Department of Chemistry and Biochemistry & Materials Science Graduate Program Colloquium Presentation

Sustainable Polymer/Bio-Composites and Their Advanced Manufacturing for Energy, Electronics, and Biomedicine

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Conventional technologies for the synthesis and manufacturing of polymer composites involve energy-intensive processes, it is also very challenging to recycle such polymer composite structures. To address those grand challenges, our recent research focuses on developing next-generation sustainable polymer/bio-composites using Engineered Living Materials (ELMs). ELMs represent an emerging class of materials that integrate living biological entities, such as engineered bacteria, with functional soft materials. This integration endows the composites with unique capabilities, including self-regeneration, self-healing, biosensing, and molecular computing.

Our recent work demonstrated that integrating ELMs with 3D printing enables the creation of dynamic, sustainable, and functional soft/composite structures. For instance, bone-mimetic biocomposites with precisely controlled geometries and internal structures can be created by programmable microbial biosynthesis within 3D-printed soft bioreactors. This process leverages the synergistic activity of two types of engineered bacteria to produce bionanofibers and mineral nanostructures. In another study, we developed hierarchical biocomposites with exceptional thermal conductivity based on in situ biosynthesis of cellulose nanofibers in the presence of 2D inorganic nanosheets. I will also share our recent progress on the additive manufacturing of multifunctional 3D hierarchical metallic/composite structures from soft precursors. We believe the integration of ELMs and functional nanostructures with 3D printing provides a transformative and versatile platform for creating sustainable and functional composite structures/ devices with broad applications in energy, electronics, soft robotics, and biomedicine.

Biography

Dr. Weinan Xu is currently an assistant professor in the Department of Materials Science and Engineering at the University of Tennessee, Knoxville. He obtained his Ph.D. degree in Materials Science and Engineering from Georgia Institute of Technology and did postdoctoral research at Johns Hopkins University. He then started his independent career in the School of Polymer Science and Polymer Engineering at the University of Akron before moving to Tennessee.

His current research focuses on the development of sustainable/functional polymer composites and their advanced manufacturing, with applications in energy, electronics, and biomedicine. He has been recognized with several awards, including the DARPA Young Faculty Award, Polymer Processing Society Early Career Award, NSF LEAP award, and Best Ph.D. Thesis Award from Sigma Xi and Georgia Tech.

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3:20pm, room 110 Williams Hall

Refreshments provided