Editorial

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Guifu Zou,¹ Hongmei Luo,² Baoquan Sun,³ Menka Jain,⁴ and Huisheng Peng⁵

¹ School of Energy, Soochow University, Suzhou, Jiangsu 215000, China

² Department of Chemical Engineering, New Mexico State University, Las Cruces, NM 88003, USA

³ Center for Soft Matter, Soochow University, Suzhou, Jiangsu 215015, China

⁴ Department of Physics, University of Connecticut, Storrs, Mansfield, CT 06269, USA

⁵ Macromolecular Science Department, Fudan University, Shanghai 200433, China

Correspondence should be addressed to Guifu Zou, zouguifu@suda.edu.cn

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Composite materials that traditionally incorporate micron-scale reinforcements in a bulk matrix offer opportunities to tailor material properties such as hardness, tensile strength, ductility, density, thermal and electrical conductivity, and wear resistance. With the advent of nanomaterials, nanocomposites are multiphase materials where one of the phases has at least one dimension of less than 100 nm. The properties of nanocomposite materials depend not only on the properties of the building components but also on their morphologies and interfacial characteristics. There is also the possibility of producing improved or multifunctionalities and/or new properties due to the coupling between the two components, which may not be found for each component at a pure state. The published works are briefly addressed as follows.

The paper by Shanghai Jiao Tong University, China, reports a web server, FOLDNA, which can automatically design two-dimensional (2D) self-assembled DNA nanostructures according to custom pictures and scaffold sequences provided by the users. Self-assembled DNA is built by a long single strand scaffold DNA and a lot of short single strand DNA known as staples. Self-assembled DNA nanostructures are increasingly valuable in nanomaterial and biosensing applications. A paper from Italy investigates the preparation and mechanical properties of polytetrafluoroethylene-poly(methyl methacrylate) (PTFE-PMMA) core-shell particles by a seeded emulsion polymerization method. Compact nanocomposites were prepared by annealing the core-shell particles at a temperature higher than the glass transition temperature of PMMA. Another paper also from Italy is about microwave-assisted hydrothermal synthesis to

magnetite (Fe_3O_4) nanoparticles with a monodispersed crystallite structure with particles size around 15–20 nm, which were used as filler for a commercial polymethylmethacrylate resin.

Altra paper from Japan is about the self-assembled supramolecular architectures. Anionic tris (biimidazolate) nickelate (II) ($[\text{Ni}(\text{Hbim})_3]^-$), a hydrogen-bonding (H-bonding) molecular building block, undergoes self-organization into honeycomb-sheet superstructures connected by complementary intermolecular H-bonds. The crystal obtained from the stacking of these sheets is assembled into channel frameworks, approximately 2 nm wide, that clathrate two cationic K^+ -crown ether derivatives organized into one-dimensional (1D) double-columnar arrays. In this paper, the authors showed that all five cationic guest-included crystals form nanochannel structures that clathrate the 1D double-columnar arrays of one of the four types of K^+ -crown ether derivatives, one of which induces a polymorph. The paper from Russia, studies the influence of modification by hydroxyapatite (HA) nano- and microparticles on tribotechnical properties of ultrahigh-molecular-weight polyethylene (UHMWPE) to develop polymer implants for endoprostheses. It was concluded that nanofilling of UHMWPE by 0.1–0.5 wt% HA increases its wear resistance in 3.5 times compared to the pure polymer. High-energy treatment by N^+ ion beam brings structural rearrangement and cross linking of macromolecules in the polymer surface layers resulting in an increase of its wear resistance. The authors expected that the high-energy treatment of UHMWPE-based composites can be used in combination with filling by

HA nanoparticles as a method of sterilization of products for medical applications (orthopaedic implants). Another paper is a collaborative study from Brazil, Latvia, and USA. This paper focuses on demonstrating how nanomaterials with nanolevel size can contribute to the development of 3D human tissues and organs which have macrolevel organization. The authors presented several examples of novel tissue and organ biofabrication technologies based on using novel nanomaterials and described a robotic device for fabrication of compliant composite electrospun vascular graft.

