Surface Engineering for Amorphous-, Nanocrystalline-, and Bio-materials

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Recent developments in the understanding of amorphous and nanostructured materials have established that the disordered atomic arrangement and microstructural features at the nano-scale can play an important role in enhancing the structural and functional properties of materials. While significant progress has been made in the processing of these advanced materials in bulk shapes, there are major issues related to crystallization, undesirable phase transformations, and grain growth during bulk processing of these materials. On the other hand, these materials can be good candidates for engineered surfaces. Surface engineering is rapidly gaining acceptance for synthesizing surfaces (in the form of coatings and modified surfaces) of amorphous-, nanocrystalline-, and bio-materials with outstanding properties. The forefront of this area continues to evolve with exploration of new concepts and methodologies, novel surface processing routes, microstructure analysis, property evaluations, and simulation/modeling. To discuss the developments and opportunities in this area, a symposium titled "Surface Engineering for Amorphous-, Nanocrystalline-, and Bio-materials" was held at the TMS 2010 Annual Meeting. The symposium was comprised of around 40 technical presentations, including eight invited presentations by leading researchers in this field of surface engineering. The symposium also featured an invited presentation by Dr. Clark Cooper, Director of the Materials and Surface Engineering program at National Science Foundation (NSF). His presentation provided the NSF perspective on the needs and opportunities in surface engineering research/education. The surface engineering topic in this *JOM* issue is intended to follow up the discussions at the TMS

2010 Annual Meeting and provide a representative spectrum of current research efforts in the rapidly evolving field of surface engineering. Five papers that represent this spectrum are presented in this issue.

The first paper, "Spark Plasma Sintering for Multi-scale Surface Engineering of Materials" by M. Mulukutla et al., presents an overview of their ongoing efforts on using novel spark plasma sintering (SPS) process for producing engineered coatings of amorphous and nanostructured materials for various applications, including structural, tribological, and biomedical applications. The SPS route is explored for processing coatings of iron-based bulk metallic glasses, nanocrystalline hydroxyapatite, and nanocrystalline alumina.

The second paper, "Electrophoretic Deposition of Hyaluronic Acid and Composite Films for Biomedical Applications" by R. Ma et al. presents detailed investigations of a new electrochemical approach for development of composite coatings containing bioceramics, bioglass, heparin, and salicylate drugs, and bovine serum albumin protein in the hyaluronic acid matrix. The paper highlights the potential applications of electrophoretic deposition for the surface modification of biomedical implants and fabrication of biosensors.

The third paper, "Laser Process Effects on Physical Texture and Wetting in Implantable Ti-Alloys" by S.R. Paital et al. presents an overview of surface engineering techniques based on laser processing of implantable titanium alloys for improved wettability and cell compatibility. The paper discusses three different laser processing techniques, laser interference patterning, continuous wave laser direct melting, and pulsed la-

ser direct melting.

The fourth paper, "Characteristics of Hemocompatible TiO_2 Nano-films Produced by the Sol-gel and Anodic Oxidation Techniques" by C.E. Schvezov et al. presents an overview of two simple techniques for producing TiO_2 nano-films for implants where hemocompatibility properties are required as well as good mechanical and tribological behavior.

The fifth paper, "Effect of Current Density on the Pulsed Co-electrodeposition of Nanocrystalline Nickel-copper Alloys" by M. Agarwal et al. presents an in-depth investigation of the electrochemical synthesis of nanocrystalline Ni-Cu films from citrate baths. Various strategies for controlling the composition and properties of the films are presented.

We would like to thank the participants of our symposium in 2010 for making it a success. We also thank the authors for making excellent contributions to this surface engineering topic. We hope the articles presented here will help the researchers working in the field of surface engineering and possibly trigger thoughts for new developments.

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