41st ICMCTF
International Conference on Metallurgical Coatings & Thin Films

Program
Technical Sessions
Abstracts
Exhibition

April 28 – May 2, 2014
Town & Country Hotel & Convention Center
San Diego, California

Sponsored by:
Advanced Surface Engineering Division of AVS
## Monday Afternoon, April 28, 2014

### Coatings for Biomedical and Healthcare Applications
Room: Sunrise - Session D1
Surface Functionalization, Drug Delivery, and Anti-microbial Coatings
Moderators: S. Rodri Posada, Universidad Nacional Autonoma de Mexico, Mexico D.V. Shtansky, National University of Science and Technology "MISIS", Russian Federation

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<td>1:30 pm</td>
<td>D1-1</td>
<td>Wetting and Biocompatible Properties of Oxygen Plasma Treatment on Diamond-like Carbon Thin Films, C. JONGWANNASIRI, Nippon Institute of Technology, Japan, A. KHANTACHAWANA, King Mongkut's University of Technology Thonburi, Thailand, S. WATANABE, Nippon Institute of Technology, Japan</td>
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<td>1:50 pm</td>
<td>D1-2</td>
<td>Preparation and Assessment of Bone Morphogenetic Properties Immobilized Titanium Oxide on Titanium Surface for Bone Implant, K.W. SHU, Feng Chia University, Taiwan, H.T. CHEN, China Medical University Hospital, Taiwan, C.J. CHUNG, Central Taiwan University of Science and Technology, Taiwan, J.L. HE, Feng Chia University, Taiwan</td>
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<td>2:10 pm</td>
<td>D1-3</td>
<td>Invited talk continued. Biofilm formation and consequences in dental implants: New insights, A. ALMAGUER-FLORES, Universidad Nacional Autonoma de Mexico, Mexico</td>
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<td>2:50 pm</td>
<td>D1-5</td>
<td>Medical Coating Innovations: Antimicrobial PVD Coatings, C. AKIKOZ, C. PINERO, V. DERFLINGER, A. JANSSSEN, H. RUDIGIER, Oerlikon Balzers Coating AG, Liechtenstein</td>
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<td>3:10 pm</td>
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<td>Surface Modification of Biodegradable Magnesium Alloys via Plasma-based Methods, G.S. WU, P.K. CHU, City University of Hong Kong, Hong Kong Special Administrative Region of China</td>
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<td>3:30 pm</td>
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<td>Corrosion Resistance, Anti-microbial Properties of Cu-Zr-Ag Thin Film Metallic Glass with Various Cu/Zr Ratio in PBS Solution, K.C. HSU, J.G. DUH, National Tsing Hua University, Taiwan</td>
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<td>3:50 pm</td>
<td>D1-8</td>
<td>Comparison of anti-HER2 Immobilization Using Three Different Techniques on Al-AIN-Al Thin Films, M. HERNANDEZ, I. GONZALEZ, H. GARCIA, J. OSEGUERA, ITSIM-CEN, Mexico</td>
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<td>4:10 pm</td>
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<td>Formation and Characterization of Nanostructured Bioactive Apatite Coating on TiAl Alloys, Y. GREISH, A. AL SHAMS, A. AYESH, United Arab Emirates University (UAEU), UAE, K. POLYCHRONOPOLOU, Khalifa University, UAE</td>
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<td>4:30 pm</td>
<td>D1-10</td>
<td>Invited talk continued. Yb: Fiber Laser Surface Texturing of Stainless Steel Substrate, with MCAlY Deposition and CO2 Laser Treatment, V. TELEGINSKI, D. CHAGAS, Instituto Tecnológico de Aeronáutica (ITA), Brazil, J.C. SANTOS, J. AZEVEDO, G. VASCONCELOS, Instituto de Estudos Avançados (IEAv), Brazil</td>
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<td>4:50 pm</td>
<td>D1-11</td>
<td>Design and Evaluation of a Novel Testing Method for Surfaces Subjected to Combined Impact and Sliding or Rolling Loads, P. EPAMINONDA, C. REBOLZ, University of Cyprus, Cyprus</td>
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**Welcome Mixer 6:00 - 7:30 pm in the Atlas Foyer**

Sponsored by Oerlikon Balzers
3:10pm D1-6 Surface Modification of Biodegradable Magnesium Alloys via Plasma-based Methods, Guosong Wu (guosongwu@cityu.edu.hk), P.K. Chu, City University of Hong Kong, Hong Kong Special Administrative Region of China

Recently, magnesium alloys are considered revolutionary metallic biomaterials due to their biodegradability and Young’s modulus being similar to that of human bone. However, their applications are hampered by poor corrosion resistance as well as low wear resistance. Plasma-based surface modification techniques including sputtering, filtered cathodic vacuum arc, and ion implantation are useful and environmentally friendly compared to most chemical methods. We have applied these technologies to modify the surface properties of magnesium alloys to meet actual requirements. A metallic interlayer is usually prepared to improve the adhesion between the insulating ceramic coating and magnesium substrate. However, it also provides the possibility of galvanic corrosion in aqueous environments via the defects such as pores and cracks in the coatings. Ion implantation involves a process in which ions are accelerated and impinge into the surface. Different from surface coatings, an ion-implanted layer does not have an abrupt interface and layer delamination is thereby not a serious issue. Samples with a complex shape can also be processed easily with a more advanced technique termed plasma immersion ion implantation (PIII). In this talk, recent work related to magnesium research conducted in our laboratory is described and reviewed.

