The role of (FeCrSi)2(MoNb)-type Laves phase on the formation of Mn-rich protective oxide scale on ferritic stainless steel

Microalloying of stainless steel with reactive elements increases oxidation resistance but makes the alloy prone to microstructural changes. XPS results reveal changes in the initial oxidation mechanism on Ti–Nb stabilized ferritic stainless steel (EN 1.4521) after 120 h heat treatment at 650 °C. Age-precipitation of (FeCrSi)2(MoNb)-type Laves phase resulted in less pronounced surface segregation and oxidation of microalloying elements. Si oxidizes preferentially at the Laves precipitate locations via outward diffusion forming diffusion barrier for the other scale forming elements. Most significantly the diffusion of Mn and the formation of low volatile (Mn,Cr)3O4 spinel oxide at the surface was strongly suppressed.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Photonics, Research group: Surface Science, University of Oulu, MAX IV Laboratory, Lund University
Pages: 214-222
Publication date: Mar 2018
Peer-reviewed: Yes

Development of Advanced Fe–Cr Alloys for Demanding Applications Utilizing Synchrotron Light Mediated Electron Spectroscopy

High-temperature corrosion resistance of ferritic stainless steels (Fe–Cr based alloys) is built upon the formation of protective Cr-rich oxide scale. However, Cr vaporization limits the use of Fe–Cr alloys under extreme service conditions; in particular, it has been identified as the most significant failure mechanism in solid-oxide fuel cells (SOFCs). Our study focusses on the initial stages of oxide scale formation on ferritic stainless steels and shows that the Cr vaporization can be controlled via the alloy composition and heat treatments.

In this work, we investigate the influence of heat treatment on the initial stages of oxidation of two Ti–Nb stabilized ferritic stainless steels (EN 1.45091,2 and EN 1.45213,4) at 650 °C by synchrotron light mediated X-ray photoelectron spectroscopy (XPS) and photoemission electron microscopy (PEEM). The high degree of alloying makes these alloys suitable for high temperature applications, but also renders the alloys prone to microstructural changes that can affect the growth of protective oxide scale. As a demonstration of this, we show that the heat treatment induced precipitation of (FeCrSi)2(MoNb)-type Laves phase results in less pronounced surface segregation and oxidation of minor alloying
elements (Mo, Mn, Nb, Ti, Si). Most significantly, the diffusion of Mn and the formation of low volatile (MnCr)3O4 spinel oxide at the surface above Cr2O3 are strongly suppressed.

**General information**
State: Published
Organisations: Photonics
Authors: Ali-Löytty, H., Valden, M.
Publication date: 4 Dec 2017
Peer-reviewed: Unknown

Event: Paper presented at Joint Annual Meeting of Finnish Synchrotron Radiation User Organisation (FSRUO) and Finnish Structural Biology Network (FinnBox), Turku, Finland.

Electronic versions:
Ali-Löytty- FSRUO poster

Research output: Scientific › Paper, poster or abstract

**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 steels occurred in all cases, but the amount of plastic deformation and the depth of the wear scars varied.

**General information**
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization
Authors: Valtonen, K., Ratia, V., Ojala, N., Kuokka, V.
Pages: 93-100
Publication date: 15 Oct 2017
Peer-reviewed: Yes

**Publication information**
Journal: Wear
Volume: 388-389
ISSN (Print): 0043-1648
Ratings:
Scopus rating (2016): CiteScore 3 SJR 1.558 SNIP 2.071
Scopus rating (2015): SJR 1.527 SNIP 2.017 CiteScore 2.73
Scopus rating (2014): SJR 1.715 SNIP 2.38 CiteScore 2.46
Scopus rating (2013): SJR 1.319 SNIP 2.416 CiteScore 2.37
Scopus rating (2012): SJR 1.36 SNIP 2.178 CiteScore 1.85
Scopus rating (2011): SJR 1.547 SNIP 2.865 CiteScore 2.43
Scopus rating (2010): SJR 1.509 SNIP 2.153
Scopus rating (2009): SJR 1.684 SNIP 2.07
Scopus rating (2008): SJR 1.597 SNIP 1.863
Scopus rating (2007): SJR 1.286 SNIP 1.889
Scopus rating (2006): SJR 1.435 SNIP 2.036
Scopus rating (2005): SJR 1.473 SNIP 2.007
Scopus rating (2004): SJR 1.335 SNIP 1.965
Scopus rating (2003): SJR 1.104 SNIP 1.788
Scopus rating (2002): SJR 0.958 SNIP 1.365
Scopus rating (2001): SJR 0.937 SNIP 1.47
Scopus rating (2000): SJR 1.069 SNIP 1.149
Scopus rating (1999): SJR 0.848 SNIP 1.338
Original language: English
Keywords: Wear testing, Abrasion, Impact wear, Steel, Mining
ASJC Scopus subject areas: Materials Science(all), Metals and Alloys
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.
Number of pages: 10
Publication date: 15 Jun 2017
Peer-reviewed: Yes

Publication information
Journal: Wear
ISSN (Print): 0043-1648
Ratings:
Scopus rating (2016): CiteScore 3 SJR 1.558 SNIP 2.071
Scopus rating (2015): SJR 1.527 SNIP 2.017 CiteScore 2.73
Scopus rating (2014): SJR 1.715 SNIP 2.38 CiteScore 2.46
Scopus rating (2013): SJR 1.319 SNIP 2.416 CiteScore 2.37
Scopus rating (2012): SJR 1.36 SNIP 2.178 CiteScore 1.85
Scopus rating (2011): SJR 1.547 SNIP 2.865 CiteScore 2.43
Scopus rating (2010): SJR 1.509 SNIP 2.153
Scopus rating (2009): SJR 1.684 SNIP 2.07
Scopus rating (2008): SJR 1.597 SNIP 1.863
Scopus rating (2007): SJR 1.286 SNIP 1.889
Scopus rating (2006): SJR 1.435 SNIP 2.036
Scopus rating (2005): SJR 1.473 SNIP 2.007
Scopus rating (2004): SJR 1.335 SNIP 1.965
Scopus rating (2003): SJR 1.104 SNIP 1.788
Scopus rating (2002): SJR 0.958 SNIP 1.365
Scopus rating (2001): SJR 0.937 SNIP 1.47
Scopus rating (2000): SJR 1.069 SNIP 1.149
Scopus rating (1999): SJR 0.848 SNIP 1.338
Original language: English
ASJC Scopus subject areas: Metals and Alloys, Materials Science(all), Polymers and Plastics
Keywords: Wear testing, Steel, Elastomers, Edge effect, Particle embedment, Mining, Mineral processing
Electronic versions:
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DOI:
10.1016/j.wear.2017.06.004
Links:
Links:
https://authors.elsevier.com/a/1/vIb59q8Nca16 (Available for free until Oct. 30th 2017 with this link)
Research output: Scientific - peer-review › Article

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.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, Valmet Technologies Oy
Authors: Fantozzi, D., Matikainen, V., Uusitalo, M., Koivuluoto, H., Vuoristo, P.
Number of pages: 11
Pages: 233-243
Publication date: 25 May 2017
Peer-reviewed: Yes

