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Optical Probing of Electronic Interaction between Graphene and Hexagonal Boron Nitride (hBN)

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Even weak van der Waals (vdW) adhesion between two-dimensional solids may perturbtheir various materials properties owing to their low dimensionality. Although the electronic structure of graphene has been predicted to be modified by the vdW interaction with other materials, its optical characterization has not been successful. In this report, we demonstrate that Raman spectroscopy can be utilized to detect a few % decrease in the Fermi velocity (v_F) of graphene caused by the vdW interaction with underlying hexagonal boron nitride (hBN). Our study also establishes Raman spectroscopic analysis which enables separation of the effects by the vdW interaction from those by mechanical strain or extra charge carriers. The analysis reveals that spectral features of graphene on hBN are mainly affected by change in v_F and mechanical strain, but not by charge doping unlike graphene supported on SiO_2 substrates. Graphene on hBN was also found to be less susceptible to thermally induced hole doping.

Keywords: Graphene, Boron nitride, Raman spectroscopy, 2D band, Electronic coupling