Polymer Program

INSTITUTE OF MATERIALS SCIENCE

Seminar: 11:10 am Friday, April 28
Science 1: Room 1002

Host: Anson Ma

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Rheological Considerations for Materials and Process Design in Polymer Extrusion Additive Manufacturing

Abstract: Additive manufacturing (AM) is revolutionizing manufacturing by enabling complex geometries and multimaterial structures that cannot be fabricated using traditional approaches. Extrusion additive manufacturing is one of the most identifiable modes of AM that implements predominantly polymeric materials. However, the technology is limited in terms of material availability and corresponding process design. Researchers have been pushed by consumers and industry to stretch the capabilities of AM across many different modalities.

Polymer extrusion AM, which encompasses modalities commonly referred to as pellet fed AM (BAAM), fused filament fabrication (FFF) and direct ink write (DIW) have differing and unique rheological requirements that can guide both materials and process design for enabling "printable" polymers and polymer composites. In this talk, I will touch on experimental and modeling efforts in our research group that rheologically address some of the commonly encountered considerations in extrusion AM processes, including challenges and opportunities surrounding interlayer diffusion, property anisotropy, extrusion failure modes and considerations for fiber and particle loaded composites. I will further discuss how to consider "successful" printing, with application focused examples that make us question how to define considerations for material formulations, process design and rheology "requirements".

Bio: Dr. Michael J. Bortner is an associate professor in Chemical Engineering, the Director of the MACR graduate program, the Associate Director of the Macromolecules Innovation Institute (MII) and a College of Engineering Faculty Fellow at Virginia Tech. His research is in the areas of polymer and composite rheology, and process-structure-property relationships. Dr. Bortner spent 10 years in industry focusing on manufacturing process development for novel polymer nanocomposites. His current research efforts at Virginia Tech are focused on development of materials and process technologies, and computational methodologies, to advance the state of the art in 1) polymer based additive manufacturing, 2) cellulose nanocrystals: production, characterization and CNC/polymer composite materials development, and 3) fiber reinforced polymer matrix composites. He is an associate editor of the journal *Additive Manufacturing,* on the Executive Committee of the Adhesion Society, and recently served as the Treasurer of the Cellulose and Renewable Materials (CELL) division of the American Chemical Society (ACS).