Publication information
Journal: Surface and Coatings Technology
Volume: 318
Article number: Volume 318
ISSN (Print): 0257-8972
Ratings:
Scopus rating (2016): CiteScore 2.56 SJR 0.874 SNIP 1.359
Scopus rating (2015): SJR 0.871 SNIP 1.415 CiteScore 2.46
Scopus rating (2014): SJR 0.998 SNIP 1.681 CiteScore 2.44
Scopus rating (2013): SJR 1.057 SNIP 1.859 CiteScore 2.58
Scopus rating (2012): SJR 1.049 SNIP 1.658 CiteScore 2.2
Scopus rating (2011): SJR 1.053 SNIP 1.851 CiteScore 2.38
Scopus rating (2010): SJR 1.155 SNIP 1.66
Scopus rating (2009): SJR 1.449 SNIP 1.526
Scopus rating (2008): SJR 1.479 SNIP 1.564
Scopus rating (2007): SJR 1.165 SNIP 1.509
Scopus rating (2006): SJR 1.276 SNIP 1.709
Scopus rating (2005): SJR 1.252 SNIP 1.666
Scopus rating (2004): SJR 1.269 SNIP 1.498
Scopus rating (2003): SJR 1.276 SNIP 1.516
Scopus rating (2002): SJR 1.208 SNIP 1.183
Scopus rating (2001): SJR 1.115 SNIP 1.181
Scopus rating (2000): SJR 0.981 SNIP 1.03
Scopus rating (1999): SJR 1.062 SNIP 1.167
Original language: English
Keywords: chlorine , high temperature corrosion, Thermal spray, HVOF, HVAF, cold spray, arc spray
DOIs: 10.1016/j.surfcoat.2016.12.086
Research output: Scientific - peer-review › Article

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-assemblies 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.

**General information**

State: Published

Ministry of Education publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Surface Science, Department of Physics and Astronomy, Russian Acad Sci, Ioffe Physical Technical Institute, Russian Academy of Sciences, Ioffe Phys Tech Inst

Authors: Kuzmin, M., Lahtonen, K., Vuori, L., Sánchez-de-Armas, R., Hirsimäki, M., Valden, M.

Number of pages: 6

Pages: 111-116

Publication date: 4 Mar 2017

Peer-reviewed: Yes

**Publication information**

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Volume: 409

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Ratings:

- Scopus rating (2016): CiteScore 3.37 SJR 0.951 SNIP 1.225
- Scopus rating (2015): SJR 0.914 SNIP 1.3 CiteScore 3.13
- Scopus rating (2014): SJR 0.958 SNIP 1.477 CiteScore 2.96
- Scopus rating (2013): SJR 0.965 SNIP 1.488 CiteScore 2.78
- Scopus rating (2012): SJR 0.918 SNIP 1.373 CiteScore 2.26
- Scopus rating (2011): SJR 0.908 SNIP 1.402 CiteScore 2.27
- Scopus rating (2010): SJR 0.924 SNIP 1.141
- Scopus rating (2009): SJR 0.842 SNIP 1.023
- Scopus rating (2008): SJR 0.899 SNIP 1.087
- Scopus rating (2007): SJR 0.795 SNIP 0.945
- Scopus rating (2006): SJR 0.852 SNIP 1.052
- Scopus rating (2005): SJR 0.679 SNIP 0.946
- Scopus rating (2004): SJR 0.964 SNIP 1.126
- Scopus rating (2003): SJR 0.988 SNIP 1.027
- Scopus rating (2002): SJR 0.921 SNIP 0.954
- Scopus rating (2001): SJR 0.841 SNIP 0.796
- Scopus rating (2000): SJR 0.866 SNIP 0.772
- Scopus rating (1999): SJR 1.064 SNIP 0.907

Original language: English

Keywords: Cu(100), STM, Glycine, Glycinate, DFT, Self-assembly, Nanoscience

ASJC Scopus subject areas: Surfaces and Interfaces, Condensed Matter Physics, Metals and Alloys

Electronic versions:

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Links:

http://urn.fi/URN:NBN:fi:tty-201704181304

Research output: Scientific - peer-review > Article

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**Materiaaleja haastaviin kulumisolosuhteisiin**

**General information**

State: Published

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

Organisations: Materials Science, Research group: Materials Characterization

Authors: Valtonen, K.

Number of pages: 1

Pages: 50

Publication date: Mar 2017

Peer-reviewed: Unknown

**Publication information**
High-stress abrasion of wear resistant steels in the cutting edges of loader buckets

To simulate the wear behavior of the cutting edge of the mining load-haul-dumper bucket, high-stress abrasion laboratory wear tests were conducted and compared to the in-service tests. The effects of test parameters and different abrasives on the wear rates and wear mechanisms of wear resistant steels were studied using the high-speed slurry-pot with a dry abrasive bed (dry-pot) and in the actual in-service use as a cutting edge. The laboratory wear tests produced results that are well comparable with the in-service case observations. Especially at the higher sample rotation speed with granite as an abrasive, the wear rates were quite similar as determined from the cutting edge of a loader bucket that had been used in a mine.

General information
State: E-pub ahead of print
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, Lapland University of Applied Sciences
Authors: Valtonen, K., Keltamäki, K., Kuokkala, V.
Pages: 707-720
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Tribology International
Volume: 119
ISSN (Print): 0301-679X
Ratings:
Scopus rating (2016): CiteScore 3.16 SJR 1.382 SNIP 2.094
Scopus rating (2015): SJR 1.437 SNIP 2.04 CiteScore 2.61
Scopus rating (2014): SJR 1.545 SNIP 2.5 CiteScore 2.44
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.

General information
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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, MAX IV Laboratory, Lund University
Authors: Vuori, L., Ali-Löytty, H., Lahtonen, K., Hannula, M., Lehtonen, E., Niu, Y., Valden, M.
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Corrosion
Volume: 73
Application oriented wear testing of wear resistant steels in mining industry

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.
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 Pulku Piechoty 1, 45-500 Chorzów, Poland, Institute of Physics, University of Silesia, 75 Pulku Piechoty 1, 45-500 Chorzów, Poland
Authors: Majtyka, A., Trębala, M., Tukiainen, A., Chrobak, D., Borgieł, W., Räisänen, J., Nowak, R.
Number of pages: 3
Pages: 1131-1133
Publication date: 1 Oct 2016
Peer-reviewed: Yes

Publication information
Journal: Acta Physica Polonica A
Volume: 130
Issue number: 4
ISSN (Print): 0587-4246
Ratings:
Scopus rating (2016): SJR 0.235 SNIP 0.411 CiteScore 0.51
Scopus rating (2015): SJR 0.267 SNIP 0.493 CiteScore 0.56
Scopus rating (2014): SJR 0.276 SNIP 0.614 CiteScore 0.6
Scopus rating (2013): SJR 0.345 SNIP 0.556 CiteScore 0.63
Scopus rating (2012): SJR 0.287 SNIP 0.575 CiteScore 0.54
Scopus rating (2011): SJR 0.254 SNIP 0.471 CiteScore 0.43
Scopus rating (2010): SJR 0.289 SNIP 0.409
Scopus rating (2009): SJR 0.262 SNIP 0.419
Scopus rating (2008): SJR 0.225 SNIP 0.316
Scopus rating (2007): SJR 0.29 SNIP 0.449
Scopus rating (2006): SJR 0.283 SNIP 0.333
Scopus rating (2005): SJR 0.273 SNIP 0.391
Scopus rating (2004): SJR 0.345 SNIP 0.406
Scopus rating (2003): SJR 0.25 SNIP 0.325
Scopus rating (2002): SJR 0.28 SNIP 0.356
Scopus rating (2001): SJR 0.324 SNIP 0.416
Scopus rating (2000): SJR 0.313 SNIP 0.362
Scopus rating (1999): SJR 0.341 SNIP 0.282
Original language: English
DOIs: 10.12693/APhysPolA.130.1131

Bibliographical note
JUFOID=50342
Research output: Scientific - peer-review › Article

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.

