Doping-induced rhombohedral to Bernal structural transformation in trilayer graphene

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Abstract

Great progress has been made towards the understanding of properties of single and bilayer graphenes. In nowadays, the research focus has been shifted towards few-layer graphenes which show unique properties and phenomena [1]. Moreover, in thicker graphene layers, there is an additional degree of freedom that governs the tuning of electronic properties, which is the crystallographic stacking order. Trilayers exhibit two different crystallographic configurations, namely the Bernal (or ABA) stacking and the rhombohedral (or ABC) stacking. It was demonstrated [2] that both configurations have distinct electronic and transport properties. Particularly, the ABC-type materials possess semiconducting properties and their electronic band gap can be adjusted by the application of an external electric field [3]. In this work, we report the ABC to ABA transformation of mechanically exfoliated trilayer graphene after doping with nitric acid vapors at a temperature of about 75 ^{o}C. After the physical adsorption process, certain ABC-stacked domains were converted to ABA-stacked ones. This was confirmed by the shifts and lineshape changes of the main Raman active peaks of trilayer graphene. In addition, through intense Raman mapping we managed to follow the sliding of the upper layer as a function of doping which is in the order of 1 μm. We suggest that the observed transformation is due to the "ironing" of the wrinkled regions present in the boundaries between ABC and ABA domains in the undoped sample.

References

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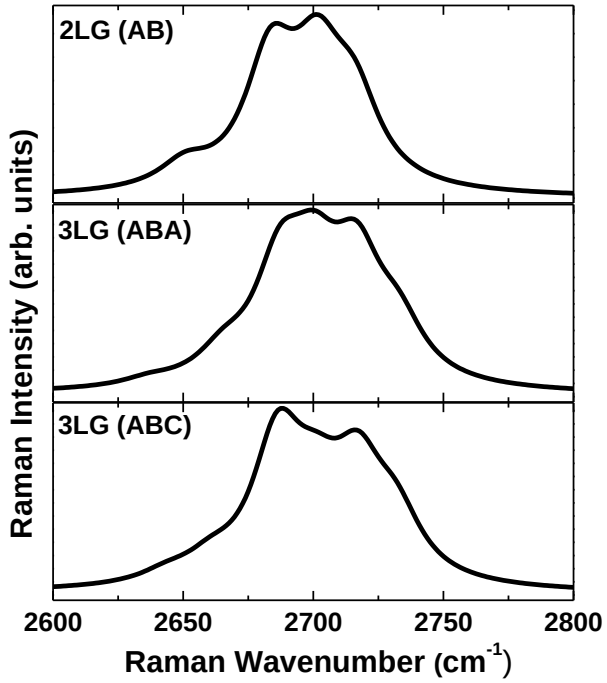

Figure 1. Characteristic spectra obtained using the 2.41 eV excitation energy in the 2D band frequency regime of bilayer and trilayer graphene with ABA and ABC stacking configurations.