

Editorial

Jaroslav Drellich

Department of Materials Science and Engineering, Michigan Technological University, Houghton, MI, USA

This issue features eight original research reports prepared by researchers from various countries. In the first contribution, selected as the feature article for this issue, the research team led by Professor Ji Liang from the Institute for Superconducting and Electronic Materials at the University of Wollongong in Australia and his collaborators from China describe a novel method to enhance photoactivity of hematite used as a photoanode for water oxidation.¹ The authors demonstrate benefits of annealing hematite-based photoanode material in a molten salt of potassium chloride at high temperature. This thermal treatment in the molten salt enhances the structure and crystallinity on the hematite surface, leading to higher photoelectrochemical performance. This simple innovation could be applied to passivate surface recombinations of photoelectrodes made of other ceramic materials and enhance their photoactivity.

Then, Li *et al.* report on a new method for preparing luminous polyester non-woven fabric by treating the fabric surface with a photosensitive rare-earth strontium aluminate material, capable of emitting blue-violet light.² The process is simple and involves dipping the fabric in a suspension made of the luminescent powder and diluent with a binder, followed by drying and baking. The authors demonstrate that their fabric, coated with photosensitive particles, has absorption peaks at 280 and 365 nm. The main wavelength of the luminescent fabric is 413 nm, which corresponds to the blue-violet region in the chromatogram. This luminous fabric could be attractive to applications such as night traffic warning signs, decorations for entertainment events and households.

Next, the inter-institutional research team lead by Professor Jan Miller from the University of Utah used molecular dynamics and ab initio simulations for the analysis of the wetting characteristics of silica surfaces including quartz, talc and tridymite.³ Through computer simulations, the authors determined the water contact angle, interfacial water structure, hydroxylation reaction and hydration energy, and found most of these values in close agreement with the experimental ones reported in the literature. They also demonstrate that wetting of surfaces and interfacial water molecules orientation strongly depend on silica polarity and its hydroxylation. Polar silica surfaces can be wetted by water that forms ordered interfacial water structures, whereas non-polar siloxane surfaces are quite inert to water, having weak interactions with water molecules.

The locomotion of liquids for lab-on-a-chip processes and in microfluidics has received increasing attention in the recent year. In

Ludmila Boinovich

A.N. Frumkin Institute of Physical Chemistry and Electrochemistry, Russian Academy of Sciences, Russia

Ziqi Sun

Queensland University of Technology, Brisbane, Australia

an original contribution, Dai *et al.* present the behavior of water deposited into superhydrophilic diverging grooves, surrounded by a superhydrophobic substrate.⁴ They show theoretically and experimentally that the propelling of water can be controlled by the angles of superhydrophilic diverging grooves. To propel water uphill, the divergence angle of at least six degrees is recommended.

In the fifth contribution, Khalil *et al.* describe the formulation of hexagonal zinc nanoparticles using the arc discharge technique.⁵ The zinc nanoparticles produced had a narrow distribution of sizes; from 14 to 23 nm. It is expected that this arc discharge method could also be used to prepare high-purity nanoparticles made of other metals. The authors also demonstrate antimicrobial properties of the zinc nanoparticles against common bacteria including *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus* and *Bacillus cereus*, and suggest applications of these nanoparticles in water desalination plants and water filters.

In the contribution by Liu *et al.*, the authors study adsorption of three fatty acids including lauric acid, oleic acid and stearic acid at the magnesite surface using molecular dynamics simulations.⁶ They show that carbonate groups of fatty acids preferentially interact with magnesium atoms on the mineral surface. Additionally, the authors found that hydrophobicity of magnesite modified with an adsorbed fatty acid layer increases with the increase in fatty acid carbon chain length. The simulations also reveal the magnesite surface can become hydrophilic when stearic acid adsorbs as a bilayer. The results of these molecular dynamics simulations elevate understanding of magnesite–fatty acid interactions for the benefits of this mineral in applications such as a filler in polymers (for fire retardation), cosmetics, paint and paper, as well as in selective flotation separation during recovery of magnesite from ore.

The paper by Kumar *et al.* focuses on nanocomposite polymer gel electrolytes containing weak aliphatic dicarboxylic acids including oxalic, malonic and succinic acids, dimethylsulfoxide as solvent, polyvinyl alcohol as polymer and nanoparticles of fumed silica as the filler.⁷ The authors demonstrate an increase in the conductivity of polymer gel electrolytes with increasing addition of silica nanoparticles, and explain this effect by a double percolation threshold model. A maximum room temperature conductivity of over 2 mS/cm is reported, with small changes in conductivity caused by rising temperature. These new polymer gel electrolytes could be attractive to solid-state batteries, supercapacitors, fuel cells and other energy devices.

In the last paper of this issue, Vasilieva *et al.* describe studies on surface tension and rheology measurements of aqueous solutions containing pyrrolidinium surfactant with hexadecyl hydrocarbon tail and hydroxyethyl moiety at the quaternary nitrogen atom with added polymers (polyacrylic acid, polyethylene glycol, polyvinylpyrrolidone) and hydrotropes (sodium salicylate, sodium benzoate, sodium tosylate).⁸ They report that sodium salicylate causes the largest effect on the surface activity of pyrrolidinium surfactant. Addition of that hydrotropic salt decreases almost sevenfold the critical micelle concentration and increases the viscosity of the solution by four orders of magnitude. Determining the aggregation properties in polyacrylic acid/pyrrolidinium surfactant mixtures for various molecular weights of polymer, they demonstrated that the most synergistic effect (aggregation and solubilization ability) was observed in the presence of a low molecular weight anionic polyacrylic acid. Addition of non-ionic polymers (polyvinylpyrrolidone or polyethylene glycol) to pyrrolidinium surfactant solutions did not significantly change their properties, suggesting that the interactions between polymers and pyrrolidinium surfactant are mainly of an electrostatic nature.

We hope that you will find the content of this issue interesting and useful to your research projects. Please do not hesitate to email your comments and suggestions to us.

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