**General information**
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, BioMediTech, University of Jyväskylä, Department of Physics, NanoScience Center
Publication date: 6 Jul 2016
Peer-reviewed: Yes

**Publication information**
Journal: Scientific Reports
Volume: 6
Article number: 29324
ISSN (Print): 2045-2322
Ratings:
Scopus rating (2016): CiteScore 4.63 SJR 1.625 SNIP 1.401
Scopus rating (2015): SJR 2.057 SNIP 1.684 CiteScore 5.3
Scopus rating (2014): SJR 2.103 SNIP 1.544 CiteScore 4.75
Scopus rating (2013): SJR 1.886 SNIP 1.51 CiteScore 4.06
Scopus rating (2012): SJR 1.458 SNIP 0.896 CiteScore 2.44
Original language: English
Electronic versions:
hynninen et al - Improved antifouling properties and selective biofunctionalization
DOIs:
10.1038/srep29324
Links:
http://urn.fi/URN:NBN:fi:tty-201607294340
Research output: Scientific - peer-review › Article

**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., Hutunen-Saarivirta, E., Kuokkala, V.
Number of pages: 10
Pages: 732-741
Publication date: 1 Jun 2016
Peer-reviewed: Yes

**Publication information**
Journal: Corrosion
Volume: 72
Issue number: 6
ISSN (Print): 0010-9312
Ratings:
Scopus rating (2016): SJR 1.093 SNIP 1.465 CiteScore 2.02
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
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.
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
Keywords: Abrasion, Wear testing, Impact wear, Steel, Mining, mineral processing
Electronic versions:
Valtonen_Nordtrb 2016
Links:
http://urn.fi/URN:NBN:fi.tty-201708141674
Research output: Professional › Conference contribution
**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.

**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.
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.

General information
State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Materials Science, Research group: Materials Characterization, University of Oulu, Faculty of Technology, SSAB
Authors: Haiko, O., Miettunen, I., Porter, D., Ojala, N., Ratia, V., Heino, V., Kemppainen, A.
Number of pages: 15
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ASJC Scopus subject areas: Metals and Alloys
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Research output: Professional › Conference contribution
Tuntemalla olosuhteet voit optimoida materiaalit kulutussovelluksiin

**General information**
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Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Ratia, V., Ojala, N., Valtonen, K., Heino, V.
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Peer-reviewed: Unknown

**Publication information**
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Volume: 3
ISSN (Print): 1797-2000
Original language: Finnish
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ASJC Scopus subject areas: Materials Science(all), Engineering(all)
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Research output: Professional › Article

Kitka ja kuluminen haastavat koneensuunnittelijat

**General information**
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Organisations: Department of Materials Science, Research group: Materials Characterization, Research group: Tribology and Machine Elements
Authors: Valtonen, K., Lehtovaara, A.
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**Publication information**
Journal: Materia
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http://www.vuorimiesyhdistys.fi/julkaisut/materia (Materia)
Research output: Professional › Article

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., Hutunen-Saarivirta, E., Kuokkala, V., Paju, M.
Publication date: 2016
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 Thermafit 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 Thermafit 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.
Publication date: 2016
Peer-reviewed: Yes
Early online date: 8 Dec 2015

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Scopus rating (2015): SJR 0.489 SNIP 1.143 CiteScore 1.71
Scopus rating (2014): SJR 0.7 SNIP 1.298 CiteScore 1.69
Scopus rating (2013): SJR 0.672 SNIP 0.964 CiteScore 1.32
Scopus rating (2012): SJR 0.245 SNIP 0.685 CiteScore 0.49
Scopus rating (2011): SJR 0.321 SNIP 0.801 CiteScore 0.74
Scopus rating (2010): SJR 0.422 SNIP 0.852
Scopus rating (2009): SJR 0.576 SNIP 1.069
Scopus rating (2008): SJR 0.378 SNIP 0.73
Scopus rating (2007): SJR 0.498 SNIP 1.099
Scopus rating (2006): SJR 0.537 SNIP 1.053
Scopus rating (2005): SJR 0.406 SNIP 0.917
Scopus rating (2004): SJR 0.524 SNIP 1.018
Scopus rating (2003): SJR 0.52 SNIP 0.95
Scopus rating (2002): SJR 0.526 SNIP 1.525
Scopus rating (2001): SJR 0.68 SNIP 1.762
Scopus rating (2000): SJR 0.874 SNIP 1.327
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Original language: English
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Biomedical Engineering, Instrumentation
Keywords: coaxial wire feed, hot-wire laser cladding, Inconel 625, super duplex stainless steel
DOIs:
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Influence of age-precipitation of Nb-Ti stabilized FeCr alloy on the initial stages of oxide film formation at 650 °C

General information
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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

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Original language: English
Links:
https://www.maxlab.lu.se/cmis/display?id=workspace%3A%2F%2FSpacesStore%2Fbd7dec7f-b5c5-478a-af1e-8fbe1d875fe7
Links:
https://www.maxlab.lu.se/node/2032#I311-PEEM_
Research output: Professional › Commissioned report

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 spectroscopy (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
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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.
Number of pages: 10
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Publication date: 2016
Peer-reviewed: Yes

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Scopus rating (2015): SJR 1.686 SNIP 1.896 CiteScore 5.16
Scopus rating (2014): SJR 2.204 SNIP 2.396 CiteScore 5.87
Scopus rating (2013): SJR 2.174 SNIP 2.582 CiteScore 5.58
Scopus rating (2012): SJR 2.435 SNIP 2.707 CiteScore 5.25
Scopus rating (2011): SJR 2.175 SNIP 2.638 CiteScore 5.16
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
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Volume: 674
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Scopus rating (2014): SJR 0.212 SNIP 0.349 CiteScore 0.23
Scopus rating (2013): SJR 0.19 SNIP 0.308 CiteScore 0.21
Scopus rating (2012): SJR 0.172 SNIP 0.377 CiteScore 0.19
Scopus rating (2011): SJR 0.176 SNIP 0.441 CiteScore 0.22
Scopus rating (2010): SJR 0.183 SNIP 0.295
Scopus rating (2009): SJR 0.211 SNIP 0.246
Scopus rating (2008): SJR 0.192 SNIP 0.285
Scopus rating (2007): SJR 0.191 SNIP 0.36
Scopus rating (2006): SJR 0.221 SNIP 0.411
Scopus rating (2005): SJR 0.222 SNIP 0.369
Scopus rating (2004): SJR 0.214 SNIP 0.414
Scopus rating (2003): SJR 0.206 SNIP 0.289
Scopus rating (2002): SJR 0.202 SNIP 0.223
Scopus rating (2001): SJR 0.24 SNIP 0.326
Scopus rating (2000): SJR 0.295 SNIP 0.325
Scopus rating (1999): SJR 0.262 SNIP 0.301
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.
Number of pages: 2
Publication date: 2016

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Links: https://www.maxlab.lu.se/cmis/display?id=workspace%3A%2F%2FSpacesStore%2Fa92d6a04-214f-4072-9777-93aeddd805058

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
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Journal: Ohutlevy-lehti
Issue number: 2
ISSN (Print): 1239-4122
Original language: Finnish
Links: http://www.e-julkaisu.fi/ohutlevy/2016/02/

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
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.

