SYNTHESIS, CHARACTERIZATION, AND APPLICATION OF NOVEL SURFACE-ERODING PHOTOPOLYMER FORMULATIONS

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Three-dimensional (3D) printing has gained popularity in recent years for its ability to produce personalized 3D parts on demand with minimal supplies and with specific functionalities. Photocurable resins, typically consisting of a combination of multi-functional monomers and oligomers, a photoinitiator, and an optical absorber, are formulated for numerous applications in light-based 3D printing. Several groups have studied the application of water-soluble resin formulations, with a common concern being the swelling of the polymer matrix during the dissolution process [1]. Previous efforts to incorporate surface-eroding oligomers into resin formulations has been further limited by the commercial availability of surface-eroding constituents that are suitable for use in light-based 3D printing [1].

In this work, a synthesis protocol was invented for the production of unique surface-eroding oligomers that later react to form crosslinked networks during the 3D-printing process and readily degrade in the presence of water. Addition of particular constituents in the reaction mechanism at different stages influences the physiochemical behavior of the oligomer in unique environments by incorporating different degrees of hydrophobicity into the oligomer backbone. Further incorporation of the surface-eroding oligomers into novel resin formulations provides for high resolution 3D printable acrylic-based resins that chemically degrade in the presence of water. Chemical degradation leads to surface-erosion of the crosslinked network, which provides ample opportunity for a wide-array of applications where swelling of the polymer matrix has previously been a significant drawback in the functionality of water-susceptible 3D-printed parts.

[1] Liska, Robert, et al. "Water-soluble photopolymers for rapid prototyping of cellular materials." *Journal of applied polymer science* 97.6 (2005): 2286-2298.