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Digital Light Processing of Dynamic Bottlebrush Materials

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What was achieved?: A new class of 3D printing resins that generate super-soft, dynamic, and self-healable elastomers, based on natural building blocks (α-lipoic acid) was developed. These elastomers can be 3D printed via digital light processing (DLP) under mild conditions using commercially available printers and convenient exposure conditions. The resulting materials are crosslinked bottlebrush networks that can undergo dynamic disulfide exchange when exposed to ultraviolet light or elevated temperatures, facilitating reprocessing and post-fabrication healing.

Why is it important?: Due to their low module values that resemble those of biological tissue and muscle, bottlebrush elastomers have attracted significant attention as a class of super-soft 3D printing materials. However, current processing strategies have been limited to molding or extrusion-based 3D printing. The novel materials developed in this paper expand the range of applications for bottlebrush elastomers by making them available for light-based 3D printing. Moreover, these materials establish a simple, user-friendly design strategy for the preparation of DLP resins from cheap and bio-derived starting materials, leading to printed objects that can be reshaped and healed after experiencing damage, extending the lifecycle of the printed material. Finally, these findings expand the types of properties that can be achieved by DLP and add to the contemporary toolbox of resin chemistry for light-based 3D printing.

How did BioPACIFIC MIP enable this?

This work was performed on the Lumen X printer in the BioPACIFIC MIP Additive Manufacturing facility. The Lumen X enables printing under 385nm illumination for high resolution and fidelity. BioPACIFIC MIP also provided financial support for materials and researchers through the Fellows program.

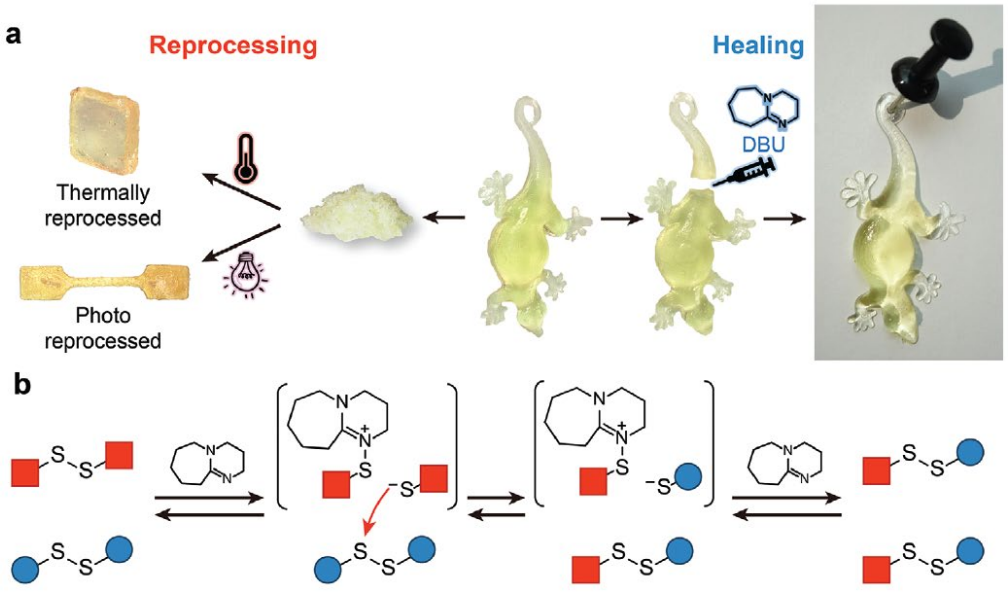

***Figure 1.** a) Objects printed from the optimized resin can be reprocessed with heat or light under compression (left) and cut surfaces are healed at room temperature by the addition of DBU (right). b) Proposed mechanism of DBU-mediated self-healing via disulfide exchange.*

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