frontiers | Frontiers in Materials

EDITORIAL
published: 17 August 2022
doi: 10.3389/fmats.2022.932784

Editorial: Biodegradable Polymers and Composites

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Keywords: biodegradable polymers, composite materials, synthesis, processing, characterization, application

Editorial on the Research Topic

Biodegradable Polymers and Composites

The increasing reliance on disposable and durable plastic products makes synthetic polymers ubiquitous. Most plastic breaks down into microplastics and ends up in the ocean, threatening aquatic life, birds, and eventually humans. Microplastics come from various resources, which can usually be traced back to either larger plastic debris or macro-to-micro pieces. The transition from traditional petroleum-derived plastics to biodegradable polymers is now a direction that researchers and industries cannot circumvent.

Recently, poly(lactic acid) (PLA), polybutylene adipate-co-terephthalate (PBAT), cellulose, keratin, starch, chitosan, and many other biopolymers and biodegradable polymers have been employed to produce products for commercialization. For example, PLA/paper straws and disposable bags from 80% PBAT and 20% PLA increasingly exist in large grocery stores and take-out delivery of featured delis in China. However, there is still room for biodegradable polymer products to improve, in terms of cost and performance properties, in order to expand their applications in food packaging, mulching film, textiles, and biomedical devices, and many other areas. In this Research Topic, we hope to promote cutting-edge work about chemical and physical modifications and processing of biodegradable polymers to make them compatible and competent substitutions for current plastic products.

Based on this aim, the current issue includes promising and novel research trends in the field of biodegradable polymers and composites, covering synthesis, characterization, and processing of biodegradable polymers; research focusing on biopolymers such as PLA, PBAT, cellulose, keratin, starch, chitosan, applications of biodegradable polymers for packaging, medicine, agriculture, and so on; and functional biodegradable polymers. The eight articles published in this issue could meet the call for fundamental research in the improvement of biodegradable polymers' properties and functionalities. Among the eight papers, seven are research articles and one is a literature review related to bio-synthesized polymers, natural macromolecules from plant and poultry agro-wastes, novel technology to manipulate biopolymers for biomedical applications, and polymeric products for soil enhancement toward agricultural upgradation.

Polylactic acid is attracting global attention as one of the most commercial bio-derived and biodegradable polymers. However, the poor thermal-hydro-stability of PLA restricted its wide applications in either textile or biomedical areas. Zhao et al. introduced nano-silver into electrospun stereo-complexed polylactide fibers and obtained PLA nanofibrous mats, which have antibacterial capability and could be sterilized under high temperature.

OPEN ACCESS

Edited and reviewed by:
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Specialty section:
This article was submitted to Polymeric and Composite Materials, a section of the journal Frontiers in Materials

Received: *30 April 2022*
Accepted: *09 May 2022*
Published: *17 August 2022*

Citation:
Xu H, Ma B, Zhang Z and Hu J (2022) Editorial: Biodegradable Polymers and Composites. Front. Mater. 9:932784. doi: 10.3389/fmats.2022.932784

Keratins are a special group of animal proteins with outstanding properties for biomedical applications. Du et al. developed a clean and efficient approach for the extraction of wool keratin targeting the reuse and recycling of discarded wool-containing textiles. Wang et al. employed freeze-thaw cycles to prepare hydrogels from rabbit hair keratin and assessed the molecular structure and the mechanical and optical properties of hydrogels. These two articles presented novel approaches for keratin reuse and provided new insights into the manipulation of highly crosslinked proteins.

Suleman et al. summarized bioceramics and polymers used in 3D printing technologies for bone tissue engineering. This review specifically discussed drug-loaded scaffolds designed for localized chemotherapy for osteosarcoma. Diverse organic and inorganic substances for bone tissue engineering were discussed, including chitosan, alginate, collagen, gelatin, silk fibroin and other natural polymers, polycaprolactone, polyurethane, poly(lactic)acid poly(vinyl) alcohol, and other synthetic polymers, as well as calcium phosphate, calcium silicate, bioglass, and other bioceramics. The authors also analyzed articles reporting that 3D printing technologies assisted with drug nano-delivery technologies.

Lin et al. introduced a new approach to endowing cotton fabrics with thermal protection using polyurethane enhanced silica aerogel. Silica dioxide aerogel has been promoted to be incorporated into low-temperature protection garments for its extraordinary thermal insulation properties and lightweight. However, the extreme brittleness of the aerogel impeded its real applications in commercial products. By introducing optically active polyurethane, this technology improved mechanical robustness while not jeopardizing the thermal insulation of silica aerogels.

Ramachandran et al. used dextran produced from bacteria for soil stabilization and assessed the mechanical properties of the dextran products. Morphographic and nanomechanical testing *via* atomic force microscopy, nanoindentation, and scanning electron micrographs were employed to reveal the fundamental mechanism of bacterial biopolymer-based cementation. Characterizations indicated that *in situ* generated dextran could be as effective as commercial biopolymers.

Residual polyethylene mulching films caused serious soil pollution in farmland. Biodegradable films usually are incompetent due to mechanical loss during the degradation process. In this work, Liu et al. compared the impact of more de-composable mulching films on soil hydrothermal status and water utilization efficiency with common polypropylene mulching films. This research was done in a real maize field under natural conditions and thus could provide important guidance for real practices of mulching film for improved maize cultivation.

Sulaiman et al. used rice husks as reinforcement and polypropylene as a matrix to develop thermoplastic biocomposites. This work investigated the impact of aqueous glycerol treated rice husk on the surface mechanical properties of produced biocomposites. *Via* nanomechanical analysis, glycerol treatment was proven effective in improving the mechanical properties and creep behavior. The study indicated that aqueous glycerol pretreatment can partially strip off non-cellulosic constituents from lignocellulose matrix to generate cellulose-rich pulp for engineered composite applications.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

FUNDING

The authors appreciated the financial support from the International Joint Research Laboratory for Eco-Textile Technology (IJRLETT) at Jiangnan University, the National Defense Cultivation Project of Fundamental Research Funds for the Central Universities (JUSRP41904), and the 111 Project (B17021).

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