General information
State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Materials Science, Research group: Materials Characterization, Luleå University of Technology, University of Oulu, Faculty of Technology
Authors: Vuorinen, E., Heino, V., Ojala, N., Haiko, O., Hedayati, A.
Publication date: 2016

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Links:
http://urn.fi/URN:NBN:fi-ty-201708141673
Research output: Professional › Conference contribution

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 abrasive conditions. 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.

General information
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Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Materials Science, Research group: Materials Characterization
Authors: Heino, V., Kallio, M., Valtonen, K., Kuokkala, V.
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

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
Number of pages: 2
Publication date: 2016

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.
Pages: 372-390
Publication date: 2016
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)
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.
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

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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 of Modena and Reggio Emilia, Department of Engineering Enzo Ferrari
Authors: Milanti, A., Matikainen, V., Koivuluoto, H., Bolessi, G., Lusvarghi, L., Vuoristo, P.
Number of pages: 10
Pages: 81-90
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Peer-reviewed: Yes

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Scopus rating (2015): SJR 0.871 SNIP 1.415 CiteScore 2.46
Scopus rating (2014): SJR 0.998 SNIP 1.681 CiteScore 2.44
Scopus rating (2013): SJR 1.057 SNIP 1.859 CiteScore 2.58
Scopus rating (2012): SJR 1.049 SNIP 1.658 CiteScore 2.2
Scopus rating (2011): SJR 1.053 SNIP 1.851 CiteScore 2.38
Scopus rating (2010): SJR 1.155 SNIP 1.66
Scopus rating (2009): SJR 1.449 SNIP 1.526
Scopus rating (2008): SJR 1.479 SNIP 1.564
Scopus rating (2007): SJR 1.165 SNIP 1.509
Scopus rating (2006): SJR 1.276 SNIP 1.709
Scopus rating (2005): SJR 1.252 SNIP 1.666
Scopus rating (2004): SJR 1.269 SNIP 1.498
Scopus rating (2003): SJR 1.276 SNIP 1.516
Scopus rating (2002): SJR 1.208 SNIP 1.183
Scopus rating (2001): SJR 1.115 SNIP 1.181
Scopus rating (2000): SJR 0.981 SNIP 1.03
Scopus rating (1999): SJR 1.062 SNIP 1.167
Original language: English
Keywords: Corrosion behaviour, Fe-based coating, HVAF, Structure
ASJC Scopus subject areas: Chemistry(all), Condensed Matter Physics, Materials Chemistry, Surfaces, Coatings and Films, Surfaces and Interfaces
DOIs: 10.1016/j.surfcoat.2015.07.018
Links: http://www.scopus.com/inward/record.url?scp=84939782846&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source-ID: 84939782846
Research output: Scientific › peer-review › Article

Enhanced photoactive and photoelectrochemical properties of TiO2 sol-gel coated steel by the application of SiO2 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 TiO₂ films by applying an intermediate SiO₂ film between the TiO₂ film and the stainless steel substrate. TiO₂ and SiO₂ coatings are synthesized by a sol-gel method and the thickness of TiO₂ 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 TiO₂ films. The enhanced photocatalytic properties of SiO₂/TiO₂ coatings as compared to TiO₂ films are verified using methylene blue (MB) discoloration tests, while the improved photoelectrochemical properties are shown by potentiodynamic i-V scans, open circuit potential (OCP) monitoring and electrochemical impedance spectroscopy (EIS). We attribute the beneficial effect of the intermediate SiO₂ film on the photocatalytic and photoelectrochemical performance to the high electrical resistance of the SiO₂ that imposes a high-energy barrier for electron transfer and, therefore, (partly) insulates the TiO₂ 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 TiO₂ films.

**General information**

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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Frontier Photonics, Department of Materials Science, Research group: Ceramic materials, Optoelectronics Research Centre, Research group: Nanophotonics, Research group: Surface Engineering, Research group: Materials Characterization
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Peer-reviewed: Yes

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Volume: 174-175
ISSN (Print): 0926-3373
Ratings:
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Scopus rating (2015): SJR 2.26 SNIP 2.081 CiteScore 7.72
Scopus rating (2014): SJR 2.232 SNIP 2.164 CiteScore 6.92
Scopus rating (2013): SJR 2.345 SNIP 2.134 CiteScore 6.42
Scopus rating (2012): SJR 2.629 SNIP 2.236 CiteScore 6.08
Scopus rating (2011): SJR 2.585 SNIP 2.345 CiteScore 6.14
Scopus rating (2010): SJR 2.461 SNIP 1.895
Scopus rating (2009): SJR 2.301 SNIP 2.232
Scopus rating (2008): SJR 2.455 SNIP 2.275
Scopus rating (2007): SJR 2.493 SNIP 2.5
Scopus rating (2006): SJR 2.284 SNIP 2.229
Scopus rating (2005): SJR 2.095 SNIP 2.233
Scopus rating (2004): SJR 2.393 SNIP 2.41
Scopus rating (2003): SJR 1.979 SNIP 2.259
Scopus rating (2002): SJR 2.304 SNIP 1.847
Scopus rating (2001): SJR 2.781 SNIP 2.441
Scopus rating (2000): SJR 2.687 SNIP 2.13
Scopus rating (1999): SJR 2.18 SNIP 1.874
Original language: English
ASJC Scopus subject areas: Catalysis, Process Chemistry and Technology, Environmental Science(all)
Keywords: Electrical resistance, Electrochemical impedance spectroscopy, Photocatalysis, Substrate, Titanium dioxide
DOIs: 10.1016/j.apcatb.2015.03.014
Links: 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
Evaluation of crushing strength of spray-dried MgAl$_2$O$_4$ granule beds

The crushing strengths of four different experimental magnesium aluminate spinel (MgAl$_2$O$_4$) granule beds were monitored with the axial die pressing test after heat treatments. Precursor, magnesium hydroxide (Mg(OH)$_2$) and magnesium oxide (MgO) as Mg precursor and aluminium oxide hydroxide Al(O)OH and α-Al$_2$O$_3$ 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(O)OH as Al and Mg(OH)$_2$ as Mg precursor.
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.

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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.
Number of pages: 12
Pages: 191-202
Publication date: 2 Jul 2015
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Journal: Tribology International
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ISSN (Print): 0301-679X
Ratings:
Scopus rating (2016): CiteScore 3.16 SJR 1.382 SNIP 2.094
Scopus rating (2015): SJR 1.437 SNIP 2.04 CiteScore 2.61
Scopus rating (2014): SJR 1.545 SNIP 2.5 CiteScore 2.44
Scopus rating (2013): SJR 1.473 SNIP 2.793 CiteScore 2.51
Scopus rating (2012): SJR 1.406 SNIP 2.331 CiteScore 1.96
Scopus rating (2011): SJR 1.247 SNIP 2.209 CiteScore 1.89
Scopus rating (2010): SJR 1.394 SNIP 2.159
Scopus rating (2009): SJR 1.294 SNIP 2.09
Scopus rating (2008): SJR 1.365 SNIP 1.823
Scopus rating (2007): SJR 1.195 SNIP 1.766
Scopus rating (2006): SJR 1.082 SNIP 1.744
Scopus rating (2005): SJR 0.916 SNIP 1.809
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.

