MECHANICAL ENGINEERING SEMINAR

High-throughput additive manufacturing based on thiol chemistries

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Abstract

Additive manufacturing has the potential to transform traditional manufacturing through the ability to produce customized parts with complex internal geometries that are impossible to create through conventional means. However, parts made using 3D printing techniques such as stereolighography (SLA) and fused filament fabrication (FFF) are frequently unsuitable for industrial end-use applications due to poor mechanical and thermal performance. Both techniques suffer from mechanical anisotropy in the printed parts, where the part performs well in-line with the print direction but is fragile when stressed perpendicular to the printed layers.

By using novel thiol-based chemistries we have demonstrated 3D printed resins that retain ↑ 90% of their x-axis toughness (23 MJ/m3) in the z-axis (21 MJ/m3). Other resins in this family are capable of extreme toughness, with integrated areas under tensile stress-strain curves up to 130 MJ/m3. This represents an increase in toughness over existing resins by one order of magnitude. Innovative self-healing resins have been developed for FFF processes that are 235% more mechanically isotropic compared to current FFF filaments such as PLA. We have demonstrated the ability to print large, geometrically complex parts with these resins. The isotropic toughness of these resins enables industry to employ additive manufacturing for high performance end-use applications.

Biography

Walter Voit is a Dallas-based entrepreneur at the head of Adaptive3D since 2007, which sells proprietary polymer resins which enable manufacturing some of the world's toughest and stretchiest additive manufacturing polymeric parts. Dr. Voit is a technical founder and leader, and currently President and CEO. Adaptive3D is commercializing its ToughPoint, ToughRubber and ToughNet families of specialty 3D printing resins which boast industry leading thermomechanical properties with a focus on strain-tolerant polymers. He received tenure from UT Dallas in the Materials Science and Engineering Department and is a UT Dallas alum (BS '05, MS '06).

While at UT Dallas, Dr. Voit built and managed both the Advanced Polymer Research Lab and the Center for Engineering Innovation which together boast a comprehensive grant portfolio (NSF, NIH, DARPA, FDA, corporate sponsorship), mentor graduate students and post docs and explore the thermomechanics of shape memory polymers, flexible bioelectronics, next-generation neural interfaces, 3-D printing, degradable polymers and the effects of ionizing radiation on polymers. He taught hundreds of graduate and undergraduate students via courses in Thermodynamics, Nanostructured Materials, Biomechanics and Materials Manufacturing and received a teaching award for his efforts. Dr. Voit has helped nucleate 6 companies from his $8 million research enterprise over the past seven years.