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High through-plane thermal conductivity of polymer based product with vertical alignment of graphite flakes achieved via 3D printing

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Abstract

The polymer/graphite based products fabricated by conventional molding method possess limited through-plane thermal conductivities (TPTCs) because the graphite flakes are strongly aligned in the in-plane direction. Based on the characteristic of fused deposition modeling (FDM, a trendy technology of 3D printing), rational design of 3D printing (3DP) process can make the graphite flakes orient along the through-plane direction. In this paper, high TPTC of polymer/graphite based products with graphite flakes vertically aligned are achieved via FDM. Although lots of voids generated during the fused deposition process, the optimal product shows a high TPTC as $5.5 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ because the fluent heat conductive pathways are not blocked by the voids. Finally, a heat sink with good thermally conductive property used for the 3D printer is successfully fabricated and it can well meet the heat dissipation requirement of 3D printer.

Keywords: Fused deposition modeling; polymers; thermal properties; anisotropy; scanning electron microscopy.

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