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Fabrication and Characterization of Graphene-based Heterostructure and Basic Characterization of CVD Graphene

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In this project, we focus on fabrication and characterization of graphene-based heterostructures. First, we use "Pick-up method"at low transfer temperature (T = 40 - 60 oC) in order to fabricate the h-BN/graphene/h-BN van der Waals heterostructure on silicon oxide substrate. We find that transferring graphene at low temperature leaves hydrocarbon residues between graphehe/h-BN interface which show up as bubbles. To avoid these bubbles, we use high transfer temperature (T = 110 oC). We find that, with high transfer temperature, h-BN/graphene/h-BN van der Waals heterostructures are atomically flat with no bubbles at the interfaces when observed by an optical microscope. To confirm this observation, we use atomic force microscope to study surface morphology of our heterostructures and find no bubble present in our samples. In addition, graphene has no structural damage during high-temperature transfer process as evidenced by the absence of D peak in Raman spectra.
Furthermore, we transfer CVD graphene to silicon oxide substrate by wet transfer method. We observe that graphene thickness is not uniform. Some area has a few layer graphene while other areas have no graphene at all. In addition, we observe copper ion residues from copper foil which does not get completely etched away during the wet transfer process. We find that the resistance of CVD graphene is about 40 kΩ and 2 kΩ when measured by 2-probe and 4-probe measurements respectively. Hence, the high resistance of CVD graphene when measured by 2 probe measurement is a result of high contact resistance which is approximately 38 kΩ.

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