NEW DEVELOPMENTS IN DUAL CURE EPOXIES

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Direct write 3D printing provides an exciting new means of generating novel structures from thermosetting resins via an additive approach. Initial efforts along these lines demonstrated the preparation of homogenous, high quality parts. More recent work has shown that it is possible to modulate the properties of these parts locally through changes in orientation of high aspect ratio fillers.

In this work, we present complementary developments related to resin chemistry that should provide practitioners of direct write 3D printing with additional options as far as the realization of functional gradations is concerned. This is accomplished via the creation of so-called “dual cure” resins. Here this term refers to materials that undergo thermal cure in a similar fashion to many conventional resins. Then, in a second step, the selective exposure of these materials to high energy radiation (gamma rays, electrons, etc.) results in further increases in local crosslink density, altering thermomechanical performance and providing a means of inducing arbitrary gradations in properties in a post-processing step.

A number of different families of dual cure resins have been explored and are presented here, as well as data concerning changes in thermal and mechanical performance as a function of the details of the dual curing process. Preliminary efforts giving evidence of the generation of stable functional gradations in practice are also described. Ongoing and future efforts are focused on the optimization of these systems and the incorporation of their cure-dependent mechanical behavior into simulations in order to enable design optimization.