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: Surface Engineering, Department of Mechanical Engineering and Industrial Systems, Research group: Laser
Authors: Peura, P., Vuoristo, P., Vihinen, J.
Number of pages: 4
Pages: 73-76
Publication date: Jun 2015
Peer-reviewed: Unknown

Publication information
Journal: Hitaustekniikka
Volume: 65
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ISSN (Print): 0437-6056
Original language: English

Bibliographical note
ORG=mol,0.5
ORG=mei,0.5
Research output: Professional › Article

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.

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), Ernst Mach Inst, Fraunhofer Gesellschaft, Fraunhofer Inst High Speed Dynam
Authors: Isakov, M., Hiermaier, S., Kuokkala, V.
Number of pages: 4
Pages: 2352-2355
Publication date: Jun 2015
Peer-reviewed: Yes
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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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, Research group: Ceramic materials, Engineering materials science and solutions (EMASS), Univ Toronto, University of Toronto, Dept Mat Sci & Engn, Univ Toronto, University of Toronto, Dept Mech & Ind Engn
Authors: Puranen, J., Laakso, J., Honkanen, M., Heinonen, S., Kylmälähti, M., Lugowski, S., Coyle, T. W., Kesler, O., Vuoristo, P.
Number of pages: 12
Pages: 6216-6227
Publication date: 18 May 2015
Peer-reviewed: Yes

Publication information
Volume: 40
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.

General information
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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Engineering materials science and solutions (EMASS), Outotec Research Center
Authors: Lindgren, M., Suihkonen, R., Vuorinen, J.
Number of pages: 10
Pages: 391-400
Publication date: 5 Apr 2015
Peer-reviewed: Yes

Publication information
Journal: Wear
Volume: 328-329
ISSN (Print): 0043-1648
Ratings:
Scopus rating (2016): CiteScore 3 SJR 1.558 SNIP 2.071
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.
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
Links:
Source: Scopus
Source-ID: 84924069828
Research output: Scientific - peer-review › Article

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

**General information**

**State:** Published

**Ministry of Education publication type:** A1 Journal article-refereed

**Organisations:** Department of Materials Science, Research group: Ceramic materials, Research group: Materials Characterization, Engineering materials science and solutions (EMASS), Prizztech Magnet Technology Centre, VTT Technical Research Centre of Finland

**Authors:** Isotahdon, E., Huttunen-Saarivirta, E., Heinonen, S., Kuokkala, V. T., Paju, M.

**Number of pages:** 11

**Pages:** 349-359

**Publication date:** 25 Mar 2015

**Peer-reviewed:** Yes

**Publication information**

**Journal:** Journal of Alloys and Compounds

**Volume:** 626

**ISSN (Print):** 0925-8388

**Ratings:**

Scopus rating (2016): CiteScore 3.05 SJR 0.961 SNIP 1.321
Scopus rating (2015): SJR 0.987 SNIP 1.43 CiteScore 3.03
Scopus rating (2014): SJR 1.135 SNIP 1.66 CiteScore 3.13
Scopus rating (2013): SJR 1.064 SNIP 1.597 CiteScore 2.73
Scopus rating (2012): SJR 1.249 SNIP 1.584 CiteScore 2.43
Scopus rating (2011): SJR 1.166 SNIP 1.479 CiteScore 2.41
Scopus rating (2010): SJR 1.07 SNIP 1.221
Scopus rating (2009): SJR 0.957 SNIP 1.367
Scopus rating (2008): SJR 0.899 SNIP 1.207
Scopus rating (2007): SJR 0.889 SNIP 1.216
Scopus rating (2006): SJR 0.897 SNIP 1.147
Scopus rating (2005): SJR 1.074 SNIP 1.212
Scopus rating (2004): SJR 0.903 SNIP 1.35
Scopus rating (2003): SJR 0.909 SNIP 1.04
Scopus rating (2002): SJR 0.797 SNIP 1.047
Scopus rating (2001): SJR 0.615 SNIP 0.967
Scopus rating (2000): SJR 0.738 SNIP 0.94
Scopus rating (1999): SJR 0.766 SNIP 0.927

**Original language:** English

**Keywords:** Corrosion, Electrochemical impedance spectroscopy, Permanent magnets, Rare-earth alloys and compounds, Scanning electron microscopy, SEM

**ASJC Scopus subject areas:** Mechanical Engineering, Mechanics of Materials, Materials Chemistry, Metals and Alloys

**DOIs:**

10.1016/j.jallcom.2014.12.048

**Links:**

http://www.scopus.com/inward/record.url?scp=84920283616&partnerID=8YFLogxK (Link to publication in Scopus)

**Source:** Scopus

**Source-ID:** 84920283616

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

**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 Al2O3 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
Number of pages: 20
Pages: 125-144
Publication date: 15 Mar 2015
Peer-reviewed: Yes

Publication information
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Volume: 265
ISSN (Print): 0257-8972
Ratings:
Scopus rating (2016): CiteScore 2.56 SJR 0.874 SNIP 1.359
Scopus rating (2015): SJR 0.871 SNIP 1.415 CiteScore 2.46
Scopus rating (2014): SJR 0.998 SNIP 1.681 CiteScore 2.44
Scopus rating (2013): SJR 1.057 SNIP 1.859 CiteScore 2.58
Scopus rating (2012): SJR 1.049 SNIP 1.658 CiteScore 2.2
Scopus rating (2011): SJR 1.053 SNIP 1.851 CiteScore 2.38
Scopus rating (2010): SJR 1.155 SNIP 1.66
Scopus rating (2009): SJR 1.449 SNIP 1.526
Scopus rating (2008): SJR 1.479 SNIP 1.564
Scopus rating (2007): SJR 1.165 SNIP 1.509
Scopus rating (2006): SJR 1.276 SNIP 1.709
Scopus rating (2005): SJR 1.252 SNIP 1.666
Scopus rating (2004): SJR 1.269 SNIP 1.498
Scopus rating (2003): SJR 1.276 SNIP 1.516
Scopus rating (2002): SJR 1.208 SNIP 1.183
Scopus rating (2001): SJR 1.115 SNIP 1.181
Scopus rating (2000): SJR 0.981 SNIP 1.03
Scopus rating (1999): SJR 1.062 SNIP 1.167
Original language: English
Keywords: Abrasive wear, Hardmetal, High velocity air-fuel (HVAF), High velocity oxy-fuel (HVOF), Sliding wear, WC-10Co4Cr
ASJC Scopus subject areas: Chemistry(all), Condensed Matter Physics, Materials Chemistry, Surfaces, Coatings and Films, Surfaces and Interfaces
DOIs:
10.1016/j.surfcoat.2015.01.048
Links:
http://www.scopus.com/inward/record.url?scp=84925299473&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source-ID: 84925299473
Research output: Scientific - peer-review › Article
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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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Ojala, N., Valtonen, K., Kivikytö-Reponen, P., Vuurinen, P., Kuokkala, V.
Number of pages: 9
Pages: 36-44
Publication date: Mar 2015
Peer-reviewed: Yes

