

University of California, Irvine

THE DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

MSE 298 SEMINAR

FALL 2025: MSE IN THE SPOTLIGHT

**Distinguished Professor
Xiaoqing Pan
Materials Science and
Engineering**



**RESEARCH TALK:
VISUALIZING ATOMIC VIBRATIONS: A NEW FRONTIER IN
ELECTRON MICROSCOPY**

**SHORT CAREER TALK:
MY CAREER JOURNEY: CHALLENGES, CHOICES, AND CHANGE**

Abstract: Recent groundbreaking developments in aberration-corrected scanning transmission electron microscopy (STEM) combined with advanced vibrational electron energy-loss spectroscopy (EELS) techniques have fundamentally transformed the way atomic-scale lattice dynamics and phonon behaviors are studied. In this seminar, I will highlight our seminal work in developing and applying state-of-the-art, spatially and momentum-resolved vibrational EELS methodologies to directly visualize phonon modes at atomic resolution. Our approach enables the unprecedented observation of localized phonon phenomena at individual defects, interfaces, and nanostructures, profoundly advancing our understanding of phonon-defect interactions, thermal boundary conductance, and electron-phonon coupling in materials.

I will present key examples from our recent studies, including the direct imaging of defect-localized vibrational modes, nanoscale mapping of interfacial phonons, and quantification of phonon momentum distributions in quantum dots and phonon-electron coupling at superconducting interfaces. These insights provide critical foundations for addressing fundamental challenges in thermal management, quantum materials engineering, and solid-state ionic devices. Ultimately, our innovations offer powerful tools to elucidate and engineer the atomic-scale behaviors that dictate the performance of next-generation functional materials and systems.

Bio: Pan is the Henry Samueli Endowed Chair in Engineering, professor of materials science and engineering, and professor of physics and astronomy. He is the inaugural director of the Irvine Materials Research Institute (IMRI) and founding director of the Center for Complex Active Materials – an NSF MRSEC. Pan is an internationally recognized materials scientist and electron microscopy expert due to his pioneering development and applications of novel transmission electron microscopy (TEM) methods for probing the atomic scale structure, properties and dynamic behaviors of materials. His work has led to the discoveries of new materials and novel functionalities. Pan has received the NSF CAREER Award and the Chinese NSF's Outstanding Young Investigator Award. He is an elected fellow of the American Ceramic Society, American Physical Society, Microscopy Society of America, and the Materials Research Society. He has published over 500 peer-reviewed scientific papers in high impact journals.

DATE: Thursday, October 16, 2025

TIME: 2:00 - 3:20 PM

**LOCATION: McDonnell Douglas Engineering
Auditorium**