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BOOK OF ABSTRACTS

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aggressive gases and liquids. Thus the abrasion and corrosion behaviour of MDO coatings is of increasingly significant scientific and technical interest. In this work, various MDO coatings deposited on aluminium alloy substrates were characterised by a variety of mechanical and tribological methods, including micro-hardness testing and wet/dry rubber wheel abrasive wear tests. A Solatron 1286 ECI system was employed for assessment of corrosion resistance. SEM with EDAX was employed to observe the abraded and corroded surfaces, and X-ray diffraction analyses were also performed, using a Siemens D-5000 diffractometer with glancing-angle attachment. The results indicated that MDO treated aluminium alloys can provide much higher abrasion resistance and better corrosion performance than (for example) stainless steels, whilst giving significant weight-saving benefits for practical applications.

EP-14 Influence of the Heat Treatment on the Tribological Behavior of a Ni-P-BN(h) Autocatalytic Composite Coatings, *M.H. Staia*, Central University of Venezuela, ***O.A. León***, UNEXPO, Venezuela, *H.E. Hintermann*, University of Neuchatel, Switzerland

Pin on disc tests have been performed in order to evaluate the influence of the heat treatment temperature on both friction coefficient and wear resistance of a Ni-P-BN(h) composite coating on a 316L stainless steel substrate. The "as deposited" samples have been heat treated for 1 hour at 200, 300 and 4000C in Argon atmosphere. X-ray diffraction analysis has been employed in order to study the phase transformations produced during heating , meanwhile the coating morphology and wear mechanism were studied by Scanning Electron Microscopy. Microhardness values for the coatings with and without heat treatment are also reported.

EP-15 Performance of a Rotating Gear Pair Coated with an Amorphous Carbon Film Under a Loss-of-Lubrication Condition, *M. Murakawa*, Nippon Institute of Technology, Japan, *T. Komori*, Kyouiku Gear Mfg, Co., Ltd., Japan, *S. Takeuchi*, Nippon Institute of Technology, Japan, *K. Miyoshi*, NASA Lewis Research Center

The ability of gear boxes to complete their missions following the loss-of-lubrication is an important parameter in design criteria for various machines. This paper shows the results of the actual gear performance test conducted using a gear testing machine which was subjected to a loss-of-lubrication condition immediately after a short operating period under fully lubricated condition. The result showed that a gear pair subjected to an initial shot peening process and a subsequent PVD process to deposit an amorphous carbon film (WC/C film) could endure for very long before it failed or seized (more than 10^7 times of repeating rotational meshing) even under a very severe loading condition, i.e., under a Lloid's K factor of 4 MPa thus demonstrating the utility of gears coated with an amorphous carbon film.

EP-16 Influence of Magnetic Field on Aluminium / XC48 Tribological Behaviour, *Z.H. Zaidi, A.S. Senouci*, Laboratoire de Mécanique des Solides, France

The application of magnetic field alters significantly the plastic properties of crystal and surface oxidation.

The action of magnetic field on sliding surfaces: ferromagnetic steel XC48/aluminium may cause a surface modifications and then the friction and wear behaviour modifications.

Aluminium and steel surface modifications induced by the magnetic field during sliding test are analysed and performed by Vickers Microhardness, Optical Microscopy, Scanning Electron Microscopy, EDS analysis and by the oxidation ratio measurement.

This paper presents a study of the surfaces modification, the wear and friction behaviour of aluminium in non feroomagnetic, aluminium/ferromagnetic XC48 steel sliding contact in magnetic field.

EP-17 Subsurface Stress Field Modifications Owing to the Presence of Isolated Crack in Elastically Loaded Bi-Layers : A Boundary Element Study in Ball on Flat Contact Geometry, *C. Comte, R. Kouitat, J. von Stebut*, Ecole des Mines, France

The presence of pre-existing crack in a layer structure is expected to modify the subsurface contact stress field owing to elastic contact. In case of brittle failure the presence of such cracks is likely to lower the critical stress required to trigger crack propagation and/or nucleate new cracks. In the present study boundary element method is retained to model such effects. This numerical technique has been shown to be especially well adapted for modelling of contact-induced elastic subsurface stress fields. In addition, this technique is very economic in terms of required computer performance and can be easily implemented on a standard P.C..

