2D materials and Van der Waals heterostructures

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Abstract

Two-dimensional (2D) materials such as graphene, hexagonal boron nitride (hBN), and transition metal dichalcogenides (TMDs, e.g. MoS2) have attracted considerable attention in the past few years since their electronic, mechanical and optical properties are significantly different compared to their respective three-dimensional allotropes. With novel properties, that are due to reduction of their dimension (from bulk to atomic thickness), came a versatile potential application that rapidly pushes this field forward.

Natural next step in researching 2D materials was integrating one monolayer material into another monolayer material (lateral 2D heterostructure) and stacking different materials on one another (vertical 2D heterostructure). Doing this in controlled fashion can create new Van der Waals materials with tailored properties that offer another promising approach to design and fabricate novel electronic devices.

In this seminar, after a brief introduction to 2D materials, I will review the current state in different ways of fabrication, characterization and applications of various 2D heterostructures. We will discuss the different ways of stacking 2D materials (vertical and lateral heterostructures) and their physical properties. Also, we will take a closer look at yielding superstructures (moiré pattern) that are a product of vertical stacking.

Keywords: two-dimensional materials, lateral and vertical heterostructures, vapor-phase growth, molecular beam epitaxy, chemical vapor deposition, moiré pattern, van der Waals interaction

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