COMF QCAM SÉRIE DE SÉMINAIRES

COMF QCAM SEMINAR SERIES

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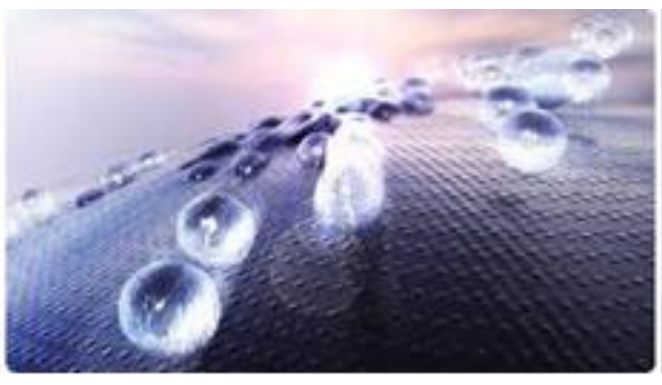
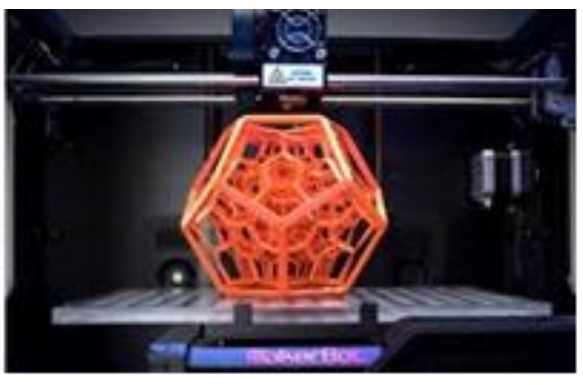
Title | **Multiscale Polymer–Nanoparticle Assembly via Advanced Manufacturing: From Nonequilibrium Processing to Functional Materials**

Abstract | Advanced composite materials, particularly nanoparticle-reinforced polymer composites, provide a versatile platform for engineering lightweight materials with exceptional mechanical, thermal, and functional properties. However, achieving predictable performance requires fundamental control over multiscale assembly processes that govern nanoparticle dispersion, polymer–nanoparticle interfacial interactions, and orientation of structural elements during fabrication. This seminar explores how advanced manufacturing techniques, including additive manufacturing and fiber-based fabrication, enable nonequilibrium assembly of polymer–nanoparticle systems across nano-, micro-, and macro-length scales. By integrating polymers with nanoparticles of different dimensionalities (e.g., 1D nanotubes and 2D nanosheets), we demonstrate how controlled processing fields, such as shear, confinement, and flow, can direct particle organization and polymer chain alignment to generate hierarchical layered architectures. Our recent work on the scalable fabrication of fibers, coatings, and three-dimensional architectures that exhibit tunable structural and functional properties will be discussed. These systems reveal fundamental relationships between processing conditions, nanoparticle assembly mechanisms, and resulting material performance. Examples include nanostructured composites for mechanical reinforcement, thermal management, electrical conductivity, stimuli-responsive materials, and biodegradable scaffolds for tissue regeneration. By connecting materials chemistry, interfacial physics, and advanced manufacturing, our work establishes new pathways to design programmable polymer–nanoparticle materials for applications ranging from energy and infrastructure to biomedical devices and regenerative medicine.





Bio | Kenan Song is currently holding an Associate Professor position at the University of Georgia (UGA) (2023-now) after obtaining his tenure at Arizona State University (ASU) (2017-2023). Before joining ASU in 2017, he was a postdoc affiliated with the Department of Materials Science and Engineering and the Department of Chemical Engineering at MIT. Dr. Song obtained his Ph.D. degree in Mechanical

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Engineering from Northeastern University (Boston, MA) in 2014 and his B.S. in Engineering Mechanics in 2010. Dr. Song's research interest includes the processing-structure-property relationships, especially the manufacturing, characterization, simulation, and application of polymer-based nanoparticle-filled composites, aiming for high performance in structural and functional utilization. Kenan Song's research is funded by the National Science Foundation (NSF), Department of Defense (DoD) AFOSR & ONR, Department of Commerce (DOC) NIST, Department of Energy (DOE), Binational Science Foundation (BSF), Qatar National Research Fund (QNRF), American Chemistry Society (ACS) Petroleum Research Fund (PRF), Department of Health Services (DHS), philanthropic foundations, and industrial partners. In addition, Kenan Song has been the recipient of the NSF CAREER Award (2022), ACS PMSE Young Investigator Award (2022), SAMPE North America Young Professionals Emerging Leadership Award (YPELA) (2022), DHS New Investigator Award (NIA) (2023), ASME Young Manufacturing Engineer Award (2023), The Minerals, Metals & Materials Society (TMS) Young Leaders Professional Development Award (2025), Humbolt Fellowship (2025), and National Academy of Inventors (NAI) Senior Member (2025).

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