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Resin Additive for UV 3D printing resins with (Bio)degradable properties

Constance Thomas[1], Noémie Gil[2], Jean-Louis Clément[2], Yohann Guillaneuf[2], Olivier Soppera[1*]
[1]*Université de Haute-Alsace, IS2M CNRS (UMR7361), Mulhouse, France*
[2]*Aix-Marseille Université, ICR CNRS (UMR7273), Marseille, France*
[*]*olivier.soppera@uha.fr*

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Three-dimensional (3D) printing and especially VAT photopolymerization leads to highly cross-linked materials with high thermal, chemical and mechanical properties. Nevertheless, such stability is incompatible with degradability and re/upcyclability. A high volume of 3D-printed thermoset must be incinerated or stored in landfills following use, making this so promising manufacturing process not environment friendly or sustainable. In order to solve this problem, thionolactone and especially dibenzo[c,e]-oxepane-5-thione (DOT) was used as an additive (only 2wt%) to model acrylate-based resins. The principle is based on the introduction of heteroatoms (more specifically thioester linkage) into the network backbone via a radical ring-opening polymerization. These weak bonds confer (bio)degradability to the 3D-printed object. The low amount of additive allows to only slightly modify the printability of the resin, keep intact its resolution and maintain the mechanical properties of the 3D polymer object. The resins with additive were used in UV microfabrication setup, two-photon stereolithography setup and commercial 3D printers. The fabricated objects were shown to degrade in basic solvent under mild conditions as well in a home-made compost. The rate of degradation is nonetheless dependent of the size of the object. This feature was used to prepare 3D objects with support structures that could be easily solubilized, opening the door to the 3D printing of stacked objects in the z direction.

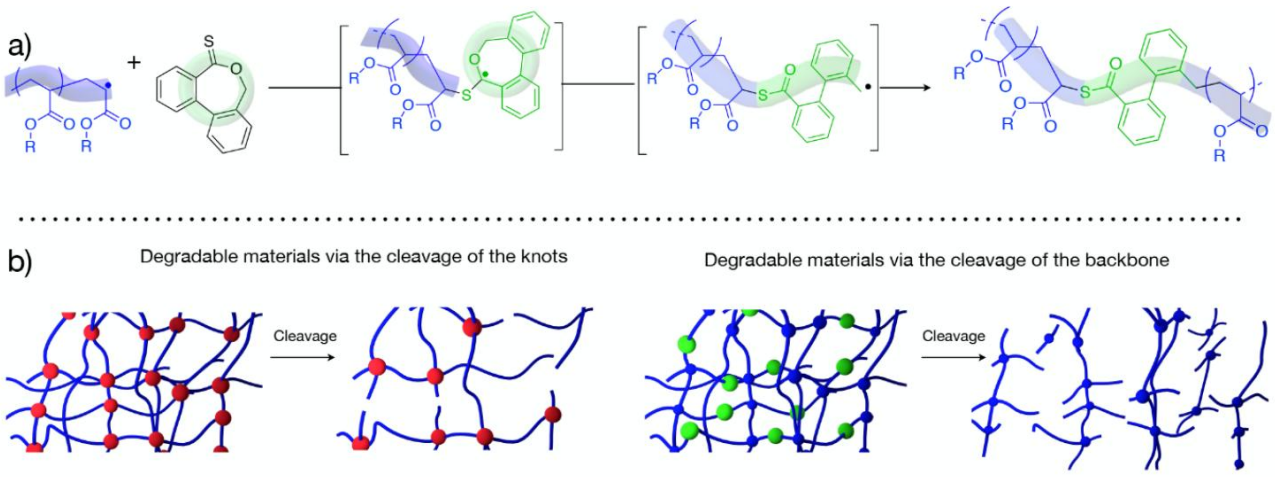

Figure 1. a) Polymerization mechanism involving the DOT/acrylate monomer pair b) Degradation illustration: knots cleavage and backbone cleavage. Both from [1].

[1] N.Gil, C.Thomas, R.Mhanna, J.Mauriello, R.Maury, B.Leuschel, J-P. Malval, J-L. Clément, D.Gigmes, C.Lefay, O.Soppera, Y.Guillaneuf Angewandte Chemie, **2022**, Volume 61, Issue 18.