Professor Nasim Alem

Associate Professor of Materials Science and Engineering

The Pennsylvania State University

Probing nanostructures atom by atom

Recent advancements in scanning/transmission electron microscopy (S/TEM) imaging and spectroscopy have revolutionized our understanding of the nanoscale phenomena in a wide range of materials. With unprecedented spatial and energy resolutions, the development of monochromators and more sensitive detectors have further enabled us to directly uncover how defects, interfaces, and quantum dots affect the electronic, physical, and nano-optical response of nanostructures under static and dynamic conditions. In addition, recent progress in data-driven analysis techniques and machine learning (ML) algorithms has allowed us to further quantify subtle structural distortions down to sub-Angstrom length scales and extract the physical and electronic properties of nanostructures from the analysis of large data sets. This talk highlights some of our recent efforts in understanding the structure of defects, quantum dots, and interfaces along with their roles on the optical, plasmonic, and electronic properties found in a wide range of nanostructures including 2D and low dimensional crystals, high entropy oxides, and multiferroics using high resolution S/TEM imaging in combination with electron energy loss spectroscopy (EELS) and cathodoluminescence (CL) techniques. In particular, this talk will present our recent findings on the exciton formation and the nano-optical response of two-dimensional (2D) transition metal dichalcogenide (TMD) quantum dots in in-plane monolayer heterostructure TMDs using STEM-EELS-CL. In addition, this will include recent investigations in understanding the competition in polar/nonpolar phases in multiferroics and the underlying physics responsible for their room temperature phase transformation.

Nasim Alem is an associate professor of Materials Science and Engineering Department at Penn State University. She received her B.S. degree in Metallurgical Engineering from Sharif University of Technology, Tehran, Iran and her PhD from the Materials Science Department at Northwestern University. Nasim was a postdoctoral researcher at the Physics Department at University of California Berkeley and National Center for Electron Microscopy (NCEM) at Lawrence Berkeley National Lab before joining Penn State as an assistant professor in 2013. Her awards include NSF CAREER award, Fulbright visiting scholar fellowship, NCEM young investigator fellowship, faculty mentoring award, and McFarlane endowment professorship. The Alem group uses scanning/transmission electron microscopy imaging and spectroscopy and advanced data analysis methods to enable transformative insights into structure-property relationships in a variety of nanostructures such as low dimensional materials, high entropy oxides, complex oxides, and wide band gap semiconductors. Her research aims to investigate the materials-by-design paradigm by accurately interfacing atomic-level theory and experiments in a close feedback loop and to uncover the underlying atomic scale physics in quantum materials, low dimensional nanostructures, energy materials, electronics, and optoelectronics.

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In person only; no Zoom

Questions? Contact allison.macknick@northwestern.edu

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