Amgen Seminar Series in Chemical Engineering

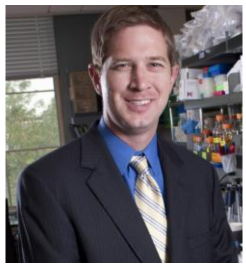
in

Cherry Auditorium, Kirk Hall, 12:45 PM

Presents on October 11, 2018

Heating, Curing, and Welding of 3D Printed Carbon Nanotube-Polymer System by Locally Induced RF Heating

By



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Additive manufacturing through material extrusion (ME), often termed 3D printing, is a burgeoning method for manufacturing thermoplastic components. However, a key obstacle facing 3D-printed plastic parts in engineering applications is the weak weld between successive filament traces, which often leads to delamination and mechanical failure. This is the chief obstacle to the use of thermoplastic additive manufacturing. We have recently demonstrated a novel concept for welding 3D-printed thermoplastic interfaces using intense localized heating of carbon nanotubes (CNTs) by microwave irradiation. The microwave heating of the CNT-polymer composites are a function of CNT percolation, as shown through in situ infrared imaging and simulation. We apply CNT-loaded coatings to 3D printer filament; after printing, microwave irradiation is shown to improve the weld fracture strength by 275%. These remarkable results open up entirely new design spaces for additive manufacturing and also yield new insight into the coupling between dielectric properties and RF field response for nanomaterial networks. Further study has shown that low-frequency RF fields can also couple with CNT networks, allowing for a variety of rapid scanning techniques without any need for shielding. We have demonstrated that such techniques can be used to induce rapid localized heating in a range of applications, including rapid thermoset curing and 3D printing, curing of polycarbosilanes to form silicon carbide, and even rapid assessment of printed CNT sensors and electronics.

BIO: Micah J. Green received his bachelor's degree in chemical engineering at Texas Tech in 2002. He then entered the Chemical Engineering Ph.D. program at MIT where he was co-advised by National Academy members Bob Armstrong and Bob Brown. His Ph.D. focused on computational studies of phase behavior and rheology of rodlike liquid crystals; his studies also included a minor in early Christian history at Harvard. After finishing his Ph.D. in 2007, he developed nanotube-based liquid crystals and fibers as an Attwell-Welch Postdoctoral Fellow at Rice University.

After several years on the faculty at Texas Tech, he joined Texas A&M as an Associate Professor in the Artie McFerrin Department of Chemical Engineering in Summer 2014. He has received the NSF CAREER Award, the Young Investigator Award from the Air Force Office of Scientific Research, and the DuPont Young Faculty Award for his work in the area of nanomaterial dispersions and morphology dynamics, with applications to gels, composites, and additive manufacturing. His group combines experiment and simulation to bring the fields of chemical engineering, colloid science, and polymer physics to bear on critical nanotechnology applications.

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