Leveraging Nanoscale Mechanics for Next Generation Materials Design and Fabrication

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12:30 PM

Bowen Hall Room 222

PMI/MAE Special Seminar

At the length scale of modern-day devices and components, nanoscale confinement effects drive mechanical phenomena, leading to defect dynamics and microstructure formation that deviate from bulk behavior. In this presentation, I will discuss how engineered microstructure and defects coupled with quantitative in situ mechanical testing can enable new insight into these complex structure-property relationships over Ångstrom to micron length scales. The first part of the presentation will describe how tailored nanofabrication can tune dislocation interactions with intrinsic and extrinsic interfaces to enhance strength, strain hardening, and fracture mitigation. I will discuss practical strategies for incorporating desirable interfaces in lightweight metals and alloys. The second part of the presentation will detail how enhanced diffusivity and creep at the nanoscale can be exploited to further develop a new scalable and material-agnostic nanomanufacturing technique, thermomechanical nanomolding (TMNM). I will show how TMNM can enable fabrication of metastable compounds and tune grain size/crystallographic orientation in 2D nanostructures over wafer-scale distances. I will conclude with a roadmap to systematically screen materials using TMNM for applications ranging from transportation to microelectronics.

Mehrdad Kiani is currently a postdoctoral associate in Judy Cha's group in the Department of Materials Science and Engineering at Cornell University. He received his Ph.D. in materials science and engineering in 2021 from Stanford University where he was an NDSEG fellow in the laboratory of Dr. Wendy Gu in the Department of Mechanical Engineering. He was a Whitaker Fellow at Imperial College London during 2015-2016. He received his B.S. in materials science and engineering in 2015 from Brown University where he was advised by Dr. Ian Wong.

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