In a first part we consider a homogeneous, isotropic solid half-space placing the crack at various depths with $a_H/10 < t < 3a_H$ (a_H being the hertzian contact radius). We show that for the upper limit the presence the presence of a crack has practically no effect anymore.

In a second part we consider layered composites with a coating to substrate modulus ratio of roughly 2 and the inverse situation. Here again the position of the crack is modified : within the coating, at the interface and in the substrate. The object is to show the effect of crack in relation with the unperturbed stress distribution.

EP-20 Improvement of Tribological Properties of 9Cr18 Bearing Steel Using Metal and Nitrogen Plasma Immersion Ion Implantation, ***Z.M. Zeng***, City University of Hong Kong and Harbin Insitute of Technology, China, *T. Zhang*, City University of Hong Kong, *B.Y. Tang, X.B. Tian*, City University of Hong Kong and Harbin Institute of Technology, China, *P.K. Chu*, City University of Hong Kong

Employing an improved cathode arc plasma source, metal plasma immersion ion implantation (PIII) is performed on 9Cr18 bearing steel. Titanium and Tantalum ions are implanted into the 9Cr18 samples followed by nitrogen plasma immersion ion implantation to result in a modified surface layer with superior wear resistance. The surface properties of the 9Cr18 bearing steel samples are evaluated by measuring the microhardness, wear property, coefficient of friction, as well as elemental depth profiles and chemical composition of the modified layer. The results show that the wear resistance of the samples implanted with $Ti^+ + N^+$ is enhanced to a larger degree than that of the samples undergoing nitrogen PIII alone. The XPS results indicate that many nitride phases such as CrN, TiN and TaN have been formed in the implanted layer. In this paper, we will also discuss the new improvements on the metal and source arc source and experimental protocols. Using the new procedures incorporation both metal ion and gas PIII, the surface properties of 9Cr18 bearing steel is significantly improved.

EP-21 Investigation of Dose Uniformity in Industrial Parts with Interior and Exterior Races and Grooves Treated by Plasma Immersion Ion Implantation, ***Z.M. Zeng***, City University of Hong Kong and Harbin Insitute of Technology, China, *T.K. Kwok*, City University of Hong Kong, *B.Y. Tang, X.B. Tian*, City University of Hong Kong and Harbin Institute of Technology, China, *P.K. Chu*, City University of Hong Kong

Plasma immersion ion implantation (PIII) prolongs the working lifetime of industrial components and is an effective surface treatment technique. However, the lateral implantation dose uniformity is usually not very good particularly for samples with an irregular shape. In this work, we focus on real industrial bearings possessing grooves and races both on the inside and outside and investigate the PIII dose uniformity. The sheath expansion around the inner and outer races is simulated using a time-dependent, two-dimensional fluid mode. The angular distribution of the incident ions and retained dose along the irregular surface are derived. It is found that the retained dose is highest on the bottom of the arc trench along both the inner and outer races. The minimum retained dose is observed near the corner of the groove due to the more glancing ion impact as a result of the evolution of the ion sheath. Our results indicate that the nonuniformity can be minimized by reducing the implantation pulse duration.

EP-22 Mechanical Characterization of Diamond-like Films Using the Combination of the Methods of Nanoindentation and Acoustic Emission with an Improved Tunnel Microscope, *N.V. Novikov, O.G. Lysenko, V. Grushko, S. Dub*, V.Bakul Institute for Superhard Materials, UKRAINE

A method, which couples nanoidentation experiments and imaging procedures, has been developed. Piezoelectric elements are used to move an improved tip of a tunnel microscope. A three-sided pyramidal (Berkovich) diamond tip has been used to obtain a load-displacement curve with residual depth of the order of 0.1 nm. The same tip has been used to generate topographic images, while the sample remains stationary. A second tip is used for noncontact measuring of acoustic emission waves during indentation. Results obtained on diamond-like thin films are presented as to illustrate the method

EP-23 Electrometallization and Plasma Coatings Modification Under Laser Action, *A.V. Pokhmurska*, Institute of Applied Problems of Mechanics and Mathematics, Ukraine

atings have been obtained by electric arc spraying and plasma spraying of powder wire. Powder wire mixture consists of different refractory components. Some of them are not completely melted in electric arc and almost do not come into reaction with shell material. Laser treatment has been carried out in such a regime in which the coating and a thin layer of a