TWO-DIMENSIONAL HETEROSTRUCTURE MATERIALS

This special issue of the Journal of Materials Research contains articles that were accepted in response to a call for manuscripts.

Introduction

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"All surface" makes all the difference. This motto helps define the incredible enthusiasm and interest directed towards two-dimensional (2D) materials research. Atomically-thin materials are exquisitely sensitive to their environment and interfaces, and they represent the ultimate limit in scaling for planar materials. Using the tools and techniques perfected to manipulate and study graphene, researchers are expanding their efforts to study the larger family of monolayer 2D layered materials. With similar goals to those found for conventional thin-film devices, attention has pivoted toward interfacing 2D layered materials together, forming heterostructures that may achieve better performance or inspire new applications. Such efforts have been underway for only a few years, and rapid progress is being made across many sub-areas within the '2D' research community.

This Focus Issue of the *Journal of Materials Research* (*JMR*) takes a snapshot of recent developments in the area of 2D heterostructure material research. Transition metal dichalcogenides (TMDs) such as MoS_2, WSe_2, WS_2, and their alloys are receiving increased attention due to their semiconducting bandgaps, and several papers here discuss the photo-response of these systems. High-quality, large-area growth is undoubtedly one of the most important areas to master in the field and multiple papers here discuss strategies to form films, heterostructures, and superlattices within different growth regimes. Two review articles revisit aspects of graphene and graphene heterostructures, including mechanical properties and out-of-plane transport. Interfacing 2D materials into heterosystems requires an understanding of electronic hybridization and/or perturbations to their intrinsic bandstructures and is given a theoretical treatment within.

ON THE COVER:

Atomistic model of a 2D heterostructure made of two different transition-metal dichalcogenides: Tungsten diselenide (top) and molybdenum disulfide (bottom). Credit: Donna Deng, Penn State University

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