Characterization of atomically thin graphene/h-BN stacked heterostructures

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Hexagonal boron nitride (h-BN) is a 2D layered material. It contains boron and nitrogen arranged in a sp^2 hexagonal lattice via covalent bonding [1]. h-BN has attracted wide interest due to its great compatibility with the graphene crystalline structure (Gr). It can be considered as an ideal substrate or an encapsulating layer in graphene-based electronic devices [2]. In this work, graphene and h-BN are grown on a similar Cu foil, but in two separate chemical vapor deposition furnaces to ensure high-quality synthesis of each 2D material. Subsequently, few-layers (1 cm^2) of graphene are successfully transferred onto h-BN thin films on SiO_2/Si using a PVA lamination transfer. Raman spectroscopy confirms high-quality graphene domains deposited on h-BN thin films. Graphene number of layer analysis is investigated based on the shape, intensity, and positions of the Raman G and 2D peaks. X-ray photoelectron spectroscopy spectra of graphene/h-BN heterostructures on SiO_2/Si substrates provide insights on the chemical composition and bonding states of the materials involved. Kelvin probe force microscopy (KPFM) reveal variations in the work function between the Gr/h-BN/SiO_2 and h-BN/SiO_2 regions (Fig.1). These differences are attributed to variations in h-BN layer and/or graphene layer thickness, or due to strain induced by graphene domains formed on fractured h-BN. This work paves the way to synthesize good-quality graphene/h-BN heterostructures on insulating substrates and contributes to next-generation graphene-based device applications.

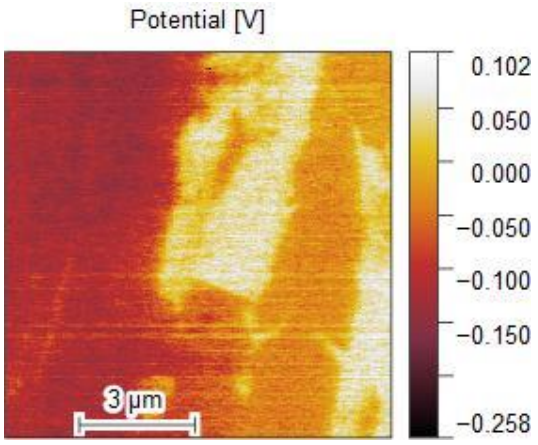

Figure 1: Kelvin probe force microscopy image of monolayer and bilayer graphene on a folded h-BN thin film.

References

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