Publication information
Journal: Tribologia - Finnish Journal of Tribology
Volume: 33
Issue number: 1
ISSN (Print): 0780-2285
Ratings:
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Scopus rating (2015): SJR 0.101 SNIP 0
Scopus rating (2014): SJR 0.316 SNIP 0.126
Scopus rating (2013): SJR 0.118 SNIP 0.019
Scopus rating (2012): SJR 0.24 SNIP 0.312
Scopus rating (2011): SJR 0.237 SNIP 0.103
Scopus rating (2010): SJR 0.125 SNIP 0.055
Scopus rating (2009): SJR 0.459 SNIP 0.37
Scopus rating (2008): SJR 0.13 SNIP 0.228
Scopus rating (2007): SJR 0.126 SNIP 0.186
Scopus rating (2006): SJR 0.159 SNIP 0.438
Scopus rating (2005): SJR 0.181 SNIP 0.429
Scopus rating (2004): SJR 0.104 SNIP 0.479
Scopus rating (2003): SJR 0.227 SNIP 0.277
Scopus rating (2002): SJR 0.101 SNIP 0
Scopus rating (2001): SJR 0.221 SNIP 0
Scopus rating (2000): SJR 0.238
Scopus rating (1999): SJR 0.119
Original language: English
Keywords: Wear testing, Slurry erosion, Slurry-pot, Mining, mineral processing, Steel, Rubber
ASJC Scopus subject areas: Metals and Alloys, Materials Science (miscellaneous)
Electronic versions:
Tribologia 2015 Ojala et al
Links:
http://urn.fi/URN:NBN:fi:ttty-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 absorptance 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.

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, Research group: Ceramic materials, Engineering materials science and solutions (EMASS), Univ Helsinki, University of Helsinki, Dept Phys
Authors: Kotilainen, M., Mizohata, K., Honkanen, M., Hyvärinen, L., Vuoristo, P.
Number of pages: 8
Pages: 244-251
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Ratings:
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Scopus rating (2015): SJR 1.869 SNIP 1.896 CiteScore 5.16
Scopus rating (2014): SJR 2.204 SNIP 2.396 CiteScore 5.87
Scopus rating (2013): SJR 2.174 SNIP 2.582 CiteScore 5.58
Scopus rating (2012): SJR 2.435 SNIP 2.707 CiteScore 5.25
Scopus rating (2011): SJR 2.175 SNIP 2.638 CiteScore 5.16
Scopus rating (2010): SJR 2.524 SNIP 2.121
Scopus rating (2009): SJR 1.991 SNIP 1.977
Scopus rating (2008): SJR 1.654 SNIP 1.458
Scopus rating (2007): SJR 1.359 SNIP 1.488
Scopus rating (2006): SJR 1.447 SNIP 1.799
Scopus rating (2005): SJR 1.141 SNIP 1.619
Scopus rating (2004): SJR 0.932 SNIP 1.178
Scopus rating (2003): SJR 0.992 SNIP 1.34
Scopus rating (2002): SJR 1.042 SNIP 1.114
Scopus rating (2001): SJR 0.896 SNIP 1.235
Scopus rating (2000): SJR 0.828 SNIP 0.986
Scopus rating (1999): SJR 0.701 SNIP 0.75
Original language: English
Keywords: Solar thermal, Absorber, Anodized aluminium, Al substrate, IR reflector, Thermal ageing, ENERGY APPLICATIONS, THERMAL COLLECTORS, COMPOSITE COATINGS, SURFACE DURABILITY, CHROMIUM, LIFE DOIs:
10.1016/j.solmat.2014.12.006
Source: WOS
Source-ID: 000349728100031
Research output: Scientific - peer-review › Article

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-sulfuric-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.
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.

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**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 Stellite21cobalt 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.

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**Bibliographical note**
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.

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**Bibliographical note**
xoa ei tarkistettu
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.

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Research output: Scientific - peer-review › Conference contribution

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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Authors: Hlavaty, I., Kozak, J., Tuominen, J.
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.
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.
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.
High Temperature Tension HSB Device Based on Direct Electrical Heating

The effects of strain rate and temperature on the mechanical properties of various engineering materials have been extensively studied within the past few decades. However, the high temperature high strain rate tension Hopkinson Split Bar (HSB) testing is still quite challenging to perform due to the need to fix the sample to the stress bars. Mechanical fixing of a sheet material sample is not very convenient and can produce low quality results. Therefore, the sheet samples are typically glued directly to the stress bars. This glue joint, however, loses strength rapidly if the temperature of the glue joint increases above room temperature, which makes the high temperature testing more difficult. In this paper, we present a tension Hopkinson Split Bar device with a high temperature system that allows the sample to be heated while keeping the glue joint at or close to room temperature. The sample is rapidly heated by a powerful low voltage high amperage DC pulse. When testing stainless steels, test temperatures between 400 and 800 °C are reached in less than one second, and even the melting temperature of the material is reached in less than 2 s. The system is fully computer controlled allowing accurate timing and control of the different actions during the test including heating of the sample, pneumatic manipulation of the heating electrodes, releasing of the striker bar, and recording of the test results. The results obtained with the current high temperature system are high quality and the obtained high temperature stress strain curves are essentially oscillation free. © The Society for Experimental Mechanics, Inc. 2015.
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 absorptance 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
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.

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

High strength steels (HSS) used in highly abrasive environments, such as in mining and crushing, must endure high stress abrasion. To properly understand the wear behavior of materials under such circumstances, the connection between surface loading, work hardening, and material removal has first to be determined. In this study, wear resistant steels with initial hardness ranging from 400 to 750 HV were investigated in single-grit abrasion. In the cyclic abrasion experiments, the abrasion resistance of the steels was improved noticeably from the initial state due to surface hardening. However, the highest surface hardening rate did not result in the highest wear resistance. Moreover, when the surface loading was sufficiently increased, the transition to a high wear rate mechanism was observed.

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Scopus rating (2008): SJR 1.597 SNIP 1.863
Scopus rating (2007): SJR 1.286 SNIP 1.889
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X-ray Diffraction based Residual Stress Profiling of Heat Affected Surface Layer in Flame Cut Heavy Steels

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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.
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.

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
the abrasion 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.

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10.1016/j.wear.2014.06.003
Links:
http://www.scopus.com/inward/record.url?scp=84903144175&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-11-28<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 1185
Research output: Scientific - peer-review › Article
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

Publication series
Name: Tampere University of Technology. Publication
Publisher: Tampere University of Technology
No.: 1216
ISSN (Print): 1459-2045
Electronic versions:
eerola.pdf
Links:

Bibliographical note
Awarding institution:Tampere University of Technology
Source: researchoutputwizard
Source-ID: 274
Research output: Monograph › Doctoral Thesis

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.

