

Fall 2018 Joint Colloquium

Materials Department & Materials Research Laboratory

Professor Nasim Alem

Materials Science and Engineering
Penn State University

Friday, October 5th, 2018
11:00 am, Elings 1601



Probing nanostructured materials atom by atom: An ultra-high resolution aberration-corrected electron microscopy study

Defects can have a profound effect on the macroscale physical, chemical, and electronic properties of nanostructures. They can lead to structural distortions, introduce extra states in the band gap and give rise to excess potential locally at buried interfaces. While defects and interfaces have been a well-studied subject for decades, little is known about their local atomic and chemical structure, sub-Angstrom structural distortions within their vicinity, and their stability and transition dynamics under extreme conditions. Using ultra-high-resolution aberration-corrected *S/TEM* imaging and spectroscopy, this talk will discuss our recent efforts on the determination of the defect chemistry and sub-Angstrom relaxation effects in nanostructures around dopants, grain boundaries, domain walls, and interfaces in the family of 2D crystals, complex oxides, and diamond carbon nanothreads. In the family of 2D crystal transition metal dichalcogenides (TMDs) alloys, we show how the formation of chemically ordered states and vacancy/dopant coupling leads to unusual relaxation effects around dopant-vacancy complexes. In addition, we explore stability and transition dynamics of defects leading to grain boundary migration in monolayer TMDs under electron beam irradiation. This talk also presents how ferroelectric polarization emerges at the atomic level across the domain walls in single phase and hybrid complex oxide systems and the impact of this emergence on the macroscale properties. Finally, we uncover the atomic and chemical structure of the carbon nanothreads using low dose high resolution electron microscopy.

Bio

Nasim Alem is an assistant professor in the Materials Science and Engineering department at the Penn State University. Nasim received her B.S. degree in Metallurgical Engineering from Sharif University of Technology, Tehran, Iran and her M.S. degree in Materials Science and Engineering from Worcester Polytechnic Institute. She received her PhD from the Materials Science Department at Northwestern University. Nasim has been a postdoctoral researcher in the Physics Department at University of California Berkeley and National Center for Electron Microscopy (NCEM) at Lawrence Berkeley National Lab, before joining Penn State in 2013. Her awards include NSF CAREER award, Wilson research grant, and NCEM young investigator fellowship. Alem group research is focused on probing the atomic and chemical structure of the defects, edges, grain boundaries and interfaces and their stability and transition dynamics using scanning/transmission electron microscopy imaging and spectroscopy.

<https://news.psu.edu/expert/nasim-alem>

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