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Synthesis, Modeling, and Integration of Multifunctional Composites for Stretchable Thermoelectric Wearables

ABSTRACT

Room temperature liquid metal alloys, such as eutectic gallium-indium, have gained significant attention due to their high electrical and thermal conductivity, low viscosity, and biocompatibility. Integrating these liquid conductors into wearables, soft robotics, and biomedical devices presents challenges in deposition and encapsulation, which are essential for maintaining functionality without leakage or smearing. In this seminar, I will introduce liquid metal polymer composites, discussing synthesis techniques and the intriguing solid-liquid interface, along with a modeling framework to predict their structural and functional properties. I will also highlight the role of 3D printing in creating soft functional materials for stretchable thermoelectric generators, focusing on how device architecture can optimize energy conversion. Additionally, I will demonstrate the electrical self-healing properties and high damage tolerance of these stretchable thermoelectric devices, highlighting their potential in self-sustaining intelligent systems. I will conclude my talk by outlining our current research efforts to leverage machine learning in designing soft multifunctional composites, with a transformative impact on the sustainable development of wearable technologies.

BIO

Dr. Mohammad Malakooti is an Assistant Professor of Mechanical Engineering at the University of Washington – Seattle. He leads the iMatter Lab, a research group dedicated to creating materials that match the extraordinary adaptability, rich multi-functionality, and embodied intelligence of natural material systems. He received his PhD at the University of Florida in 2015, had a Postdoctoral Fellowship at the University of Michigan (2015-2017), and was a Research Scientist at Carnegie Mellon University (2017-2019). Dr. Malakooti has published over 45 peer-reviewed articles in leading scientific journals. Additionally, he has been honored with several professional awards, including ASME's Best Paper Award in 2016 and 2022, as well as the 2017 Outstanding Postdoctoral Fellow Award at the University of Michigan.

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