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Anisotropic properties of oriented short carbon fibre filled polypropylene parts fabricated by extrusion-based additive manufacturing

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Abstract

For composites based on polypropylene (PP) filled with short carbon fibres (CF), extrusion-based additive manufacturing provides a promising and cost-effective manufacturing technique that utilises the flow-induced orientation of the fibres for their targeted alignment through the control of the printing direction. This study investigates the impact of the fibre orientation on mechanical properties and thermal conductivity of 3D-printed PP composites filled with short-CF. Provided a homogeneous fibre-dispersion and a good fibre-matrix adhesion, the composites showed considerably improved mechanical properties compared to neat PP regardless of the fibre orientation. However, for the different printing orientations, a strong anisotropy in terms of flexural and impact properties and thermal conductivity was observed. For example, it was found that the thermal conductivity along the printing and, thus, the fibre direction was three times higher than perpendicular to that direction. The present work provides a key to the fabrication of parts with tailored, orientation-dependent properties.

Keywords

A. Carbon fibres; B. Mechanical properties; B. Thermal properties; E. 3-D Printing