General information
State: Published
Ministry of Education publication type: G5 Doctoral dissertation (article)
Organisations: Department of Materials Science
Authors: Sarlin, E.
Number of pages: 71
Publication date: 16 May 2014

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

Publication series
Name: Tampere University of Technology. Publication
Publisher: Tampere University of Technology
Volume: 1208
ISSN (Print): 1459-2045
Electronic versions:
sarlin.pdf
Links:

Bibliographical note
Awarding institution:Tampere University of Technology
Source: researchoutputwizard
Source-ID: 1467
Research output: Collection of articles › Doctoral Thesis

8 Erityisalueita. 8.1. Tilvistimet

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Department of Materials Science
Authors: Miettinen, J.
Number of pages: 14
Pages: 405-417
Publication date: 2014

Host publication information
Title of host publication: Koneenosien suunnittelu
Place of publication: Helsinki
Publisher: Sanoma Pro Oy

Bibliographical note
8 Erityisalueita, 8.5 Mekatroniikka

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Department of Materials Science
Authors: Miettinen, J.
Number of pages: 8
Pages: 485-492
Publication date: 2014

Host publication information
Title of host publication: Koneenosien suunnittelu
Place of publication: Helsinki
Publisher: Sanoma Pro Oy

Bibliographical note
Contribution: organisation=mol,FACT1=1\n\nSource: researchoutputwizard
Source-ID: 1079
Research output: Scientific › Chapter

Abstracts of the 28th International Conference on Surface Modification Technologies, SMT28, Tampere University of Technology, Tampere, Finland, June 16-18, 2014

General information
State: Published
Ministry of Education publication type: C2 Edited books
Organisations: Department of Materials Science
Number of pages: 150
Publication date: 2014

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

Bibliographical note
Contribution: organisation=mol,FACT1=1\n\nSource: researchoutputwizard
Source-ID: 1780
Research output: Scientific - peer-review › Anthology

Apparent Fracture Toughness Versus Micro-Scale Fracture Toughness of Interfaces-The Challenge of Critical Values

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Department of Materials Science, Research group: Plastics and Elastomer Technology, Aalto University
Authors: Kanerva, M., Jokinen, J., Sarlin, E., Saarela, O.
Pages: 173-188
Publication date: 2014
Peer-reviewed: Yes
Application of DIC technique for studies of Kuru Granite rock under static and dynamic loading

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science
Authors: Fourmeau, M., Gomon, D., Vacher, R., Hokka, M., Kane, A., Kuokkala, V.
Number of pages: 7
Pages: 691-697
Publication date: 2014

Host publication information
Title of host publication: 20th European Conference on Fracture (ECF20), Fracture at all scales, 30th June - 4th July, 2014, Trondheim

Publication series
Name: Procedia Materials Science
Volume: 3
ISSN (Print): 2211-8128
DOIs:
10.1016/j.mspro.2014.06.114

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-29
Source: researchoutputwizard
Source-ID: 314
Research output: Scientific - peer-review › Conference contribution

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:
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:
Scopus rating (2016): CiteScore 1.75 SJR 0.668 SNIP 1.173
Scopus rating (2015): SJR 0.687 SNIP 1.303 CiteScore 1.71
Scopus rating (2014): SJR 0.657 SNIP 1.319 CiteScore 1.58
Scopus rating (2013): SJR 0.555 SNIP 1.244 CiteScore 1.53
Scopus rating (2012): SJR 0.716 SNIP 1.529 CiteScore 1.65
Scopus rating (2011): SJR 0.844 SNIP 1.703 CiteScore 1.77
Scopus rating (2010): SJR 0.679 SNIP 1.462
Scopus rating (2009): SJR 0.919 SNIP 1.573
Scopus rating (2008): SJR 0.881 SNIP 1.494
Scopus rating (2007): SJR 0.823 SNIP 1.492
Scopus rating (2006): SJR 0.744 SNIP 1.58
Scopus rating (2005): SJR 0.82 SNIP 1.584
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:
Scopus rating (2016): SJR 0.297 SNIP 0.464 CiteScore 0.64
Scopus rating (2015): SJR 0.305 SNIP 0.476 CiteScore 0.51
Scopus rating (2014): SJR 0.362 SNIP 0.38 CiteScore 0.36
Scopus rating (2013): SJR 0.247 SNIP 0.312 CiteScore 0.32
Scopus rating (2012): SJR 0.333 SNIP 0.376 CiteScore 0.27
Scopus rating (2011): SJR 0.276 SNIP 0.363 CiteScore 0.3
Scopus rating (2010): SJR 0.353 SNIP 0.261
Scopus rating (2009): SJR 0.155 SNIP 0.114
Scopus rating (2008): SJR 0.122 SNIP 0
Original language: English
DOIs:
10.1179/1751584X13Y.0000000055

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
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: 2014-08-30
Source: researchoutputwizard
Source-ID: 1452
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
Source: researchoutputwizard
Source-ID: 894
Research output: Scientific › Conference contribution

Controlling the synergetic effects in (3-aminopropyl) trimethoxysilane and (3-mercaptopropyl) trimethoxysilane coadsorption on stainless steel surfaces

General information
State: Published
Determinition of the functionality of monolayers of aminopropyl trimethoxy silane and mercaptopropyl trimethoxy silane on stainless steel with SR-PES and chemical derivatization

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: Vuori, L., Hannula, M., Hirsimäki, M., Tönisoo, A., Nömmiste, E., Valden, M.
Number of pages: 2
Pages: 1-2
Publication date: 2014

Host publication information
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<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 1771
Research output: Scientific : Chapter

Effect of abrasive properties on the high-stress three-body abrasion of steels and hard metals
Especially in tunneling, the abrasiveness of rock is an important property, which can easily be determined by several methods developed for the purpose. With this in mind, it is rather surprising that the effects of different rock types on the wear mechanisms of engineering materials have not been too widely studied. In this paper, high stress three-body abrasive tests were conducted with four different abrasives with a relatively large (2-10 mm) particle size. As test materials, three different steels and three hard metals were used. The tests clearly showed that material type has an influence on how different abrasive and material properties affect the abrasive wear mechanisms and severity. For example with hard metals, the most important property of the abrasives is their crushability, as only small abrasive particles are able to properly attack the binder phase and cause high wear rates. On the other hand, it seems that the
abrasiveness of rock is not the dominating property determining the severity of wear in the current test conditions for any of the tested materials. In fact, with steels no single abrasive property could be shown to clearly govern the abrasive wear processes. In any case, when using the determined abrasiveness values in wear estimations, the contact conditions in the method used for determining the abrasiveness values should be as similar as possible with the end application.

**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: 16
Pages: 3-18
Publication date: 2014
Peer-reviewed: Yes

**Publication information**
Journal: Tribologia - Finnish Journal of Tribology
Volume: 32
Issue number: 1
ISSN (Print): 0780-2285
Ratings:
Scopus rating (2016): CiteScore 0.24 SJR 0.141 SNIP 0.076
Scopus rating (2015): SJR 0.101 SNIP 0
Scopus rating (2014): SJR 0.316 SNIP 0.126
Scopus rating (2013): SJR 0.118 SNIP 0.019
Scopus rating (2012): SJR 0.24 SNIP 0.312
Scopus rating (2011): SJR 0.237 SNIP 0.103
Scopus rating (2010): SJR 0.125 SNIP 0.055
Scopus rating (2009): SJR 0.459 SNIP 0.37
Scopus rating (2008): SJR 0.13 SNIP 0.228
Scopus rating (2007): SJR 0.126 SNIP 0.186
Scopus rating (2006): SJR 0.159 SNIP 0.438
Scopus rating (2005): SJR 0.181 SNIP 0.429
Scopus rating (2004): SJR 0.104 SNIP 0.479
Scopus rating (2003): SJR 0.227 SNIP 0.277
Scopus rating (2002): SJR 0.101 SNIP 0
Scopus rating (2001): SJR 0.221 SNIP 0
Scopus rating (2000): SJR 0.238
Scopus rating (1999): SJR 0.119
Original language: English
Electronic versions:
Ratia_Tribologia_2014
Links:
https://journal.fi/tribologia/issue/view/3255

