Forum (2013): 3
Scopus rating (2012): 1.846 1.306
Publication Forum (2012): 3
Scopus rating (2011): 1.892 1.461
Scopus rating (2010): 1.844 1.259
Scopus rating (2009): 1.819 1.28
Scopus rating (2008): 1.875 1.333
Scopus rating (2007): 1.91 1.36
Scopus rating (2005): 1.925 1.445
Scopus rating (2004): 1.849 1.477
Scopus rating (2003): 1.427 1.371
Scopus rating (2002): 0.962 0.993
Scopus rating (2001): 0.901 0.94
Scopus rating (2000): 0.881 0.891
Scopus rating (1999): 1.131 0.953
Original language: English
DOIs:
10.1088/0957-4484/25/43/435603

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-10-17<br/>Publisher name: Institute of Physics
Source: researchoutputwizard
Source-ID: 1773
Research output: Scientific - peer-review › Article
Comparison of metallic and organic corrosion protective coatings for sintered Nd-Fe-B magnets

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Isotahdon, E., Huttunen-Saarivirta, E., Kuokkala, V., Paju, M.
Number of pages: 2
Pages: 612-613
Publication date: 2014

Host publication information
Title of host publication: IEEE International Magnetics Conference, Dresden, Germany, May 4-8, 2014
Links:
http://intermag2014.ifw-dresden.de/

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-06-27
Source: researchoutputwizard
Source-ID: 547
Research output: Scientific › Conference contribution

Computational multiscale modelling concept and supporting experimental testing procedures for material wear behaviour under severe environments

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Number of pages: 4
Pages: 1-4
Publication date: 2014

Host publication information
Title of host publication: The 16th Nordic Symposium on Tribology - NORDTRIP 2014, 10th - 13th June, Aarhus, Denmark
Publisher: Danish technological institute
ISBN (Print): 978-87-92765-26-0

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-17
Controlling the synergetic effects in (3-aminopropyl) trimethoxysilane and (3-mercaptopropyl) trimethoxysilane coadsorption on stainless steel surfaces

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Frontier Photonics
Number of pages: 11
Pages: 856-866
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Applied Surface Science
Volume: 317
ISSN (Print): 0169-4332
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.951 1.225
Publication Forum (2016): 1
Scopus rating (2015): 0.914 1.3
Web of Science (2015): 3.15 2.982 4.9 0.677 0.08258 0.574
Publication Forum (2015): 1
Scopus rating (2014): 0.958 1.477
Web of Science (2014): 2.711 2.735 5.3 0.507 0.07467 0.549
Publication Forum (2014): 2
Scopus rating (2013): 0.965 1.488
Publication Forum (2013): 2
Scopus rating (2012): 0.918 1.373
Publication Forum (2012): 2
Scopus rating (2011): 0.908 1.402
Scopus rating (2010): 0.924 1.141
Scopus rating (2009): 0.842 1.023
Scopus rating (2008): 0.899 1.087
Scopus rating (2007): 0.795 0.945
Scopus rating (2006): 0.852 1.052
Scopus rating (2005): 0.679 0.946
Scopus rating (2004): 0.964 1.126
Scopus rating (2003): 0.988 1.027
Scopus rating (2002): 0.921 0.954
Scopus rating (2001): 0.841 0.796
Scopus rating (2000): 0.866 0.772
Scopus rating (1999): 1.064 0.907
Original language: English
DOIs:
10.1016/j.apsusc.2014.08.199

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-12-31<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 1772
Research output: Scientific - peer-review › Article
Corrosion of cadmium plating by runway de-icing chemicals in cyclic tests: Effects of chemical concentration and plating quality

