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PROCEEDINGS

3D Printing of Complex Micro-Macrostructure Composites with Enhanced Mechanical Properties

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ABSTRACT

Complex hierarchical structure in nature with remarkable performances of such as lightweight, high stiffness and strength, and so on, has inspired researchers designing and fabricating aligned structures for reinforced composites. Conventional techniques like freeze-casting, self-assembly, wet-spinning, shear force, electric, and magnetic field have been demonstrated to achieve excellent reinforced structures. Still, they are limited to microstructure control and small-sized samples. While 3D printing techniques enable to achieve a large diversity of dimensions, multimaterial and multifunctional 3D structures. Particularly, recent 3D printing combined with external force e.g., shear force, magnetic and electrical field has been employed to control microscale and hierarchies at the macroscale for the applications of reinforced structure. To explore the complex micro-macrostructure in composites to reinforce mechanical properties is quite interesting.

Herein, we will present novel approaches where 3D direct ink writing is integrated with magnetic field and shear force to achieve microstructure and macro-shape design simultaneously. Specifically, the applied magnetic field and shear force are capable of tuning the alignment of microplatelets and microfibers in the extruded ink. By tuning the micro-macrostructure, the obtained complex composites possessed remarkable reinforced properties on flexible strength、compressive strength, and toughness. This innovation opens up an opportunity to fabricate remarkable complex composites with lightweight, highly printing efficient, tunable loading of fillers, control of alignment distribution for the potential applications of aerospace, buildings, and defense applications.

KEYWORDS

3D printing; microstructure; mechanical properties

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