SEMINARS IN ENGINEERING SCIENCE
Spring 2014 Seminar Series
Department of Mechanical Engineering and Mechanics

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Friday, May 9 at 1:10 p.m.
Room 466 Packard Laboratory

3D Printing of Composites with Controlled Architecture

ABSTRACT

Additive manufacturing methods have greatly increased our ability to fabricate complex shapes and multi-material architectures. However, better materials are needed which compete with conventional engineering materials and fully leverage the unique capabilities of 3D printing. Specifically, lightweight 3D-printable polymer composite materials are of considerable interest, as are new composites which incorporate hierarchical design aspects observed in natural materials, for example, bone, nacre, and wood. This presentation will focus on recent efforts in the development and characterization of epoxy-based 3D-printable composites for use with direct-write robocasting. In this process, rheologically-tailored inks are deposited via filamentary extrusion through sub-millimeter scale nozzles to manufacture parts layer-by-layer. Because the shear and extensional flow in the nozzle induce alignment of high aspect ratio particles in the ink, highly efficient short fiber composites with exceptional properties can be printed. Furthermore, anisotropy can be tuned in these materials through choice of filler particle morphology, and orientation can be locally controlled within a component by tailoring the print path. Printed composites achieve Young's modulus values of up to 24 GPa with tensile strength values comparable to existing 3D-printed polymers (40-100 MPa). This talk will include characterization of lightweight 3D-printed cellular structures, as well as preliminary efforts towards synthetic brick-and-mortar composites using these epoxy-based inks as well as a TiC/Ni cermet system.

BIOSKETCH

Brett Compton is currently a postdoctoral fellow at Harvard University where he studies the fabrication of advanced ceramics, metals, and architectured composite systems via direct 3D methods under Prof. Jennifer A. Lewis. His work is part of the Wyss Institute for Biologically Inspired Engineering. He obtained his PhD in 2012 from the University of California at Santa Barbara where he was working on the impact performance of ceramics and cermets under Prof. Frank W. Zok. Prior to that, Dr. Compton studied at the University of Kentucky where he earned a B.S. in Mechanical Engineering. His research interests lie in developing processing routes to enable a wider range of engineering materials to be utilized with additive manufacturing techniques. In particular, he establishes the links between processing parameters and the mechanical behavior of the resulting materials through mechanical testing and numerical simulation. Dr. Compton will be joining Oak Ridge National Laboratories in June.