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Opportunities and Challenges for Composite Materials in a Sustainable World

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Abstract:

The high specific mechanical properties of fiber-reinforced polymer composites make these materials attractive for lightweight applications, and as such, composite materials are valuable tools in the design and development of sustainable technologies like wind turbine blades, tidal energy harvesting, electrical grids, and transportation systems, including electric vehicles. However, the composite industry faces challenges with regards to the sustainability of its materials and processes. Specifically, the energy input required to make carbon fibers is very high, current composite processes tend to result in high fractions (~40%) of scrap material being created, and the available options for composite materials at end-of-life are currently limited, resulting in composite materials being landfilled. Solutions for improving the sustainability of composites can potentially be found through the development of new materials and processes. This presentation will discuss recent research activities that aim to reduce the environmental impact of composite structures. Firstly, replacing epoxy-based matrix systems with recyclable thermoplastic polymers that can be reformed and recycled in industrial applications. Secondly, using additive manufacturing of continuous fiber-reinforced polymer composites to expand the design space of lightweight structures to minimize weight while eliminating scrap waste. Finally, attention is directed to the growing study and use of sustainable materials in composites in the form of natural fibers and binders. Through mindful design, material selection, and process development, composites can help lead the way to sustainable technologies.

Keywords: Composite materials, Additive manufacturing, Thermoplastic composites, Natural fibres

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