Editorial

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In this fourth issue of 2021, we offer a leading Invited Feature Article on formulation and characterization of bioactive coatings on magnesium (Mg) alloys using the plasma electrolytic oxidation (PEO) method and six original technical contributions on topics related to surface nanostructures for optical, optoelectronic, electrical, and catalytic devices, wetting of superhydrophobic patterns and anti-wear coatings.

There has been considerable effort devoted to the development of resorbable implants, which can provide the biomechanical support necessary throughout the stages of surgical intervention and biosystem healing while being slowly replaced by host tissue. Resorbable metals have been proposed as candidate materials for various orthopaedic applications. Thus far, only Mg alloys have successfully gone through clinical trials as they have excellent biocompatibility, enhanced bone response and minimal stress shielding. However, in physiological environments, Mg shows rapid degradation accompanied by release of a considerable amount of hydrogen gas, which can delay bone healing, and even result in gas embolism. Because of concerns regarding too rapid degradation of mechanical properties, especially in the early stages of implant bioresorption, a significant portion of research in this area focuses on surface and coating modification methods in effort to temporarily isolate a metal from the corrosive physiologic fluid to slow down the implant degradation process. In the Invited Feature Article, Ghorbanian *et al.* comprehensively present recent research carried out in the field of preparation of bioactive coatings on Mg-Al-Zn alloys by the PEO method and investigation of factors affecting this coating process.¹ This electrolytic passivation process has been explored in effort to control the thickness, structure and porosity of natural oxide films on the surface of Mg-based alloys. Also reviewed by the authors, by selecting electrolyte composition and control over the electrical operational parameters and processing time, an oxide film structure of varying strata, from a dense inner layer to a porous outer layer, can be constructed. The resulting surface coatings are used in controlling the corrosion rate of Mg alloys, important innovations in the process of development of Mg-based bioresorbable orthopaedic implants.

Surface nanostructures have been at the forefront of innovative research since the end of the last century. A large surface area, enhanced electrochemical, optical, photocatalytic, thermoelectric and various other properties, have proven the advantages of nanostructures over traditional raw surfaces, advancing the designs of sensors, electrochemical capacitors, catalysts, batteries, fuel cells

and many others. We are pleased to report increasing submissions of scientific and engineering reports on surface nanostructures for advanced electronic, optical and catalytic applications. This issue offers four original research reports on surface nanostructures made of inorganic materials. In the first original research article, Ma *et al.* describe their study on fabrication of nanostructured copper (I) oxide/silicon (Cu₂O/Si) thin film heterojunctions using magnetron sputtering.² By adjusting the applied substrate bias during magnetron sputtering, the authors demonstrate fabrication of porous columnar structures of Cu₂O with the shape of the building blocks varying from triangular pyramids to round particles. The fabricated nanostructured heterojunctions with appealing electrical and optical properties could attract the attention of designers of electrical and optoelectronic devices such as UV sensors, solar cells, diodes and many more.

The anode materials for lithium (Li)-ion batteries are still the subject of broad research investigation. The synthesis of three-dimensional (3D), continuous, porous, Si/Cu composite film with high electrochemical capacity and cycling stability — which can be used as the anode material for Li-ion batteries — is reported by Wang *et al.*³ The authors demonstrate an efficient technological solution to improve the electrochemical performance of Li-ion batteries by fabricating a unique 3D porous current collector using non-solvent induced phase separation and heat treatment. This work should be of interest to researchers interested in current collectors and Li-ion batteries.

Fabrication of novel porous nanocrystalline aluminum–tungsten trioxide (Al-WO₃) thin composite films through ion beam sputtering, and then annealing at an elevated temperature and dealloying of the Al component is described by researchers from Changzhou University.⁴ The authors show that the Al-WO₃ composite films crystallize at 550°C, the films can then be etched into the porous nanocrystalline WO₃ with enhanced electrical resistance and unique temperature coefficient of resistance. A UV-Vis spectroscopy study shows high transmittance for visible light and a larger forbidden energy bandwidth of 2.75 eV, opening applications to these new structures in photoelectric devices and thermistors.

In the last contribution on nanostructures, Liu *et al.* report doping pristine hexagonal boron nitride (h-BN) with carbon and oxygen to modulate its photoelectrical properties.⁵ With controlled heat treatment temperature, the 5.5 eV bandgap of h-BN was reduced to 2.5 eV, leading to the effective photodegradation of Rhodamine B (RhB). The authors identified superoxide anion radicals (*O²⁻)

and holes (h^+) as the active species of h-BN, responsible for its catalytic properties in photodegradation of organic pollutants. This low-cost and metal-free h-BN photocatalyst could benefit pollution remediation technologies.

Surface Innovations journal has a strong record of publications on wetting phenomena and contact angles. In this issue we offer an additional contribution to this widespread scientific field. Sui *et al.* describe their analysis on the wetting state of a liquid droplet placed on a superhydrophobic surface made of circular truncated cones.⁶ Through thermodynamic analysis, the authors investigate the relationship between the truncated cone microarchitecture, in terms of the base angle and spacing for the cones, and wettability characteristics. The authors propose a 3D model for the optimal geometric design of such architectures, and compare theoretical predictions with published experimental data available in the literature.

In the last contribution to this issue, Zhang *et al.* reveal interesting results on the fabrication of anti-wear composite cobalt-tungsten carbide (Co-WC) coatings on steel.⁷ The researchers synthesized a novel WC and ceria (CeO_2) reinforced Co matrix composite with a one-step co-electrodeposition method. They studied the effect of deposition conditions on the morphology, microstructure, and properties of the coatings, and describe the mechanism of the influence of CeO_2 concentration on deposition rate and incorporation of WC. Results revealed that the coating fabricated at optimal ceria content significantly improves the wear resistance and hardness of the coating. They argue that multi-element

doping could further improve the relevant performance of the cobalt-based coating.

We hope that you will find the content of this issue interesting and inspiring in your research endeavors. As always, we appreciate your comments and suggestions, and wait for submissions of your cutting-edge research results, innovations and discoveries.

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