Hard Coatings and Vapor Deposition Technologies
Room Town & Country A - Session B3-WeM

Deposition Technologies and Applications for Carbon-Based Coatings

Moderators: Konrad Fadenberger, Robert Bosch GmbH, Germany, **Dr. Ivan Kolev**, IHI Hauzer Techno Coating B.V., Netherlands

11:00am **B3-WeM-10 ta-C by Magnetron Sputtering Using a Newly Designed Cylindrical Rotating Cathode with Significantly Enhanced Sputter Power Density**, ***Andreas Lümkemann,*** Platit AG, Switzerland*; J. Kluson, M. Ucik,* Platit a.s., Czechia*; H. Bolvardi,* Platit AG, Switzerland

Platit presents its sputtered ta-C coatings (tetrahedrally-bonded hydrogen-free carbon) with high fraction of sp3 hybridized carbon atoms. These coatings belong to the 3rd generation in the Platit DLC family and are designated as DLC3 coatings. Deposition of DLC3 coatings is performed by our Pi411 PLUS coating unit, an extremely flexible coater. In the DLC3 configuration, this device is equipped beside three arc cathodes situated in the doors also with one central cylindrical sputtering cathode. High strength magnetic field and very efficient target cooling are the key features of the cathode.

A newly designed Magnetron Sputtering cathode will be presented achieving significantly enhanced sputtering power densities on the target surface. Whereas in the case of our conventional cathode the magnetic field design corresponds to more or less cylindrical arrangement, the new co called “F-Type” cathode is equipped with a specific moveable magnetic core. The core is periodically moving in the longitudinal direction along the cathode axis. It results in the possibility to reach very high power densities, especially for industrial DC magnetron sputtering. For the delivered power of 25kW the maximal value of power density goes up to 800W/cm2.

Not only the hardware part of the technology but also the fine-tuned coating process is indispensable for the synthesis of novel high quality DLC coatings. Here the substrate heat management is of especial importance. On the other side high productivity and low machine maintenance needs are achieved.

Platit DLC3 coatings are characterized by very high microhardness around 50GPa and sp3 to sp2 ratio above 50%, by very low friction coefficient and low roughness. Examples of applications for which the technology was successfully used will also be shown.

11:20am **B3-WeM-11 High Performance ta-C Coatings with Enhanced Temperature Stability for Industrial Applications**, ***Klaus Böbel,*** Bosch Manufacturing Solutions, Germany*; S. Wetzel, J. Jiao,* Bosch Automotive Products, China

BOSCH is one of the pioneers of DLC coating and is operating coating centers worldwide since 1995. For our products we develop coatings with high performance and tailored for specific demands.

Ta-C layers are extremely hard hydrogen free diamond-like carbon layers with excellent mechanical and chemical properties developed for the most demanding applications in industry. BOSCH is successfully applying these coatings in large-scale mass production for over 10 years using its own high rate pulsed ta-C source. The technology allows high coating rates (>2.5µm/h with one source in 2-fold-rotation) and high coating thicknesses to guarantee efficient and economical operation. Results from the optimization of ta-C coatings for high temperature load will be presented. The influence of adhesion layer material, deposition technology and corresponding process parameters has been investigated using a DoE approach in combination with nano scratch analysis. The optimized layer system performed excellently during application withstanding temperature pulses well above 500°C.

11:40am **B3-WeM-12 DLC Coatings for Mechanical Seals Applications**, *S. Tervakangas,* Oerlikon Balzers Coating Finland Oy, Finland*; N. Manninen,* ***Julien Keraudy,*** Oerlikon Surface Solutions AG, Liechtenstein*; O. Jarry,* Oerlikon Balzers Coating Germany GmbH, Germany

Mechanical face seals are today of great importance in many applications *e.g.* in pumps, compressors, mixers, electric motors and transmissions…. Due to their high hardness, high resistance to wet corrosion and capability to resist high temperatures, various ceramics such as Silicon Carbide (SiC) are successfully being implemented in process pumps dealing with corrosive and abrasive fluids. However, ceramic components of devices such as mechanical seals of pumps face considerable tribological challenges that can ultimately affect performance and reduce the life of the larger system; particularly dry running conditions may occurs during starting and stopping or if occasional overloading occurs between the sliding faces leading to temperature increases and possible damages to the sliding faces as well as surrounding elastomer seals. Ultrananocrystalline diamond (UNCD) is a well-established solution to protect SiC seals from abrasive wear in extreme conditions.However, diamond coatings produced by conventional chemical vapor deposition (CVD) exhibit high surface roughness, which very often leads towards coating the counterface seal too in order to prevent wear. Diamond Like Carbon Coatings are cost-effective alternatives to UNCD especially for seals operating by intermittence in dry mode. They provide an extremely low friction in dry and lubricated modes and high wear resistance. The objective of the present study is to investigate the tribological performance of different DLC coated SiC when simulating mechanical face seal applications. Dry wear tests were carried out in air at room temperature by using a laboratory tribotest where two discs are rotated against each other face to face. The results show that all DLC coatings results in significantly lower friction and temperature than uncoated SiC and are therefore an interesting alternative to diamond coatings commercially available today. Amongst the DLC coatings, ta-C are particularly promising due to their unique combination of friction and wear reduction. The benefits from using ta-C coatings include lower running cost compared to diamond coatings and the possibility to use a more simple seal design.

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