ADVANCES ON THE PHOTO-CURING OF THIOL-EPOXY RESINS FOR 3D PRINTING

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Thiol-based click resins have garnered significant popularity due to their high reactivity, enabling swift photocuring under mild conditions. Click processes obviate the need for solvents and it importantly avoids the generation of by-products. Thiols have discovered utility within a variety of photo-curable systems featuring allyl or ethynyl-based resins[1-3]. Carioscia and co-workers demonstrated the light-triggered curing of diglycidyl ether of bisphenol A and thiols, which makes this class of reactions interesting for vat photopolymerization 3D printing[4]. However, the resins suffer from high viscosity at room temperature, which makes 3D printing challenging. Jian et al. reported on the low shelf life of these resins, which can cause further problems during 3D printing[5]. In contrast, Bouzrati-Zerelli and co-workers studied the photo-reaction between a thiol and a cycloaliphatic epoxy monomer, showing a slow cure rate and an unsatisfactory conversion, rendering it unsuitable for additive technologies[6]. The current study endeavours to surmount the challenge of formulating a light-curable thiol-epoxy system processable via vat photopolymerization 3D printing. The attainment of this objective necessitates the prepared resin's stability at the printing temperature, its expeditious reactivity upon exposure to light, and its requisite viscosity. To achieve this, a suitable epoxy monomer, thiol crosslinker, photolatent base and sensitizer were selected. The effect of the concentration of the components of the mixture on the photo-curing kinetics and printability was studied. With a selected formulation, 3D printed parts were fabricated and their mechanical properties were determined.

Reference:

1. Y. Wu, M. C. Simpson, J. Jin, Macromol. Chem. Phys., 222, 2000435, 2021
2. L. Chen, Q. Wu, G. Wei, R. Liu, Z. Li, J. Mater. Chem. C., 6, 11561-11568, 2018
3. E. Rossegger, J. Strasser, R. Höller, M. Fleisch, M. Berer, S. Schlögl, Macromol. Rapid Commun, 44, 2200586, 2023
4. J. A. Carioscia, J. W. Stansbury, Ch. N. Bowman, Polymer, 48, 1526-1532, 2007
5. Y. Jian, Y. He, Y. Sun, H. Yang, W. Yang, J. Nie, J. Mater. Chem. C, 1, 4481–4489, 2013.
6. M. Bouzrati-Zerelli, M. Frigoli, F. Dumur, B. Graff, J. P. Fouassier, J. Lalevee, Polymer, 124, 151-156, 2017.

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