

ABSTRACT:

Phase Engineered Metallic 2D Transition Metal Dichalcogenides for Electrochemical Applications

Over the past fifteen years, we have been studying the properties of the metallic phase of atomically thin (or two dimensional, 2D) transition metal dichalcogenides (TMDs). In 2011, we described a simple chemical method to both exfoliate and phase transform (from semiconducting to metallic phase) TMDs such as MoS₂ and WS₂. The chemically exfoliated metallic 2D TMDs exhibit versatile electrochemical properties. In this talk, I will provide examples catalytic and energy storage properties of metallic phase 2D TMDs. In particular, I will discuss their catalytic activity for the hydrogen evolution reaction, their use as electrodes in supercapacitors, and as cathodes in lithium-sulfur batteries. We find that the metallic phase facilitates charge transfer and reaction kinetics that significantly improve the performance of the devices. I will conclude by providing perspectives on remaining challenges in the field and promising pathways for addressing them.