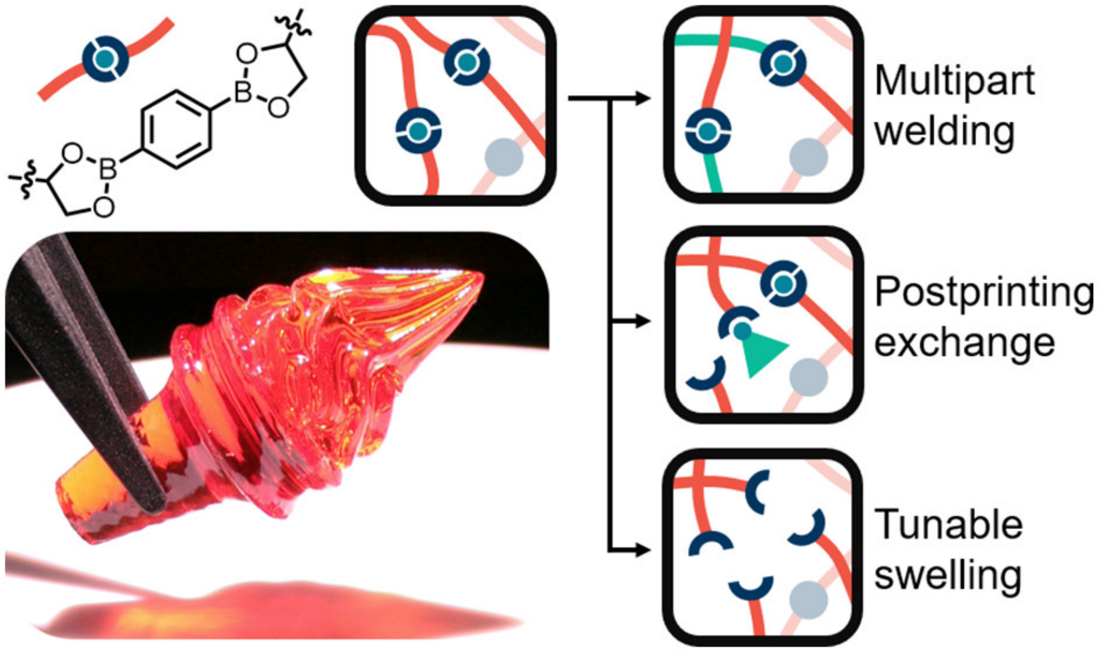
# Modular 3D-printed polymer networks based on dynamic boronic ester bonds

Christopher Bates, Craig Hawker, and Javier Read de Alaniz, UCSB

**What was achieved?:** A strategy for making a new class of additive manufacturing resins, that will allow the material to not only be printed but also be repaired and recycled, was developed. This vat photopolymerizable 3D-printing resin consists of an adaptable polymer network that takes advantage of both permanent (diallyl phthalate) and exchangeable (boronic ester) crosslinks. The static, permanent linkages provide structural reinforcement to the 3D-printed materials, while the dynamic crosslinking sites allow the materials to undergo post-additive manufacturing chemical functionalization, tunable swelling, and multipart welding (to afford more intricate 3D-printed ensembles).

**Why is it important?:** This strategy possesses great potential to address environmental challenges associated with the waste of 3D printed polymers. By incorporating a fraction of exchangeable covalent crosslinks into a resin, the resulting materials can undergo a variety of post-printing modifications. This can extend the lifecycle of the parent network and provide upcycling avenues, in contrast to the permanently crosslinked polymer networks of traditional additive manufacturing thermosets which are usually landfilled or incinerated.

**How did BioPACIFIC MIP enable this?:** BioPACIFIC MIP provided access to the one-of-a-kind Solution Mask Liquid Lithography (SMaLL) 3D-printing system, developed in-house, as well as to the Innovation Workshop facility that were used for all 3D-printing. Technical assistance from BioPACIFIC MIP staff David Bothman was instrumental to this research.




Inclusion of boronic ester crosslinking sites into additive manufacturing resins allows the printed materials to undergo various post-manufacturing manipulations. As a result, extended and more sustainable thermoset lifecycles can be accessed.