University of California, Irvine

THE DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

MSE 298 SEMINAR

FALL 2025: MSE IN THE SPOTLIGHT

Professor Ali Mohraz
Chemical and Biomolecular Engineering and Associate Dean for Graduate and Professional Studies

RESEARCH TALK:
ARCHITECTED MATERIALS FOR ENERGY AND HEALTH CARE: THE SPINODAL ADVANTAGE

SHORT CAREER TALK:
AN INTERNATIONAL STUDENT'S JOURNEY THROUGH ACADEMIA

Abstract: Architected materials—engineered structures with precisely designed micro- and nano-scale architectures—find widespread applications in both health care and energy technologies. By tailoring geometry rather than just composition, these materials can deliver extraordinary properties to meet advanced performance targets. In this talk, which will feature work almost exclusively performed by former PhD students in MSE@UCI, we will demonstrate how natural instabilities, namely spinodal decomposition of partially miscible mixtures, can be harnessed to create next-generation architected materials for the abovementioned applications. The advantage of spinodal structures partly stems from a predominance of negative Gaussian curvatures (saddle points) along their internal surfaces. This unique geometry can impact the dynamics and function of cells or the mechanics of coatings on spinodal substrates in the following beneficial ways. In electrochemical energy storage and conversion, saddle points can mitigate the stresses and strain energies that are responsible for lithiation-induced mechanical failure in composite Li-ion battery anodes. In the context of regenerative biomaterials, saddle points can mediate cell-substrate interactions in nontrivial ways, leading to different migration behavior, as well as an apparent modulation in the anti-inflammatory direction for the cells implicated in the foreign body response. These early results establish spinodal structures as exceptionally promising architected material platforms to tackle some of today's pressing challenges in medicine, energy storage, and sustainability.

Bio: Ali Mohraz received his BSc, ME, and PhD in Chemical Engineering from Azad University, The City College of New York, and The University of Michigan, respectively, and his postdoctoral training in Materials Science and Engineering at the Frederick Seitz Materials Research Laboratory at The University of Illinois in Urbana-Champaign.He is currently Professor of Chemical and Biomolecular Engineering and Associate Dean for Graduate and Professional Studies at UCI. Dr. Mohraz's primary research interests are in colloid science and complex fluids engineering, toward the development of advanced health care and energy materials. His research and teaching efforts have been recognized by awards at the university and national stage, including the NSF CAREER Award, the Distinguished Young Rheologist Award, the School of Engineering Innovation in Teaching Award, the Maseeh Best Faculty Teaching Award, and the School of Engineering Outstanding Faculty Service Award. When not doing academic work, Dr. Mohraz enjoys his time playing music in local bands, doing pottery, and loving on dogs.

DATE: Thursday, October 30, 2025
TIME: 2:00 - 3:20 PM
LOCATION: McDonnell Douglas Engineering Auditorium