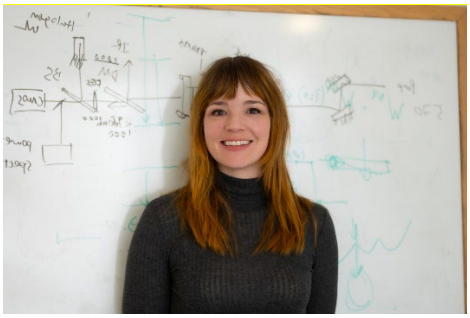
UNIVERSITY OF DELAWARE

MATERIALS SCIENCE and ENGINEERING SEMINAR

Co-Sponsored by the Center for Hybrid, Active, and Responsive Materials



Dr. Madisen Holbrook

MRSEC Center for Precision-Assembled Quantum Materials

Columbia University

Scanning Tunneling Microscopy Characterization of Atomic Defects in Two Dimensional Semiconductors

Within the expanding family of two dimensional (2D) materials, transition metal dichalcogenides (TMDs) have been established as attractive candidates for semiconductors in future 2D devices. Semiconductor electronic properties are strongly modified by defects, which can be detrimental to device performance, or beneficial as a tool to engineer electronic properties. Following the example of silicon, future 2D device performance hinges on achieving high-purity TMDs and controllably introducing known defects to harness their properties. Recent advances in 2D heterostructure device performance rely on stacking mechanically exfoliated bulk TMDs; therefore, nanoscale characterization and quantification of their native defects is of key importance. In this talk, I will present our scanning tunneling microscopy (STM) characterization of the point defects in exfoliated high-purity self-flux grown TMD monolayers, as well as bulk single crystals. I will further describe how we utilize substitutional doping of our high-purity TMDs to directly correlate STM images with the atomic lattice. I will also discuss our comparison of the defects in self-flux and chemical vapor deposition (CVT) grown TMDs, and how they modify their optoelectronic properties. Finally, I will describe our work that shows conductive atomic force microscopy (CAFM) as a reliable tool for defect quantification and characterization by direct comparison with STM.

BIOGRAPHY

Dr. Madisen Holbrook is a postdoctoral scholar at Columbia University's MRSEC Center for Precision-Assembled Quantum Materials. She collaborates with the Hone Group in the Department of Mechanical Engineering and the Pasupathy Group in the Physics Department. Her research focuses on the synthesis, nanoscale characterization, and engineering of two-dimensional (2D) materials and devices. Dr. Holbrook earned her Bachelor of Arts in Physics in 2012 from Lewis & Clark College in Portland, Oregon, where her passion for research and materials science was ignited during her study of gecko adhesion. Following a brief stint at a patent law office, she pursued graduate studies, later earning her PhD in Physics from the University of Texas at Austin under the guidance of Prof. Chih-Kang (Ken) Shih. During her doctoral studies, Dr. Holbrook's contributions to the field included the synthesis of a new 2D insulator, the creation of a nanometer-scale P-N junction, and engineering defects in 2D semiconductors, which formed the basis for her current postdoctoral research. Originally from the small rural town of Middleton, Idaho, Dr. Holbrook now resides in New York, where she enjoys exploring the city's art museums, taking park walks with her dog, and preparing elaborate Italian meals whenever she can pry herself away from her lab, her preferred habitat.

MSEG SEMINAR
4/17/2024

10:00 a.m.

ISE322

mseg.udel.edu

College of Engineering
DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

CENTER FOR HYBRID, ACTIVE, AND RESPONSIVE MATERIALS
CHARM
at the UNIVERSITY OF DELAWARE