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Editorial: 2022 retrospective: polymeric and composite materials

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Editorial on the Research Topic
2022 retrospective: polymeric and composite materials

This collection of articles covers a range of Research Topics in polymeric and composite materials. Potential application areas covered include the development of construction materials, materials for efficient thermal management of electronic devices, polymer blends from biodegradable polymers, surface modification of nanoparticles for biomedical use, molding of two-dimensional (2D) woven CFRP into complex shapes, and transparent electrodes in organic solar cells.

With demand for fly ash tending to exceed the supply for incorporation into construction materials for the building industry, Liu et al. studied the use of dactite powder to partially replace fly ash in the preparation of cementitious materials. The study found that the fineness of dacite powder is controlled by ball milling time, which affects the final performance. The authors also suggest an appropriate ratio of dactite powder to fly ash in the cement mixture, giving the best performance.

In electronic devices, the development of new materials for thermal management is important. In particular, Kong et al. developed a new composite system consisting of boron nitride nanosheets (BNNS) and cellulose nanofibers (CNFs). The BNNS were prepared by a water exfoliation method using the hexagonal boron nitride powder. The BNNS/CNF composite was then formed by a water filtration method similar to that used in the pulp industry; due to the 2D structure and in-plane compression of the BNNS, this composite has a very high in-plane thermal conductivity.

The continued awareness of the environmental impact of petroleum-derived plastics has led to a real need for the development and use of naturally derived biodegradable materials such as polylactic acid (PLA). In order to overcome the inherent brittleness of PLA, the blending with a biodegradable elastomer such as poly (ε-caprolactone) (PCL) is a possible solution. Negaresh et al. have combined glycidyl methacrylate (GMA) and nanocalcium carbonate (NCC) to improve the poor compatibility between PLA and PCL in blends and enhance the interfacial interaction between PLA and PCL. Although GMA enhanced the elongation at break and Izod impacts the strength of the blend, NCC improved the tensile modulus and impact strength.

Nanoparticles (NPs) with appropriate surface functionalization have found applications in the biomedical field; Sotoma reviewed the literature on surface coatings of a number of nanoparticle types (nanodiamond, magnetic NPs, gold NPs, gold nanorods, and mesoporous silica) coated with hyperbranched polyglycerol (HPG) and polydopamine (PDA). Both HPG and PDA have low toxicity and could potentially reduce the inherent toxicity of NPs in biological systems. Their potential applications and hurdles to their development are also illustrated.

When forming dry 2D woven CFRP fabrics into final 3D product shapes, knowledge of deformation and fiber orientation is important for understanding the performance of composite structures. Sun et al. studied and compared dry fabric forming using a number of finite element-based modeling techniques and analytical solutions, and compared simulation results with experimental observations of two punch forming-geometries, i.e., hemispheric and tetrahedron.

In organic solar cells, the development of transparent electrodes and hole transport layers requires transparency, conductivity, and stability; Sánchez Vergara et al. studied hybrid films consisting of poly (3,4-ethylenedioxythiophene): poly (styrenesulfonate) (PEDOT: PSS) and hybrid films consisting of a seven-coordinated organotin (IV) complex modified with graphene. The optical properties of the hybrid films were investigated. The hybrid films were packaged into a complete solar cell structure (glass/ITO/PEDOT: PSS/graphene complex/BPhen/Ag) together with basophenanthroline (BPhen) as an electron transport layer, and their conductive behavior was discussed.

Author contributions

RL: writing–original draft and writing–review and editing. PV: writing–original draft and writing–review and editing.

Conflict of interest

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