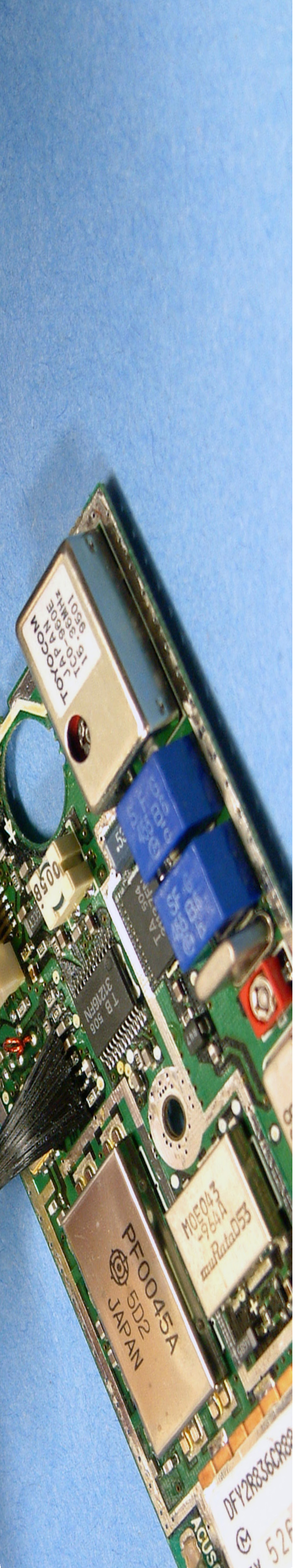

MASTERBOND
CASE STUDY

UV15DC80: Utilized in ultraviolet-assisted three-dimensional printing

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UV15DC80: Utilized in ultraviolet-assisted three-dimensional printing

Overview of UV15DC80

Master Bond UV15DC80 is a dual-cure epoxy-based system that undergoes a primary cure upon UV light exposure, followed by a secondary heat cure. This unique dual-cure system helps account for shadowing issues that may occur during UV curing. This makes it especially suitable for applications involving shadowed out portions, which cannot be exposed to UV light entirely. The thermal curing mechanism helps ensure that even the shadowed-out areas will fully cure. This is a cationic curing chemistry which is not inhibited by the presence of oxygen.

Application

Compared with conventional microfabrication techniques, ultraviolet three-dimensional printing (UV-3DP) provides greater flexibility and a faster fabrication rate. However, this technique requires careful adjustment and control over the processing techniques, including the photopolymer resin's viscosity and UV-exposure region. To help optimize these 3DP parameters, researchers at Ecole Polytechnique de Montreal manufactured photopolymer-based microdevices with 3D self-supported and freeform structures. The investigated photopolymers included a polyurethane-based resin and Master Bond UV15DC80.

Key Parameters and Requirements

To investigate the influence of the photopolymer viscosity on the freeform structure's stability after printing, the authors mixed photopolymer resins with nanoparticles to create nanocomposite inks. The photopolymers, including UV15DC80, were irradiated with 365 nm light with an intensity of 50 mW cm^{-2} using fiber optic cables. This rapidly cured the materials, thus forming self-supported, freeform shapes by changing the spatial position of the extrusion micronozzle.

Here, because UV15DC80 was directly exposed to UV light, there was no shadowing. However, in curing applications where shadowing may be an issue, UV15DC80 can be thermally cured.

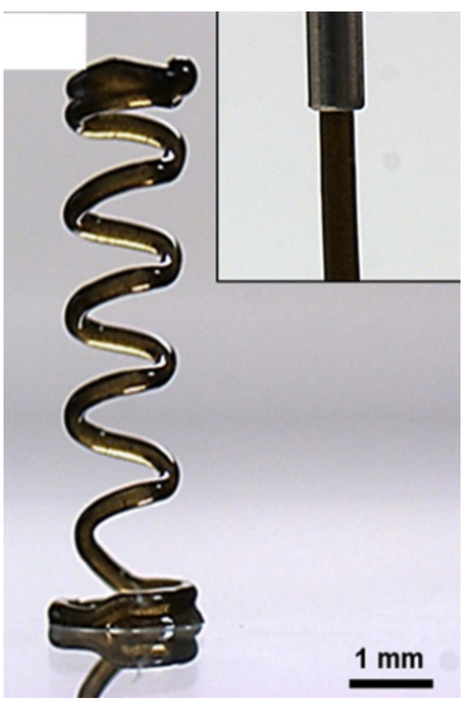

Figure 1. Photo of a UV-3DP (λ= 365 nm) fabricated microspring using UV15DC80 composited with 1 wt% carbon nanotubes. The photo shows the viscosity-dependent stability of the filament, which was exploited to build a structure with the desired microspring shape.

Results

The authors first investigated the effect of viscosity on the fabrication of microsprings and showed that a higher viscosity helped ensure the success of fabrication of a stable filament. As shown in Figure 1, the authors successfully fabricated a 6-coil microspring using UV15DC80, which was composited with 1 wt% carbon nanotubes to give the extruded filament a sufficiently high viscosity to prevent sagging before UV curing. The authors preferred a shear-thinning material for this application to prevent the material from easily flowing through the nozzle in the absence of pressure. The authors added carbon nanotubes to endow it with shear-thinning behavior. The photopolymer nanocomposite passed through the nozzle and then was UV cured, to create a rigid 3D printed structure. The authors also investigated the effect of the UV exposure zone, extrusion rate, and extrusion pressure. By optimizing these parameters, the authors created a processing map to serve as a guide for fabricating various 3D geometries using UV-curable materials such as Master Bond UV15DC80.

References

R. D. Farahani et al. Processing parameters investigation for the fabrication of self-supported and freeform polymeric microstructures using ultraviolet-assisted three-dimensional printing. 2014 J. Micromech. Microeng. 24 055020