Editorial

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Surface Innovations enters its ninth year, with a diversified portfolio of articles on scientific and engineering advances made in formulation, modification, testing and characterization of functional surfaces and coatings of novel materials, including nanomaterials. The reports published in 2013–2020 summarize research efforts in the invention and design of many novel medical biomaterials, antimicrobial and antifungal materials and coatings, electronic materials and energy storage materials, as well as their processing, including recycling. The journal intends to continue publication of articles in this broad spectrum of topics related to the science and engineering of surfaces and interfaces.

This first issue of 2021 offers a leading Invited Feature Article and seven original technical contributions on random topics related to surfaces and coatings. The feature article on organic–inorganic hybrids made of polyhedral oligomeric silsesquioxanes (POSS) and epoxy was prepared by an international team of researchers from Iran, China, Canada and USA, led by Professor Mohammad Reza Saeb from the University of Tehran, Iran.¹ As is well articulated in this article, the POSS/epoxy nanocomposites are finding numerous applications as coatings due to their attractive mechanical characteristics, enhanced thermal stability, high corrosion protection and good dielectric properties. Both microstructure and ultimate properties of the coatings are controlled by the content of POSS, formulation conditions that affect POSS dispersibility and aggregation, and interactions at a molecular level of POSS with the epoxy matrix. Molecular engineering of functional groups in the POSS opens the door for a control over the POSS/epoxy interactions and formulation of a broad spectrum of coating nanocomposites. The readers should find this comprehensive review interesting and inspiring.

In the first original research article, Professot Ali Atta from Egypt reports on ion beam sputtering of 21–25 nm copper nanoparticles (CuNPs) on polyethylene terephthalate (PET) and polytetrafluoroethylene (PTFE).² His research report provides a foundation for fabrication of very flexible CuNPs/PET and CuNPs/PTFE films with improved electrical conductivity and dielectric properties. The flexible copper/polymer hybrid films are attractive for electronic and electrical conducting devices.

The functionalization of wool fabric with silver (Ag) nanoparticles (AgNPs) using a chitosan-mediated biosynthesis is described by Hasan *et al.*³ The authors show how to formulate the wool/AgNPs hybrid fabric with a palette of colors, demonstrate antibacterial performance and show how it can be used as a catalytic material in

eliminating azo-dyes in waters discharged from the textile industry. The proposed eco-friendly technology of in-situ synthesis of nanoparticles should attract attention of many research teams working on functionalization of surfaces of organic materials.

Recently, bi-functional electrocatalysts for both oxygen reduction (OR) and oxygen evolution (OE) reactions have attracted attention due to the high demand for efficient catalysts in energy conversion systems. In the original research article, Huo *et al.*⁴ report nitrogen (N)-doped carbon (C) nanotubes encapsulating a cobalt nickel (CoNi) alloy hybrid, which can be explored as a catalyst for both OR and OE reactions. This novel non-precious metal alloy catalyst exhibits highly efficient bi-functional catalytic activity and high durability.

The team of researchers from Alexandria University in Egypt invented a technology that enhances the kinetics of tooth remineralization.⁵ The authors report the bio-acceleration of dentin/enamel remineralization by applying an external magnetic field to the gel made of casein phosphopeptide–amorphous calcium phosphate. The technology is easy to use, safe and could reshape dental care procedures used on repairing damages to dental hard tissues and structures.

In the next original research article, Cai *et al.*⁶ describe a fabrication of mixed perovskite films and their applications in photovoltaic devices. The researchers used solvent engineering techniques in controlling the perovskite material crystallization by manipulating the interactions between components of solvent: dimethyl sulfoxide and chloride (Cl[−]) ions. The fabricated composite perovskite layers are denser and more uniform, having reduced grain boundaries, cracks and surface particles. Solar cells with these perovskite films exhibit impressive 18% power conversion efficiency with negligible hysteresis.

Plasma treatment has been widely used for modifying surfaces of polymers. In a new contribution, the research team from France describes the impact of hydrophobicity, surface chemistry and topography of polycarbonate substrates treated with plasma of argon (Ar) and tetrafluorocarbon (CF₄) on bacterial and microalgal adhesion.⁷ The research confirms that the modulation of polymer hydrophobicity alone is not sufficient in controlling adhesion of bacteria and algae. Nevertheless, the authors demonstrate the possibility of preparing non-toxic antifouling surfaces for marine applications after plasma treatment used at optimized Ar/CF₄ ratio and treatment conditions.

A new generation of surface-active molecules that are synthesized using natural moieties and demonstrate biological activity, biocompatibility and reduced toxicity are the subject of intense studies in recent years. In the final contribution to this issue, the research team from the FRC Kazan Scientific Center of RAS in Kazan, Russian Federation, describe the assembly of mixed supramolecular systems (MSSs) based on glucamine-modified surfactants and metallocomplexes.⁸ The authors show that their MSSs based on cetyltrimethylammonium bromide (Ctab), alkylated Gam and their complexes with lanthanum nitrate (LaN_3O_9) in the presence of hydrophobic probes have up to 70 times higher solubilization activity than the Ctab surfactant alone. As the result, the MSSs could serve as novel nanocontainers and nanocarriers for delivery of drugs or catalysts.

We hope everyone was able to overcome roadblocks and tackle the challenges of 2020 and that you will have very positive and inspiring 2021.

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