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Korpiniemi, H., Huttunen-Saarivirta, E., Kuokkala, V., Paajanen, H.
Number of pages: 13
Pages: 91-103
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Surface and Coatings Technology
Volume: 248
ISSN (Print): 0257-8972
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.874 1.359
Publication Forum (2016): 1
Scopus rating (2015): 0.871 1.415
Web of Science (2015): 2.139 2.417 8.5 0.402 0.0356 0.527
Publication Forum (2015): 1
Scopus rating (2014): 0.998 1.681
Web of Science (2014): 1.998 2.374 8.2 0.307 0.03477 0.517
Publication Forum (2014): 2
Scopus rating (2013): 1.057 1.859
Publication Forum (2013): 2
Scopus rating (2012): 1.049 1.658
Publication Forum (2012): 2
Scopus rating (2011): 1.053 1.851
Scopus rating (2010): 1.155 1.66
Scopus rating (2008): 1.479 1.564
Scopus rating (2007): 1.165 1.509
Scopus rating (2006): 1.276 1.709
Scopus rating (2005): 1.252 1.666
Scopus rating (2004): 1.269 1.498
Scopus rating (2003): 1.276 1.516
Scopus rating (2002): 1.208 1.183
Scopus rating (2001): 1.115 1.181
Scopus rating (2000): 0.981 1.03
Scopus rating (1999): 1.062 1.167
Original language: English
DOIs:
10.1016/j.surfcoat.2014.03.036

Bibliographical note
Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2014-05-27
Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 786
Research output: Scientific - peer-review › Article

Determination of the functionality of monolayers of aminopropyl trimethoxy silane and mercaptopropyl trimethoxy silane on stainless steel with SR-PES and chemical derivatization
Effect of abrasive properties on the high-stress three-body abrasion of steels and hard metals

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Ratia, V., Heino, V., Valtonen, K., Vippola, M., Kemppainen, A., Siitonen, P., Kuokkala, V.
Number of pages: 18
Publication date: 2014
Peer-reviewed: Yes
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.141 0.076
Publication Forum (2016): 1
Scopus rating (2015): 0.101 0.0
Publication Forum (2015): 1
Scopus rating (2014): 0.316 0.126
Publication Forum (2014): 1
Scopus rating (2013): 0.118 0.019
Publication Forum (2013): 1
Scopus rating (2012): 0.24 0.312
Publication Forum (2012): 1
Scopus rating (2011): 0.237 0.103
Scopus rating (2010): 0.125 0.055
Scopus rating (2009): 0.459 0.37
Scopus rating (2008): 0.13 0.228
Scopus rating (2007): 0.126 0.186
Scopus rating (2006): 0.159 0.438
Scopus rating (2005): 0.181 0.429
Scopus rating (2004): 0.104 0.479
Scopus rating (2003): 0.227 0.277
Scopus rating (2002): 0.101 0.0
Effect of test parameters on large particle high speed slurry erosion testing

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Ojala, N., Valtosen, K., Kivikytö-Reponen, P., Vuorinen, P., Siltonen, P., Kuokkala, V.
Number of pages: 7
Pages: 98-104
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Tribology: Materials, Surfaces and Interfaces
Volume: 8
Issue number: 2
ISSN (Print): 1751-5831
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.297 0.464
Publication Forum (2016): 1
Scopus rating (2015): 0.305 0.476
Publication Forum (2015): 1
Scopus rating (2014): 0.362 0.38
Publication Forum (2014): 1
Scopus rating (2013): 0.247 0.312
Publication Forum (2013): 1
Scopus rating (2012): 0.333 0.376
Publication Forum (2012): 1
Scopus rating (2011): 0.276 0.363
Scopus rating (2010): 0.353 0.261
Scopus rating (2009): 0.155 0.114
Scopus rating (2008): 0.122 0.0
Original language: English
Electronic versions:
Paper for Tribology journal_POST-PRINT_Niko Ojala
DOIs:
10.1179/1751584X14Y.0000000066
Links:
http://urn.fi/URN:NBN:fi:tty-201605133985

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-04-29<br/>Publisher name: W. S. Maney & Son
Source: researchoutputwizard
Source-ID: 1184
Research output: Scientific - peer-review › Article
Effects of cyclic pre-straining on mechanical properties of an austenitic microalloyed high-Mn twinning-induced plasticity steel

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Engineering materials science and solutions (EMASS)
Authors: Hamada, A., Järvenpää, A., Honkanen, M., Jaskari, M., Porter, D., Karjalainen, L.
Number of pages: 6
Pages: 47-52
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Procedia Engineering
Issue number: 74
ISSN (Print): 1877-7058
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.282 0.697
Publication Forum (2016): 1
Scopus rating (2015): 0.238 0.568
Scopus rating (2014): 0.275 0.679
Scopus rating (2013): 0.217 0.464
Scopus rating (2012): 0.191 0.396
Scopus rating (2011): 0.237 0.586
Scopus rating (2010): 0.219 0.434
Original language: English
DOIs:
10.1016/j.proeng.2014.06.222