A paper from Norway is a study of the optimum dispersion of multiwalled carbon nanotubes (MWCNTs) for epoxy nanocomposites. The particle size distributions were characterized by the means of a disc centrifuge, and the effect of dispersion time, power density, and total energy input, for both bath and circulation probe ultrasonic dispersing equipment was investigated. The eighth paper from India aims to compare the scratch hardness (H_s) with the indentation hardness (H_{IT}) obtained from nanoindentation measurements of exfoliated graphite/poly (methyl methacrylate) (EG/PMMA) composites produced by in situ melt mixing method. It was found out that there is a good correlation between the scratch hardness and the indentation hardness at low indentation depths, with a linear relationship between hardness and the reinforcement content of exfoliated graphite. A paper is contributed by one of our guest editors in USA. The paper reports the preparation of two hydrocracking catalysts Pd/CoMoO₄/silica and Pd/CNTs/CoMoO₄/silica (CNTs, carbon nanotubes) and reports the catalyst activity measured in a Parr reactor with camelina fatty acid methyl esters (FAMES) as the feed. The results showed that the Pd nanoparticles have been incorporated onto mesoporous silica in Pd/CoMoO₄/silica or on the CNTs surface in Pd/CNTs/CoMoO₄/silica catalysts. The two catalysts both show high conversion and selectivity in a hydrocracking catalytic reaction. The different combinations of metals and supports have selective control cracking on heavy hydrocarbons due to synergism between metals and different reaction sites where the catalysts were loaded.

A paper from Japan is a study of mechanical and thermal characteristics of biopolymer nanocomposites consisting of poly-L-lactic acid (PLLA) and self-assembling siloxane nanoparticles with three phases. A high-density siloxane phase (plural cores), an elastomeric silicone phase, and a caprolactone oligomer phase were developed to increase the mechanical properties of PLLA. The nanoparticles, average size of 13 nm, were self-assembled by aggregation and condensation of an organosiloxane with three units: [isocyanatepropyltrimethoxysilane] (IPTS), [polymethylpropylloxysiloxane] (PMPS), and a caprolactone oligomer (CLO), which form each phase. Bending and tensile testing showed that the use of these nanoparticles (5 wt% in PLLA) greatly increases the tenacity (breaking strain) of PLLA while maintaining its relatively high breaking (maximum) strength. The elongation of the nanocomposite was more than twice that of PLLA while the elasticity modulus and breaking (maximum) strength were comparable to those of PLLA. The nanoparticles also increased the impact strength of PLLA. From

these results, the bionanocomposite using the three-phased nanoparticles is expected to be used in durable product applications and other new applications. These nanoparticles can also be applied to various other brittle polymers by modifying the structure of the outside phase to achieve a high affinity with these polymers. A paper in this issue is contributed from Singapore. A hybrid magnesium alloy nanocomposite containing AlN nanoparticle reinforcement was fabricated using solidification processing followed by hot extrusion. The nanocomposite exhibited similar grain size to the monolithic hybrid alloy, reasonable AlN and intermetallic nanoparticle distribution, nondominant (0002) texture in the longitudinal direction, and 17% higher hardness than the monolithic hybrid alloy. Compared to the monolithic hybrid alloy, the nanocomposite exhibited higher tensile yield strength (0.2% TYS) and ultimate tensile strength (UTS) without significant compromise in failure strain and energy absorbed until fracture (EA) (+5%, +5%, -14%, and -10%, resp.). Compared to the monolithic hybrid alloy, the nanocomposite exhibited unchanged compressive yield strength (0.2% CYS) and higher ultimate compressive strength (UCS), failure strain, and EA (+1%, +6%, +24%, and +6%, resp.).

Guifu Zou
Hongmei Luo
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Huisheng Peng