Tribology and Mechanical Behavior of Coatings and Engineered Surfaces

Room Pacific F-G - Session E3-2-WeA

Tribology of Coatings and Surfaces for Industrial Applications II

Moderators: Dr. Nazlim Bagcivan, Schaeffler Technologies GmbH & Co. KG, Germany, **Dr. Rainer Cremer**, KCS Europe GmbH, Germany, **Dr. Philipp Grützmacher**, Institute of Engineering Design and Product Development, Austria

4:20pm **E3-2-WeA-8 Hard MoSC Solid Lubricant Coating*, Tomas Polcar**, *I. Ponomarev, T. Vitu,* Czech Technical University in Prague, Czech Republic

Doping of transition metal dichalcogenides with carbon results in coating with much better mechanical properties (adhesion, hardness) than that of pure MoS2. Solid lubrication is achieved through tribochemical reaction during sliding, which produces a thin MoS2 tribolayer with basal planes parallel to the coating surface. The coating is a superb lubricant in a vacuum and provides a very low coefficient of friction (lower than typical DLC) in the humid air. However, MoSC prepared by d.c. sputtering is still a relatively soft coating with a hardness of 2-4 GPa, and chemical composition (e.g. carbon content) cannot be further optimized due to an insufficient understanding of tribolayer formation.

We deposited amorphous MoSC coating by co-sputtering MoS2 and C targets in HiPIMS mode, leading to enhanced hardness close to 8 GPa and improved adhesion on steel substrates. Special attention has been paid to tribological testing in various environments (vacuum, humid air) and a formation of a low-friction MoS2 tribolayer. Experimental results are compared with molecular dynamics simulations of sliding thanks to our recently developed force fields for Mo-S-C material combinations. It seems that the sliding induces the segregation of the carbon phase facilitating the formation of a solid lubricant tribolayer.

4:40pm **E3-2-WeA-9 Coating Solutions for Wind Turbine Bearings*, Esteban Broitman***, SKF - Research and Technology Development, Netherlands*; T. von Schleinitz,* SKF GmbH, Germany

Wind power, a clean and affordable alternative to fossil-fuel power generation, is becoming one of the most the preferable choices around the world thanks to novel technical and engineer advances, and also costs drops.

The operational challenges for wind turbines are enormous, like the permanent demand to increase turbine power and size, the work in extreme weather conditions, increasing heavy loads, need of installation in remote locations, etc. In turn, significant advances in rolling bearing designs, materials and heat treatments engineering, and coating technologies have helped to achieve enhanced performance, reliability, and increased service life at many parts of the wind turbines.

In this presentation, we will introduce three kind of coatings used at different bearing locations of the wind turbine: aluminum oxide INSOCOAT®, SKF tribological black oxide, and carbon-based NoWear®. The deposition, mechanical, tribological and electrical properties of the coatings will be discussed. Results will illustrate how far the use of coated bearings have evolved in meeting operational demands and improving the productivity and profitability of wind turbines.

5:00pm **E3-2-WeA-10 Scratch Testing and Tribology Combined with Integrated 3D-Profilometry for in-Depth Characterization of Damage Modes in PVD Coatings*, Philippe Kempe***, Rtec-Instruments SA, Switzerland

Scratch testing has been used to characterize the adhesion of PVD and CVD coatings. It has been normalized to different standards (ISO 20502 and ASTM C1624) which are in much use now in different industries.

The principles of the method are based on a extremely high stress at the interface between coating and substrate which generates strong damages and potential delamination in the material structure. For the development of new coatings, the correlation with real situations is not necessary straightforward and is discussed.

The integration of a 3D profilometer (confocal microscopy and white-light interferometry) combined with mechanical testing (scratch tests and tribology) allows to visualize different damages in the coating structure. It can be used with advantages in R&D projects. Different modes of testing with scratch tester are explained and could foresee various automated modes for quality control.

5:20pm **E3-2-WeA-11 Structural, Electrochemical, and Tribological Evaluation of Silver - Hydroxyapatite Multilayer Coatings Obtained by Magnetron Sputtering with Potential Application in Implants*, Julián Andrés Lenis Rodas,*** University of Antioquia, Politécnico Colombiano Jaime Isaza Cadavid and Servicio Nacional de Aprendizaje - SENA, Colombia

In the present study, silver-hydroxyapatite multilayer coatings were obtained by magnetron sputtering. The structure of the coatings was evaluated by scanning electron microscopy and transmission electron microscopy. Chemical composition and phases were determined by energy-dispersive X-ray spectroscopy, micro Raman spectroscopy, and X-ray diffraction. The corrosion resistance was evaluated using electrochemical impedance and polarization techniques, while the wear resistance of the coatings was evaluated using a pin-on-disk tribometer.

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