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-03<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 402
Research output: Scientific - peer-review › Article

Fatigue behavior of laser clad round steel bars
Laser cladding is an overlay welding method to manufacture high performance, fusion bonded metal, and metal matrix composite coatings on metallic substrates with low dilution. Owing to steep thermal gradients, rapid solidification, and possible mismatch in coefficients of thermal expansion between the coating and the substrate, laser cladding induces large tensile residual stresses in coating layer, potentially affecting the service life of clad component under external load-induced stresses. In this study, four-point bending and torsion fatigue tests were conducted on relatively large round laser clad steel bars to determine the effect of laser cladding on fatigue strength. Quenched and tempered 42CrMo4 steel clad with Inconel 625 and S355 structural steel clad with Stellite 21 were subjected to various stress levels for relatively large number of cycles with and without postweld heat treatment (PWHT). The results indicated that Stellite 21 decreased the fatigue life of S355 at all the applied loads, whereas Inconel 625 increased the fatigue life of 42CrMo4 at high loads but decreased at low loads. Applied PWHT did not show any positive influence on fatigue life.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems, Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Tuominen, J., Näkki, J., Poutala, J., Miettinen, J., Peltola, T., Vuoristo, P., Rasehorn, I., Alam, M., Kaplan, A.
Number of pages: 10
Pages: 1-10
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Journal of Laser Applications
High-speed Sliding Friction of Laser-textured Silicon Nitride in Water against Rubber

The effects of a specific laser patterning on friction of silicon nitride bulk ceramic in water against rubber were investigated. A dimple-like patterning was applied to the surfaces of silicon nitride bulk ceramic blocks with pulsed laser drilling. Friction measurements were conducted with a special device designed for high-velocity sliding wear and friction testing of hard materials in wet conditions. Sliding velocities in the water-lubricated test ranged from 3.3 to 33 m/s and the load was 80 N. Anomalies in friction behaviour were observed in 8.3 and 16.7 m/s, which can only partially be explained with test equipment characteristics.

Influence of surface hydroxylation on the oxidation of FeCr in O2 and air

The effects of surface hydroxylation on the oxidation of FeCr in O2 and air were investigated. Hydroxylation was induced by annealing in oxygen at various temperatures. The oxidation of FeCr in O2 and air was studied using TGA and XRD. The results showed that hydroxylation significantly affected the oxidation behavior.

Links:

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2015-02-27
Source: researchoutputwizard
Source-ID: 533
Research output: Professional › Commissioned report

High-speed Sliding Friction of Laser-textured Silicon Nitride in Water against Rubber

The effects of a specific laser patterning on friction of silicon nitride bulk ceramic in water against rubber were investigated. A dimple-like patterning was applied to the surfaces of silicon nitride bulk ceramic blocks with pulsed laser drilling. Friction measurements were conducted with a special device designed for high-velocity sliding wear and friction testing of hard materials in wet conditions. Sliding velocities in the water-lubricated test ranged from 3.3 to 33 m/s and the load was 80 N. Anomalies in friction behaviour were observed in 8.3 and 16.7 m/s, which can only partially be explained with test equipment characteristics.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Ceramic materials, Department of Mechanical Engineering and Industrial Systems, Research group: Laser, Research area: Manufacturing and Automation
Authors: Ismailov, A., Kumpulainen, T., Viininen, J., Levänen, E.
Keywords: (Friction, Silicon Nitride, Sliding, Wear, Laser)
Number of pages: 7
Pages: 267-273
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the Twenty Eighth International Conference on Surface Modification Technologies
ISBN (Print): 978-81-926196-1-3
Electronic versions:
high_speed_sliding_friction
Links:
http://urn.fi/URN:NBN:fi:tty-201610194615

Bibliographical note
ORG=mei,0.5
ORG=mol,0.5
Research output: Scientific - peer-review › Conference contribution

Influence of surface hydroxylation on the oxidation of FeCr in O2 and air

The effects of surface hydroxylation on the oxidation of FeCr in O2 and air were investigated. Hydroxylation was induced by annealing in oxygen at various temperatures. The oxidation of FeCr in O2 and air was studied using TGA and XRD. The results showed that hydroxylation significantly affected the oxidation behavior.

