Thermally conductive polymer nanocomposites for filament-based additive manufacturing

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ABSTRACT

Thermal management is a crucial factor affecting the performance and lifetime in several applications, such as electronics, generators, and heat exchangers. Additive manufacturing (AM) techniques provide a new revolution in manufacturing by expanding freedom for design and fabrication for complex geometries. One way to overcome these problems is by developing novel polymer-based composite materials with improved thermal conductivity properties for AM technologies. In this review, the fundamental principles of designing high thermal conductive polymer nanocomposites are presented. High thermal conductive polymer nanocomposites generally consist of the base polymer and thermally conductive filler materials such as aluminum oxide or boron nitride which are reviewed in detail. The factors affecting the thermal conductivity of composites, such as the filler loading and overall composite structure, are also summarized. This article stands on statistical data from technical papers published during 2000–2020 about the topics of fused deposition modeling (FDM) polymers or their thermal conductive composites. Finally, the most critical factors affecting the thermal conductivity of polymer nanocomposites are described in detail. Nonetheless, various novel techniques show the potential abilities of thermal conductivity of polymer nanocomposites usage by AM technologies, enabling applications in LED devices, energy, and electronic packaging. Graphical abstract: [Figure not available: see fulltext.]

KEYWORDS

3D printers; Abstracting; Additives; Alumina; Aluminum oxide; Conductive materials; Electronics packaging; Filled polymers; Fillers; III-V semiconductors; Packaging materials; Thermal conductivity

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