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PROCEEDINGS

External Field Induced High Speed Sintering of Polyurethane Covalent Adaptable Network

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ABSTRACT

Powder based high speed sintering (HSS) improves the printing efficiency compared to SLS printing. The shortened layer time for HSS requires quick melting and solidification of powders, which is a big challenge for traditional printing powders materials, especially the viscous elastomers. Herein, a dynamic cross-linked polyurethane containing Diels-Alder bonds (PUDA) was synthesized at kilo scale and used for HSS. The incorporation of dynamic DA bonds into PU enables the dissociation of the polymer chain under IR light heating, and will lead to fast relaxation, diffusion and dis/re-entanglement, addressing the problem of incomplete sintering and weak interlayer interaction faced by conventional PU. As a result, the ultimate tensile strength (UTS) and elongation at break (EaB) of PUDA part with reasonable dimensional accuracy can reach 8.1 MPa and 249%, respectively. The UTS of PUDA by HSS decreased by 58% compared with the hot-pressed one, whereas for the normal TPU it is 77%. Besides sintering quality, the sintering rates for PUDA is enhanced by 40% because of its fast melting and solidification, which are crucial for additive manufacturing as it comes to high-volume production. In addition, the dynamic DA bonds in the printed parts enable good self-healing behavior triggered by near IR spatially. This present work demonstrated that the incorporation of DA bonds in PU can greatly improve both the sintering rates and quality, which represents a valuable direction for developing HSS suitable elastomer materials.

KEYWORDS

High speed sintering; dynamic bonds; powder bed fusion; polymer powder

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