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Extrusion-Based Additive Manufacturing of Polymer-Ceramic Composites and Ceramic Components Using Highly-Filled Feedstocks: A Review

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Abstract. Extrusion-based additive manufacturing has emerged as a powerful technique for fabricating polymer-ceramic composites with complex geometries. By enabling layer-by-layer deposition without the need for molds, this process significantly reduces material waste and manufacturing costs, particularly for low-volume and customized production. Among various additive manufacturing technologies, extrusion-based 3D printing methods are widely adopted owing to their cost-effectiveness, design flexibility, and broad material compatibility. These processes typically utilize polymers as binders or matrices, combined with high loadings of ceramic powders and functional additives, where the ceramic phase plays a dominant role in defining the final mechanical, thermal, and functional properties of the component. This review provides a comprehensive overview of extrusion-based additive manufacturing of polymer-ceramic composites. It systematically examines the key material systems, binder formulations, processing routes, post-processing strategies, and critical parameters that govern microstructural development and overall performance.

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