ME Faculty Colloquium

Design and Characterization of Advanced Multifunctional Materials

Debashish Das, Mechanical Engineering, Indian Institute of Science

ABSTRACT

With the advent of architected, multifunctional materials, and the development of experimental capabilities spanning the macro, micron, and the nanometer length scales, mechanics has entered a new and exciting domain where microstructure, surfaces, interfaces, and defects, can be explicitly taken into account in the study of the electro-thermo-mechanical response of materials. In this talk, I will present my work on: (i) piezoelectric materials widely used as sensors and actuators; and (ii) on an advanced thermal interface material. The work on piezoelectric materials will focus on the role of microstructural grain orientation (texture) in the electromechanical response of nanometer and submicron thick freestanding Lead Zirconate Titanate, Pb(Zr0.52Ti0.48)O3 (PZT) films. It will be shown that the ferroelastic, ferroelectric, and piezoelectric properties, i.e., domain switching in the presence of stress and electric fields, strongly depend on microstructural grain orientation. The work on thermal interface material will show that a thin film, comprising a dense array of 10-μm high Cu nano springs, has the unique combination of high compliance (comparable to soft polymers) and high thermal conductivity to help reduce mismatch stresses at interfaces between sources and sinks. These studies are expected to provide enhanced insights into material microstructure-property relationships and subsequently help the development of reliable and durable devices.

ABOUT THE SPEAKER

Dr. Debashish Das is currently an Assistant Professor in the Mechanical Engineering department at the Indian Institute of Science, Bengaluru. Prior to joining IISc, he was a postdoctoral researcher at the University of Illinois at Urbana-Champaign (UIUC). Dr. Das received his Ph.D. in Aerospace Engineering from UIUC in 2017, and his ME from IISc and BE from Jadavpur University, both in Materials Engineering. He has received several honors and awards, including the Best Paper award at the 2018 Society for Experimental Mechanics Conference, and the H.S. Stillwell Award, recognizing the contributions of his Ph.D. dissertation research. He has been a regular reviewer for several reputed international journals. His research interests include the development of novel experimental techniques coupled with analysis to investigate the mechanics of material systems at different length and time scales, and the design of macroscale systems by taking advantage of micro and nanoscale properties.

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