Editorial

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This combined issue of 2019 offers an Invited Feature Article, two Innovation Letters and six Original Research Articles.

In the Invited Feature Article, Ryzhkov *et al.*¹ provide an overview of research activities on a new class of stimuli-responsive hybrid materials built through design and fabrication of polyelectrolyte-based interfaces with semiconductors and metals. Such inorganic–polyelectrolyte multilayer hybrids have potential applications as smart, functional and programmable materials in the fields of photochemistry and photocatalysis, electrochemistry, and in control of self-adaptive and self-regulated processes. The polyelectrolyte multilayers can either enhance or suppress photocatalytic activity of inorganic materials, on top of which these organic functionalities are deposited. For example, polyelectrolyte multilayers enhance solar cell performance through improvement in light absorption.

In the first Innovation Letter, Dolganov *et al.*² describe topological defects in freely suspended films of a smectic liquid crystalline material. They studied defect patterns created by coalescence of individual smectic islands and provide experimental evidence for the existence of islands with three and four topological defects. The anchoring conditions on island boundaries define the topology of the inner directional field. The novelty compared to previous studies is that, owing to the coalescence process, these merged islands may have more than the conventional defects.

After graphene, molybdenum disulfide (MoS₂) is one of the most-studied two-dimensional materials. The electronic structures of MoS₂ thin films can evolve from a direct semiconductor in a monolayer to an indirect semiconductor in the multilayer case. In the second Innovation Letter, Wang *et al.*³ discuss the electronic properties, lattice dynamics and transition of metastable 1T-MoS₂ phase without or with nickel (Ni)/cobalt (Co) transition-metal atoms adsorption using the first-principles method. Their calculations show that both nickel and cobalt could effectively stabilize 1T-MoS₂ through doping.

Water striders are able to walk on the surface of streams, ponds and lakes due to their hierarchical leg structure and wax coating. Fire ants relocate through water in colonies, but their ability to move on the water surface is limited due to legs designed for walking on dry ground rather than water. In the first Original Research Article, Hurchalla and Drelich⁴ describe their studies on resistance of strider and fire ant legs to submersion into water.

Using a high-sensitivity microbalance, they measured forces during immersion of insect legs at various angles into water droplets. The results revealed that legs oriented parallel to the water surface could support more force before immersion, compared to legs in a perpendicular orientation.

As next described by Gendelman *et al.*,⁵ a focused magnetic field can effectively deform a diamagnetic liquid surface to form a well, an effect known as the ‘Moses effect’. It provides a mechanism for trapping and displacing solid and gaseous objects and could be explored in magnetic digital microfluidics. The authors demonstrate the Moses effect experimentally and describe it theoretically through a derived model, which takes into account the effects of applied magnetic field, the magnetic susceptibility, liquid surface tension and gravity on the shape of a well produced using a magnetic field.

Cai *et al.*⁶ describe the process of synthesis and calcination of copper oxide (CuO) microspheres made of nanoparticles. Mesoporous copper oxide microspheres composed of thin nanosheets were fabricated using different calcination times to control pore structure parameters such as pore size and volume and specific surface area. These microspheres, made of copper oxide p-type semiconductor, showed reproducible sensitivity to vapors of ethanol over a broad range of alcohol concentration, demonstrating their capability as a gas sensor.

In the work by Zvyagina *et al.*,⁷ a simple method for fabricating graphene oxide (C₁₄₀H₄₂O₂₀) monolayers, as an alternative to chemical vapor deposition, is presented. Graphene oxide nanosheets were transferred from an oil–water interface onto substrate surfaces. The packing density of nano-flakes, their uniformity, smoothness and lateral organization was controlled by the amount of graphene oxide sheet, as well as the temperature and chemistry of organic solvent used. This appears to be an experimentally simple and feasible method, which could be used in a large-scale fabrication of graphene oxide films for optoelectronics and chemical sensing devices.

Li *et al.*⁸ report the fabrication of a coating made of Ni60/Invar36 alloy on a steel using the high-frequency induction cladding method. The experimental work is supported by a three-dimensional electromagnetic thermal multifield coupling model simulation. The authors demonstrate that an optimized Ni60 coating shows promise to enhance hardness and extend the service life of mandrels produced through powder metallurgy, while embedding Invar36 in

the Ni60 coating can effectively improve molding accuracy through a reduction in the coefficient of thermal expansion.

In the last contribution to this issue, Guo *et al.*⁹ describe functionalization of nanocellulose for the enhancement of its surface activity. This product could have a potential application as an oil-displacement agent. The authors use free radical graft copolymerization to introduce hydrophilic anionic sulfonate groups and hydrophobic fluorinated groups. The functionalization of cellulose nanoparticles is an interesting approach in the formulation of biodegradable and environmentally friendly surface-active agents, which could be used as emulsifiers of high oil–water interfacial activity.

We hope that everyone will enjoy reading the content of this issue. We are looking forward to comments and suggestions from the readers.

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