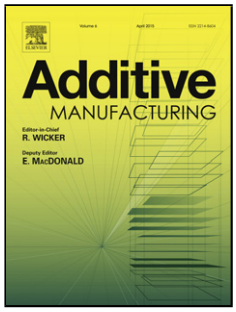

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Hot Lithography vs. Room Temperature DLP 3D-Printing of a Dimethacrylate

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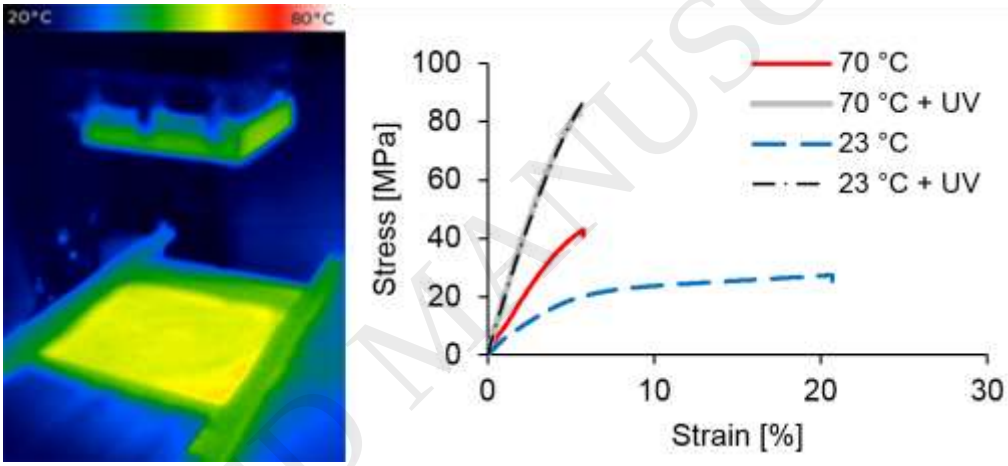
Graphical abstract



Abstract

Vat photopolymerization is used for printing very precise and accurate parts from photopolymer resins. Conventional 3D-printers based on vat photopolymerization are curing resins with low viscosity at or slightly above room temperature. The newly developed Hot Lithography provides vat photopolymerization where the resin is heated and cured at elevated temperatures. This study presents the influence of printing temperature (23 °C and 70 °C) on the properties of a printed dimethacrylate resin. The working curve was measured for 23 °C, 50 °C and 70 °C. Specimens were printed in XYZ and ZXY orientation. The resulting tensile properties were tested, dynamic mechanical analysis was carried out and the double-bond conversion was analyzed. It was found that the critical energy E_0 was significantly reduced by a higher printing temperature. Therefore, the exposure time was reduced from 50 s to 30 s to reach similar curing depth. Higher printing temperature provided higher double-bond conversion, tensile strength and modulus of the green parts. However, printing temperature did not affect the properties after post-curing in XYZ orientation. Post-cured tensile specimens in ZXY orientation had higher tensile strength when printed at 23 °C, because higher over-polymerization led to a smoother surface of the specimens. Overall, higher printing temperatures lowered the viscosity of the resin, reduced the printing time and provided better mechanical properties of green parts while post-cured properties were mostly not affected.

Keywords: Vat photopolymerization, Hot Lithography, DLP, Stereolithography, Temperature