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Hirsimäki, M., Hannula, M., Lahtonen, K., Urpelainen, S., Valden, M.
Number of pages: 2
Pages: 1-2
Publication date: 2014

Host publication information
Title of host publication: Max-Lab Activity Report 2013. Reports 2013 Synchrotron Radiation. Beamline I511-1
Place of publication: Lund, Sweden
Publisher: MAX-LAB
Links:
https://www.maxlab.lu.se/node/1913

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-12-15
Source: researchoutputwizard
Source-ID: 480
Research output: Scientific › Chapter
Influence of the spray gun type on microstructure and properties of HVAF sprayed Fe-based corrosion resistant coatings

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Milanti, A., Koivuluoto, H., Vuoristo, P.
Number of pages: 6
Pages: 334-339
Publication date: 2014

Host publication information
Title of host publication: International Thermal Spray Conference, ITSC2014, 21-23 May, 2014, Barcelona, Spain
ISBN (Print): 978-3-87155-574-9

Publication series
Name: DVS-Berichte
Volume: 302
ISSN (Print): 1341-3074

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-08-30
Source: researchoutputwizard
Source-ID: 1084
Research output: Scientific › Conference contribution

Kestävämpi teräksi kulumistutkimuksella

General information
State: Published
Ministry of Education publication type: E1 Popularised article, newspaper article
Organisations: Department of Materials Science
Authors: Ratia, V.
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: TES - Tekniikan edistämissäätiö
Original language: Finnish
Links:
http://www.tekniikanedistamissaatio.fi/rahotettua-tutkimusta

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-31
Source: researchoutputwizard
Source-ID: 1360
Research output: General public › Article

Mapping of stress raising in laser clad components depending on geometry and defects

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Mechanical Engineering and Industrial Systems, Department of Materials Science
Keywords: (Laser cladding, Fatigue, Finite element method (FEM))
Pages: 1-14
Publication date: 2014

Host publication information
Metallographic Studies of Electron Beam Welded Copper Lid: Macroscopic Studies and Hardness Measurements of the Cross-Section of XKO49 at 323deg

**General information**
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Karhula, T.
Number of pages: 54
Publication date: 2014

**Publication information**
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

**Publication series**
Name: Posiva Working Report
Publisher: Posiva
No.: 24
Electronic versions:
Posiva_WR2014_24_Karhula_XKO49_323_macro_hardness
Links:

**Bibliographical note**
myös MOL 214.<br/>Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-19
Source: researchoutputwizard
Source-ID: 660
Research output: Professional › Commissioned report

Metallographic Studies of Electron Beam Welded Copper Lids: EBSD Studies of the Cross-Section of XKO49 at 323deg

**General information**
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Karhula, T.
Number of pages: 40
Publication date: 2014

**Publication information**
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

**Publication series**
Name: Posiva Working Report
Publisher: Posiva
No.: 23
Electronic versions:
Posiva_WR2014_23_Karhula_XKO49_323_EBSD
Metallographic Studies of Electron Beam Welded Copper Plates: EBSD Studies of the Cross-Sections and Determination of EBSD Reference Curves by EB-Welded Tensile Test Samples

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Karhula, T.
Number of pages: 241
Publication date: 2014

Publication information
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

Publication series
Name: Posiva Working Report
Publisher: Posiva
No.: 2013-14
Electronic versions:
Posiva_WR2013_14_Karhula_EBSD
Links:

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27
Source: researchoutputwizard
Source-ID: 662
Research output: Professional › Commissioned report

Microstructural Characteristics and Tribological Behavior of HVOF-Sprayed Novel Fe-Based Alloy Coating

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science
Authors: Milanti, A., Koivuluoto, H., Vuoristo, P., Bolelli, G., Bozza, F., Lusvarghi, L.
Number of pages: 23
Pages: 98-120
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Coatings
Volume: 4
Issue number: 1
ISSN (Print): 2079-6412
Ratings:
Publication Forum (2017): 0
Publication Forum (2016): 0
Publication Forum (2015): 0
Publication Forum (2014): 1
Publication Forum (2013): 1
Research Institutes Representative’s Review

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Vuorinen, J., Porter, D.
Number of pages: 1
Publication date: 2014

Publication information
Place of publication: Tampere
Publisher: Fimecc
ISBN (Print): 978-952-238-136-1
ISBN (Electronic): 978-952-238-137-8
Original language: English

