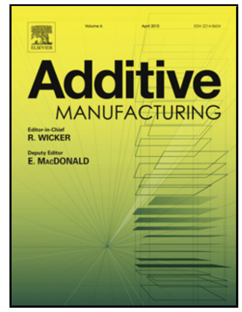

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PII:	S2214-8604(18)30563-3
DOI:	https://doi.org/10.1016/j.addma.2018.09.025
Reference:	ADDMA 514

To appear in:

Received date:	1-8-2018
Revised date:	19-9-2018
Accepted date:	20-9-2018

Please cite this article as: Hofstetter C, Orman S, Baudis S, Stampfl J, Combining cure depth and cure degree, a new way to fully characterize novel photopolymers, *Additive Manufacturing* (2018), https://doi.org/10.1016/j.addma.2018.09.025

Combining cure depth and cure degree, a new way to fully characterize novel photopolymers

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Abstract

Bottom-up stereolithography has become a common lithography-based additive manufacturing technology (L-AMT) to fabricate parts with high feature resolution for biomedical applications. Novel vinyl ester based photopolymers, with their good biocompatibility and biodegradation behavior, showed a promising capacity as bone replacement materials. Due to further tuning of the mechanical properties, those biophotopolymers exhibit reduced curing speed in comparison to highly crosslinked resins e.g. acrylates. The slow structuring of the polymer network results in difficulties at the printing process. The Jacobs working curve characterizes the cure- and penetration depth of resins, but gives no information about the mechanical properties of the cured layer. The information of cure depth and the mechanical properties of the cured layer (cure degree) is desired. In this work, we simulated the conditions at L-AMT during the structuring process with a real-time near-infrared photorheometer to evaluate the cure degree of a cured layer at constant cure depth. Therefore, we investigated the curing behavior of mixtures with variable amount of photoinitiator (PI) and light absorber (LA) of vinyl ester based biophotopolymers. We found, that a high amount of LA is crucial for good mechanical properties at constant cure depth. Moreover, we present a technique how to optimize a resin formulation regarding the content of PI and LA.

Keywords: vat photopolymerization, photorheology, biophotopolymer, Jacobs working curve, mechanical properties of cured layer