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EDITED AND REVIEWED BY
Fabrizio Sarasini,
Sapienza University of Rome, Italy

*CORRESPONDENCE
Mehdi Derradji,
derradjimehdi1@gmail.com

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Editorial: Advanced green thermosetting composites: Design and performances

Mehdi Derradji[1]*, Wenbin Liu[2] and Nicholas Fantuzzi[3]

[1]UER Procédés Energétiques, Ecole Militaire Polytechnique, Algiers, Algeria, [2]Key Laboratory of Superlight Material and Surface Technology of Ministry of Education, College of Materials Science and Chemical Engineering, Institute of Composite Materials, Harbin Engineering University, Harbin, China, [3]DICAM Department, School of Engineering and Architecture, University of Bologna, Bologna, Italy

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Editorial on the Research Topic
Advanced green thermosetting composites: Design and performances

High-performance composites are targeted in many exigent applications, such as aerospace and marine fields, for the development of lightweight structural composites. Till now, these industries only rely on petroleum-based materials for their supposedly better performances. However, latest reports confirmed that sustainable and eco-friendly composites can display similar or even better performances (Shekar and Ramachandra, 2018). Additionally, exploring alternative renewable feedstock to meet the ever-increasing demands of these industries is an essential step towards sustainable development (Derradji et al., 2021). The production of innovative composites for novel and emerging applications originating from renewable and abundant eco-friendly materials has earned particular interest. Indeed, by following the principle of green chemistry, sophisticated approaches can be developed by synergically combining the use of renewable feedstock, neoteric solvents and more energy-efficient heating sources (Anastas and Eghbali, 2010; Zegaoui et al., 2018). The ultimate goal is to develop high performance fully green composites for an efficient replacement of their traditional petroleum-based counterparts.

Based on these premises, the present Special Issue in “Frontiers in Materials”, Section “Polymeric and Composite Materials” entitled “Advanced Green Thermosetting Composites: Design and Performances” aims to further contribute to the momentum of research and development in green composites, by featuring five (05) original research papers authored and reviewed by experts in the field.

The first research article, by Yew and al., investigated the mechanical properties of Barchip polypropylene fibre-reinforced lightweight concrete made with recycled crushed lightweight expanded clay aggregate. This interesting research aims to propose an efficient replacement of conventional coarse aggregates with recycled lightweight expanded clay aggregate (LECA) which offers several advantages such as lightweight, low cost, and easy availability. Based on the experimental results, the inclusion of Barchip polypropylene fibre showed a positive effect on the mechanical properties. It helps in stopping the propagation of cracks by introducing a bridging effect, enables stress transfer, promotes additional energy absorbing mechanisms, and hence allows larger deformation.

Another interesting research article, carried out by Graupner and coworkers, focused on the development of yarns from cost-effective hemp from a disordered separation process (total fibre line) for composite reinforcements. Composites were fabricated using a miniature pultrusion process with thermosetting matrices from the yarns. The results show that around 90% of the flexural strength and flexural modulus of identically produced flax composites could be achieved with maximum values of 282 MPa for the flexural strength and 23.4 GPa for the flexural modulus. The yarns were additionally used to manufacture quasi-unidirectional fabrics to produce composite laminates using different manufacturing processes. Overall, the newly developed materials showed sufficient characteristic values for use in applications with higher mechanical requirements.

Graupner et al. also reported about a competitive study of the static and fatigue performance of flax, glass, and flax/glass hybrid composites on the structural example of a light railway axle tie. The obtained results showed that flax is very well-suited as a reinforcing fiber for components under cyclic loads. It is particularly noteworthy that the flax composites have significantly higher fatigue strength than GFRP at higher number of loading cycles. The study also demonstrated that low-cost flax tow could be processed into low-twist yarns and fabrics with little ondulation and, in the composite, has comparable properties to composites made from higher quality and more expensive long flax rovings.

A true example of how green composites can be a game changer in the medical field can be found in the fourth article of this collection. In fact, Amini et al. reported about the fabrication of fibrous materials based on cyclodextrin and egg shell waste as an affordable composite for dental applications. In the course of the study, the authors detailed the fabrication process of the fibrous nanostructures using electrospinning technique under optimal conditions. The cyclodextrin nanofibrous products were used as new nanostructures in the field of dental coatings due to the obtained properties such as uniform shape, small particle size distribution, high thermal stability and optimal abrasion resistance. The newly developed nanostructures could be a promising candidate for use as a dental nanocoating material.

The final article of the collection treats the important aspect of the pollutant gas control using green adsorber. Thus, Muzammil et al. reported about the synthesis of novel Sc-MOF@SiO_2 core/shell nanostructures under optimal conditions of ultrasonic assisted microwave routes. The final products showed small particle size distribution with homogeneous morphology, high thermal stability, high surface area and significant porosity. This study and its results promise a green future for potential controlling the gas pollutant.

In summary, the present special issue advances not only our understanding of the emerging and important role of green composites in various fields but also challenges and future research directions to fully exploit their fascinating properties in practical ways.

Author contributions

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

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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