Publication series
Name: Fimecc Publications Series
Publisher: Fimecc
No.: 4
ISSN (Print): 2342-2688
ISSN (Electronic): 2342-2696
Links:
http://hightech.fimecc.com/system/attachments/files/000/000/027/original/FIMECC_LIGHT.pdf?1414761940

Bibliographical note
Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2014-06-26
Publisher name: MDPI
Source-ID: 1085
Research output: Scientific - peer-review › Article

Review of railway track applications of Barkhausen noise and other magnetic testing methods

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Civil Engineering, Department of Materials Science, Engineering materials science and solutions (EMASS), Life Cycle Effectiveness of the Built Environment (LCE@BE)
Authors: Santa-aho, S., Sorsa, A., Nurmikolu, A., Vippola, M.
Number of pages: 7
Pages: 657-663
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Insight
Volume: 56
Issue number: 12
ISSN (Print): 1354-2575
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 0.362 0.584
Publication Forum (2016): 1
Rolling-sliding wear of nodular cast iron followers against wire ropes

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Oksanen, V., Valtonen, K., Andesson, P., Vaajoki, A., Laukkanen, A., Holmberg, K., Kuokkala, V.
Number of pages: 6
Pages: 1-6
Publication date: 2014

Host publication information
Title of host publication: The 16th Nordic Symposium on Tribology - NORDTRIP 2014, 10th - 13th June, Aarhus, Denmark
Publisher: Danish technological institute
ISBN (Print): 978-87-92765-26-0

Bibliographical note
Contribution: organisation=mol,FACT1=0.67<br/>Contribution: organisation=rak,FACT2=0.33<br/>Portfolio EDEND: 2014-12-02
Publisher name: British Institute of Non-Destructive Testing
Source: researchoutputwizard
Source-ID: 1189
Research output: Scientific › Conference contribution

Slurry pot investigation of the influence of erodent characteristics on the erosion resistance of austenitic and duplex stainless steel grades
Strain-induced martensitic transformation in EN 1.4318 during successive high and low strain rate loadings

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Isakov, M., Östman, K., Kuokkala, V.
Number of pages: 4
Pages: 1-3
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the 4th International Conference on Impact Loading of Lightweight Structures (ICILLS 2014), Cape Town, South Africa, January 12-16, 2014
Links: http://icills2014.org/?page_id=519

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-31<br/>Publisher name: Fimecc
Source: researchoutputwizard
Source-ID: 831
Research output: Professional › Commissioned report

Surface Modifications and Analysis Methods at Molecular Level

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Department of Physics, Research group: Ultrafast and intense lasers, Research group: Nanophotonics
Publication date: 2014

Host publication information
Title of host publication: Abstracts of the 28th International Conference on Surface Modification Technologies, STM28, Tampere University of Technology, Tampere, Finland, June 16-18, 2014
Place of publication: Tampere
Publisher: Tampere University of Technology
Links:
Surface segregation of microalloying elements on Ti–Nb stabilized FeCr alloy

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Ali-Löytty, H., Hannula, M., Valden, M.
Number of pages: 2
Pages: 1-2
Publication date: 2014

Host publication information
Title of host publication: Max-Lab Activity Report 2013. Reports 2013 Synchrotron Radiation. Beamline I311-XPS
Place of publication: Lund, Sweden
Publisher: MAX-LAB
Links:
https://www.maxlab.lu.se/node/1913

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-12-15
Source: researchoutputwizard
Source-ID: 94
Research output: Scientific › Chapter

Tampere Wear Center panostaa kulumisustutkimukseen

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science
Authors: Valtosenen, K.
Number of pages: 2
Pages: 22-23
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: Ohutlevy-lehti
Issue number: 2
ISSN (Print): 1239-4122
Original language: Finnish
Links:
http://www.ohutlevy.com

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-31<br/>Publisher name: Teknologiateollisuus
Source: researchoutputwizard
Source-ID: 1696
Research output: Professional › Article

The effect of test parameters in the impact resistance of a stainless steel/rubber/composite hybrid structure

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Computational Science X (CompX), Engineering materials science and solutions (EMASS)
Authors: Sarlin, E., Lindroos, M., Apostol, M., Kuokkala, V., Vuorinen, J., Lepistö, T., Vippola, M.
Thermally grown oxide films and corrosion performance of ferritic stainless steels under simulated exhaust gas condensate conditions