3:30pm D1-7 Corrosion Resistance, Anti-microbial Properties of Cu-Zr-Ag Thin Film Metallic Glass with Various Cu/Zr Ratio in PBS Solution, Kaichieh Hsu, J.G. Duh (jgd@mx.nthu.edu.tw), National Tsing Hua University, Taiwan

This study focuses on the effect of different Cu/Zr ratios in Cu-Zr-Ag-Al thin film metallic glass (TFMG) on corrosion, mechanical and anti-microbial properties. The thin films were prepared by DC magnetron sputtering with different ratios of Cu-Zr targets and a Ag-Al target. The chemical composition of the thin films was determined by field emission electron probe micro-analyzer (FE-EPMA). The morphology of cross section of thin films was examined by field emission scanning electron microscope (FE-SEM). The amorphous state was analyzed by X-ray diffractometer (XRD). The mechanical properties including hardness and elastic modulus were verified by nano-indentation test. Differential scanning calorimetry (DSC) is applied to evaluate if the thin films have glass transition temperature (Tg) and crystalline temperature (Tc), which is the thermal characteristic of metallic glass. The electrochemical corrosion behavior was investigated in 3 wt.%NaCl solution and PBS solution, which is a type of simulated body fluid (SBF), and is used in anti-microbial experiment to cultivate bacteria. Liquid culture methods and plate counting experiment to cultivate bacteria. Liquid culture methods and plate counting to model the situation in human body. The corrosion rates of the thin films were determined by the weight loss test and electrochemical impedance spectroscopy (EIS). The electrochemical impedance spectra was analyzed by ZView software. The morphology and adhesion of the thin films were observed by FESEM. The results reveal that the corrosion rates of the thin films are significantly lower than those of pure Cu and pure Ag. The anti-microbial properties of the thin films were evaluated by the inhibition zone test and liquid culture methods. The results show that the thin films exhibit excellent anti-microbial properties against E. coli and S. aureus. The mechanical properties and anti-microbial properties of the thin films are well correlated. This study provides a promising approach for the development of magnesium-based biomedical materials with improved corrosion resistance and anti-microbial properties.

3:50pm D1-8 Comparison of anti-HER2 Immobilization Using Three Different Techniques on Al-AlN-Al Thin Films, Azzael Hernández, J. González, H. García, J. Oseguera (joseguer@itesm.mx), ITESM-CEM, Mexico

Al-AlN-Al thin films were deposited by RF reactive magnetron sputtering on silicon wafers (111). A comparison among three different methods for antibody immobilization relevant for surface modification for surface acoustic wave resonators was done. Antibodies against HER2 (anti-HER2), a fundamental protein marker in breast cancer diagnostics, were used as a model for identification of the protein. The evaluated techniques were (i) direct immobilization (random immobilization); (ii) alginates (ionic immobilization) and (iii) protein G (oriented immobilization). Standardized detection capabilities were detected by ELISA (enzyme-linked immunosorbent assay), revealing substantial results for every technique. As a result, immobilization using protein G was more efficient; although immobilization using alginates presented lower detection sensitivity, it is a more affordable technique.


Thin films with large compressive residual stresses and low adhesion are prone to buckling and delamination. This is both a significant technical issue, with relevance to thin film stability, and an interesting academic problem where non-linear plate deformation couples to adhesion. This coupling produces intriguing patterns such as telephone cords, which are still ill-understood.

We have carried out an experimental study of buckle formation on a model system: the film is a Molybdenum overlay with thickness ranging between 50 and 300 nm, while compressive biaxial stress (up to nearly 3 Gpa) is adjusted through the deposition conditions [1]. In addition a thin silver film (usually 10 nm) is deposited directly on the substrate, below the Mo layer: in this way a low and reproducible adhesion develops. With this system, we have obtained a wide range of buckling conditions. Beyond telephone cords we have also met with less ubiquitous morphologies, such as branching buckles. We have systematically explored the phase diagram of morphologies as a function of stress and thickness. To help understand these results, we have also modeled the formation of the buckles. Generalized non-linearities of film deformation couple to adhesion. This coupling produces intriguing patterns such as telephone cords, which are still ill-understood.

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