Two-Dimensional Materials, Heterostructures and Devices

Xiangfeng Duan

Department of Chemistry and Biochemistry & California Nanosystems Institute
University of California, Los Angeles, Los Angeles, California 90095 USA
Email: xduan@chem.ucla.edu; http://xduan.chem.ucla.edu

Abstract

Abstract: Two-dimensional layered materials (2DLMs), such as graphene or molybdenum disulphide, represent an ideal 2D material system for exploring fundamental chemistry and physics at the limit of single atomic thickness. The covalently bonded atomic layers in 2DLMs are bound weakly to each other through van der Waals interactions, which offers considerable flexibility to isolate, mix and match individual atomic layers without the constraints of lattice and processing compatibility. It can therefore open up vast possibilities for nearly arbitrarily combining multiple materials and integrating distinct properties at the atomic scale, and thus enabling entirely new opportunities beyond the reach of existing materials. Here I will focus my discussion on exploring these 2D materials and their heterostructures as new platforms for the creation of a wide of electronic and optoelectronic devices with unique functions or unprecedented performance. Examples discussed include: high-speed transistors; a new design of vertical transistors for ultra-flexible electronics; and several new types of tunable photonic devices.