**Bibliographical note**
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-01<br/>Publisher name: Suomen Tribologia-yhdistys
Source: researchoutputwizard
Source-ID: 1361
Research output: Scientific - peer-review › Article

**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)
Number of pages: 7
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
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.
High Alpha - Termisesti ruiskutetut kromioksid- ja piikarbideseosteiset alumiinioxidipinnoitteet. Loppuraportti

General information
State: Published
Organisations: Department of Materials Science, Research group: Ceramic materials, Research group: Surface Engineering
Authors: Hyvärinen, L., Hakalahti, J., Niemi, K., Vuoristo, P.
Number of pages: 56
Publication date: 2014

Publication information
Place of publication: Tampere
Publisher: Tampereen teknillinen yliopisto. Materiaaliopin laitos
Original language: Finnish
Electronic versions:
high_alpha_termisesti_ruiskutetut_alumiinipinnoitteet.pdf
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
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., Vihinen, J., Levänen, E.
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
Keywords: Friction, Silicon Nitride, Sliding, Wear, Laser
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

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

Kestävämpiä teräksiä 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
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
Authors: Kaplan, F., Alam, M., Tuominen, J., Vuoristo, P., Miettinen, J., Poutala, J., Nääki, J., Junkala, T., Peltola, T., Barsoum, Z.
Pages: 1-14
Publication date: 2014

Host publication information
Keywords: Laser cladding, Fatigue, Finite element method (FEM)
Electronic versions:
AK IIW C IV 2014
Links:

Bibliographical note
Contribution: organisation=mol,FACT1=0.75<br/>Contribution: organisation=mei,FACT2=0.25<br/>Portfolio EDEND: 2014-12-29
Source: researchoutputwizard
Source-ID: 656
Research output: Scientific › Conference contribution

Metallographic Studies of Electron Beam Welded Copper Lid: Macroscopic Studies and Hardness Measurements of the Cross-Section of XK049 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_XK049_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
Stakeholders’ perspectives Shok’n’ Roll - from Science to Solutions

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Kuokkala, V.
Number of pages: 2
Publication date: 2014

Publication information
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, SMT28, Tampere University of Technology, Tampere, Finland, June 16-18, 2014
Place of publication: Tampere
Publisher: Tampere University of Technology

Bibliographical note
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 Synchroton 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
Portfolio EDEND: 2014-12-15
Source: researchoutputwizard
Source-ID: 94
Research output: Scientific › Chapter

Tampere Wear Center panostaa kulumistutkimukseen

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science
Authors: Valtonen, 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
Portfolio EDEND: 2014-12-31
Publisher name: Teknologiateollisuus
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.
Number of pages: 7
Pages: 469-475
Publication date: 2014
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
Pages: 344-365
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Composite Structures
Volume: 113
ISSN (Print): 0263-8223
Ratings:
Scopus rating (2016): CiteScore 4.45 SJR 2.13 SNIP 2.033
Scopus rating (2015): SJR 2.247 SNIP 2.236 CiteScore 4.25
Scopus rating (2014): SJR 2.331 SNIP 2.524 CiteScore 4.03
Scopus rating (2013): SJR 2.017 SNIP 2.937 CiteScore 3.7
Scopus rating (2012): SJR 1.867 SNIP 2.838 CiteScore 2.85
Scopus rating (2011): SJR 1.683 SNIP 2.581 CiteScore 2.68
Scopus rating (2010): SJR 1.583 SNIP 2.367
Scopus rating (2009): SJR 1.652 SNIP 2.076
Scopus rating (2008): SJR 1.447 SNIP 1.761
Scopus rating (2007): SJR 1.336 SNIP 2.006
Scopus rating (2006): SJR 1.08 SNIP 1.894
Scopus rating (2005): SJR 1.233 SNIP 1.647
Scopus rating (2004): SJR 1.022 SNIP 1.484
Scopus rating (2003): SJR 0.977 SNIP 1.101
Scopus rating (2002): SJR 1.347 SNIP 0.958
Scopus rating (2001): SJR 0.695 SNIP 1.151
Scopus rating (2000): SJR 0.896 SNIP 0.879
Scopus rating (1999): SJR 0.864 SNIP 0.868
Original language: English
Electronic versions:
Sarlin_2014_CS_2
DOIs:
10.1016/j.compstruct.2014.03.049
Links:
http://urn.fi/URN:NBN:fi.tty-201605033919

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 1466
Research output: Scientific › peer-review › Article
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
Editor: Cameron, D.
ISBN (Print): 978-0-08-096532-1

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-29<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 519
Research output: Scientific - peer-review › Article

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

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 1779
Research output: Scientific - peer-review › Chapter
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

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.

**General information**
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Materials Characterization
Authors: Ojala, N., Valtonen, K., Siitonen, P., Kuokkala, V.
Number of pages: 8
Publication date: 19 Mar 2013

**Host publication information**
Title of host publication: 3rd International Tribology Symposium of IFToMM
Place of publication: Luleå, Sweden
Formation of surface layers during laser cladding using a powerful fiber laser

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science
Authors: Zemljakov, E., Tuominen, J., Pozdeeva, E., Turichin, G., Komarova, E.
Number of pages: 6
Pages: 231-236
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Nauchno-Tekhnicheskiye Vedomosti
ISSN (Print): 1994-2354
Original language: Russian
Electronic versions:
N1.166.2013_34
Links:
https://en.ntv.spbstu.ru/ntv/article/N1.166.2013_34/
http://urn.fi/URN:NBN:fi:tty-201604253882

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-02
Source: researchoutputwizard
Source-ID: 3780
Research output: Scientific - peer-review › Article

Kirkasta valoa teräksen pinta-analyttiseen tutkimukseen

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Optoelectronics Research Centre
Authors: Ali-Löytty, H., Valden, M.
Number of pages: 2
Pages: 68-69
Publication date: 2013
Peer-reviewed: Unknown

Publication information
Journal: Materia
Volume: 71
Issue number: 3
ISSN (Print): 1459-9694
Original language: Finnish
Links:
http://www.vuorimiesyhdistys.fi/julkaisut/materia
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: Nyyssönen, T., Somani, M., Peura, P., Kuokkala, 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

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/cms/display?id=workspace%3A%2F%2FSpacesStore%2F0f1d8b0b-533a-48e6-a4cf-a85090776f76
https://www.maxlab.lu.se/node/1693

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
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:
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 September 2013
Links: http://www.mtm.kuleuven.be/English/research/compositesweek/program/papers

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

Silanolintparametrien vaikutus sähkökemiallisesti passivoidun austeniittisen teräksen pinnalle rakentuvan biofunktionaalisen seossilaaniohutkalvon koostumukseen
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.

General information
State: Published
Ministry of Education publication type: G2 Master's thesis, polytechnic Master's thesis
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Hannula, M.
Influence of substrate material on corrosion properties of nickel superalloy coatings obtained by laser cladding

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science, Research group: Surface Engineering
Authors: Tuominen, J., Vuoristo, P., Mäntylä, T.
Pages: 269-276
Publication date: 13 Aug 2001

Host publication information
Title of host publication: 8th NOLAMP Conference, 13-15th August 2001, Copenhagen, Denmark: 8th Conference on Laser Materials Processing in the Nordic Countries
Volume: Vol. II
Place of publication: Copenhagen
Editors: Olsen, F. O., Kristensen, J. K.
ISBN (Print): 87-90855-32-9
Research output: Scientific → Conference contribution