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Huttunen-Saarivirta, E., Kuokkala, V., Pohjanne, P.
Number of pages: 22
Thermal spray coating processes

General information
State: Published
Ministry of Education publication type: A3 Part of a book or another research book
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Vuoristo, P.
Number of pages: 47
Pages: 229-276
Publication date: 2014

Host publication information
Title of host publication: Comprehensive materials processing, 1st edition Volume 4: Coatings and films
Publisher: Elsevier
The role of surface modification by photosphating in corrosion protection of sintered Nd-Fe-B magnets

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Isotahdon, E., Huttunen-Saarivirta, E., Kuokkala, V.
Number of pages: 10
Publication date: 2014

Host publication information
Title of host publication: EUROCORR 2014 European Corrosion Congress, 8-12 September 2014 Pisa Italy
Place of publication: Frankfurt am Main
Publisher: DECHEMA and AIM - Associazione Italiana
ISBN (Print): 978-3-89746-159-8

Utilization of Frequency-Domain Information of Barkhausen Noise Signal in Quantitative Prediction of Material Properties

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Santa-aho, S., Vippola, M., Lepistö, T., Sorsa, A., Leiviskä, K.
Number of pages: 8
Pages: 1256-1263
Publication date: 2014

Host publication information
Publisher: American Institute of Physics
ISBN (Print): 978-073541211-8

Publication series
Name: AIP Conference Proceedings
Publisher: American Institute of Physics
Volume: 1581
ISSN (Print): 0094-243X
ISSN (Electronic): 1551-7616
DOIs: 10.1063/1.4864965

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27
Source: researchoutputwizard
Source-ID: 1779
Research output: Scientific - peer-review › Chapter
The effect of test parameters on large particle slurry erosion testing

Understanding the effect of testing parameters is important for getting the test environment as close as possible to real applications and for understanding the processes that are involved in the testing itself. A pin mill type slurry-pot wear tester was developed for heavy-duty testing with high speed and large abrasive size [1]. This study focuses on the effect of different testing parameters on large particle slurry testing. Parameters such as rotation speed of the samples, particle size and slurry concentration were varied.

Round steel samples and slurry with water and granite gravel were used for testing. The test parameter variations were 4 to 10 mm for granite particle size, up to 23 wt% for slurry concentration and up to 20 m/s for sample tip speed. The relationship between the particle size, slurry concentration, and the amount of particles are discussed. Also the role of the kinetic energy of the abrasive particles is considered for large particle sizes.

Formation of surface layers during laser cladding using a powerful fiber laser

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Microstructural Response of High Aluminum Steels to Quenching and Partitioning Treatment

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Nyssönen, T., Somani, M., Peura, P., Kuokkaa, V.
Number of pages: 10
Pages: 1-10
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the ASME 2013 International Mechanical Engineering Congress and Exposition
Volume 2A: Advanced Manufacturing San Diego, California, USA, November 15-21, 2013
Publisher: ASME
Article number: IMECE2013-63735
DOIs:
10.1115/IMECE2013-63735

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-05
Source: researchoutputwizard
Source-ID: 3034
Research output: Scientific - peer-review › Conference contribution
Optimization of interfacial oxidation properties of FeCr SOFC interconnect alloy

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Ali-Löytty, H., Jussila, P., Hirsimäki, M., Valden, M.
Number of pages: 2
Pages: 1-2
Publication date: 2013

Host publication information
Title of host publication: Max-Lab Activity Report 2012. Reports 2012 Synchroton Radiation. Beamline I311-XPS
Place of publication: Lund, Sweden
Publisher: MAX-LAB
Links:
https://www.maxlab.lu.se/cmis/display?id=workspace%3A%2F%2FSpacesStore%2F0f1d8b0b-533a-48e6-a4cf-a85090776f76
https://www.maxlab.lu.se/node/1693

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2013-11-29
Source: researchoutputwizard
Source-ID: 1912
Research output: Scientific › Chapter

Optimization of the electrical properties of Ti-Nb stabilized ferritic stainless steel SOFC interconnect alloy upon high-temperature oxidation: The role of excess Nb on the interfacial oxidation at the oxidemetal interface

