

Interfacial Engineering of Two-dimensional Nanoelectronic Heterostructures

Mark C. Hersam

*Department of Materials Science and Engineering, Northwestern University,
Email: m-hersam@northwestern.edu, Web: <http://www.hersam-group.northwestern.edu/>*

Abstract

Two-dimensional (2D) materials have emerged as promising candidates for next-generation nanoelectronic applications. With electronic properties spanning the spectrum from insulating (e.g., hexagonal boron nitride and montmorillonite) to semiconducting (e.g., transition metal dichalcogenides and phosphorene) to conducting (e.g., graphene and borophene), nearly any electronic device can be fabricated by stacking 2D materials into van der Waals heterostructures. However, in the atomically thin limit, the influence of surface chemistry, defects, interfaces, and the surrounding environment often play a dominant role, especially in comparison to bulk materials. Consequently, methods for controlling and characterizing heterostructure interfaces with atomic precision are critical for realizing the full potential of 2D materials. Towards this end, this talk will outline our latest efforts to engineer surfaces and interfaces in 2D heterostructures. For example, rotationally commensurate growth of MoS₂ has been realized on epitaxial graphene, which allows deterministic control over grain boundary orientation. For chemically reactive 2D materials (e.g., black phosphorus), encapsulation with atomic layer deposition and passivation with organic adlayers minimize ambient degradation and provide charge transfer doping. Finally, this talk will describe emerging efforts on the growth and chemical functionalization of synthetic 2D materials (e.g., borophene) that do not exist as layered materials in the bulk.

Short Biography

Mark C. Hersam is the Walter P. Murphy Professor of Materials Science and Engineering and Director of the Materials Research Center at Northwestern University. He also holds faculty appointments in the Departments of Chemistry, Applied Physics, Medicine, and Electrical Engineering and Computer Science. He earned a B.S. in Electrical Engineering from the University of Illinois at Urbana-Champaign (UIUC) in 1996, M.Phil. in Physics from the University of Cambridge (UK) in 1997, and a Ph.D. in Electrical Engineering from UIUC in 2000. His research interests include nanofabrication, scanning probe microscopy, semiconductor surfaces, and nanoelectronic materials.



Dr. Hersam has received several honors including the Presidential Early Career Award for Scientists and Engineers, TMS Robert Lansing Hardy Award, AVS Peter Mark Award, MRS Outstanding Young Investigator, U.S. Science Envoy, MacArthur Fellowship, and seven Teacher of the Year Awards. Dr. Hersam is the co-founder of NanoIntegris, which is a commercial supplier of nanoelectronic materials, and an elected member of the National Academy of Inventors. Dr. Hersam is a Fellow of MRS, AVS, APS, AAAS, SPIE, and IEEE, and also serves as an Associate Editor of *ACS Nano*.