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Frontier Photonics
Authors: Ali-Löytty, H., Jussila, P., Valden, M.
Number of pages: 13
Pages: 1039-1051
Publication date: 2013
Peer-reviewed: Yes

Publication information
Volume: 38
Issue number: 2
ISSN (Print): 0360-3199
Ratings:
Publication Forum (2017): 1
Scopus rating (2016): 1.142 1.286
Publication Forum (2016): 1
Scopus rating (2015): 1.294 1.319
Web of Science (2015): 3.205 3.419 4.6 0.651 0.08996 0.619
Publication Forum (2015): 1
Scopus rating (2014): 1.212 1.494
Web of Science (2014): 3.313 3.659 4.3 0.539 0.08226 0.619
Publication Forum (2014): 3
Scopus rating (2013): 1.278 1.467
Publication Forum (2013): 3
Scopus rating (2012): 1.515 1.729
Publication Forum (2012): 3
Scopus rating (2011): 1.456 1.837
Scopus rating (2010): 1.589 1.871
Scopus rating (2009): 1.333 1.885
Optimization of the oxide layer composition on FeCr alloy for solid oxide fuel cell applications

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Optoelectronics Research Centre
Authors: Ali-Löytty, H., Valden, M.
Number of pages: 1
Publication date: 2013

Host publication information
Title of host publication: Physics Days 2013 - Fysiikan päivät 2013, the 47th annual meeting of the Finnish Physical Society, March 14 - 16, 2013, Espoo, Finland
Publisher: Suomen fyysikkoseura

Publication series
Name: Physics Days / Fysiikan päivät : Annual Meeting of the Finnish Physical Society
Links:

Bibliographical note
Contribution: organisation=orc,FACT1=1
Portfolio EDEND: 2013-10-29
Publisher name: Suomen fyysikkoseura
Source-ID: 1914
Research output: Scientific › Conference contribution

Photoelastic Stress Evaluation and Mechanical Testing of Stainless Steel-Epoxy Hybrid

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Orell, O., Kakkonen, M., Vuorinen, J.
Number of pages: 7
Pages: 1-7
Publication date: 2013

Host publication information
Title of host publication: Composites Week, Leuven and TexComp-11 conference, 16-20 Semptember 2013
Links:
http://www.mtm.kuleuven.be/English/research/compositesweek/program/papers
This thesis examines the chemical composition of a mixed silane thin film synthesized on electrochemically passivated AISI 316L stainless steel. Silane thin films can be used to enhance the biocompatibility of stainless steel and to create surface functionalities that promote adsorption of biomolecules. Such hybrid materials made of steel and organic coatings can be utilized in e.g. medical implants and tissue engineering.

The goal of this work was to develop deposition equipment needed for the synthesis of silane thin films in order to improve the rate and reproducibility of the sample preparation. The equipment was used to investigate the effect of silanization parameters such as the composition of the silane solution, the hydrolysis time and the silanization time on the structure of the self-assembled thin film. The silane molecules used in this study were amine terminated (3-aminopropyl)trimethoxysilane (APS) and thiol terminated (3-mercaptopropyl)trimethoxysilane (MPS).

The silanization process was conducted as a liquid phase deposition in atmospheric pressure, which enables the method to be easily adapted to commercial applications. On the other hand, the measurements were performed in ultra-high vacuum utilizing both synchrotron radiation induced and conventional X-ray photoelectron spectroscopy (XPS). The acquired spectra enabled conclusions to be made on the chemical composition and thickness of the silane films. They also provided information on the ratio and orientation of the functional groups.

According to the results, the employed silanization process enables the reproducible manufacturing of approximately one monolayer thick silane films. In addition, the amount of surface functionalities can be adjusted by modifying either the silane concentration in the hydrolysis solution or the silanization time. However, changing the hydrolysis time only affects the chemical bonding between the silane molecules and steel surface, not the total amount of functional groups. Based on the measurements with varying surface sensitivities, it was possible to conclude that the majority of functional groups point outwards. This is an important result considering the adsorption of biomolecules on the surface.

This study found that the hydrolysis rate of different silane species shows considerable variation despite the similar basic structure of the molecules. In the future, the hydrolysis behaviour should be investigated more carefully in the liquid phase. This might help to understand the hydrolysis reactions and also enhance the repeatability of the sample preparation.