Graphene/SiC as a Van der Waals substrate for molecular beam epitaxy: spontaneous In or Ga intercalation

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The use of graphene as a substrate in epitaxial growth is attracting great attention based on the clear benefits of graphene transparency, high conductivity and flexibility as well as on the Van der Waals character of its interaction with the material. Nevertheless, the effects of epitaxial growth on the properties of graphene are poorly understood. In this work we analyze epitaxial graphene on (0001) SiC before and after being used as a substrate for the growth of GaN by plasma-assisted molecular beam epitaxy. We report on the formation of a self-limited Ga or In metallic bilayer which gets intercalated between graphene and the SiC surface by diffusion at SiC steps. The role of N and Ga deposition on the characteristics of graphene are investigated in different samples. The structural changes under the different treatments are addressed by Atomic Force Microscopy (AFM), and correlated with the electrical properties of the 2D layer by Kelvin Probe Force Microscopy (KPFM). Strain and doping of the graphene layers were analyzed by Raman scattering maps. The results obtained indicate that the intercalation of N or metal species between graphene and SiC takes place only in one-layer graphene regions, leading to the full decoupling of graphene from the SiC surface. When effectively detached from SiC, graphene decreases its doping level and improves considerably both strain and doping homogeneity.

Figures

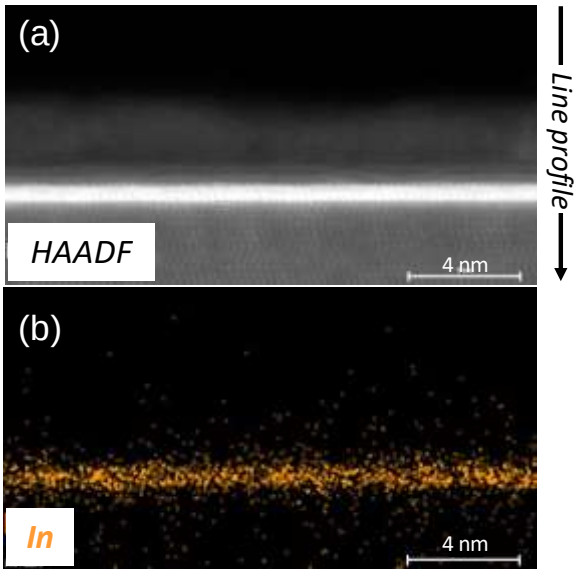

Figure 1: STEM HAADF (a) and EDX (b) observation of the SiC/In/graphene interface.

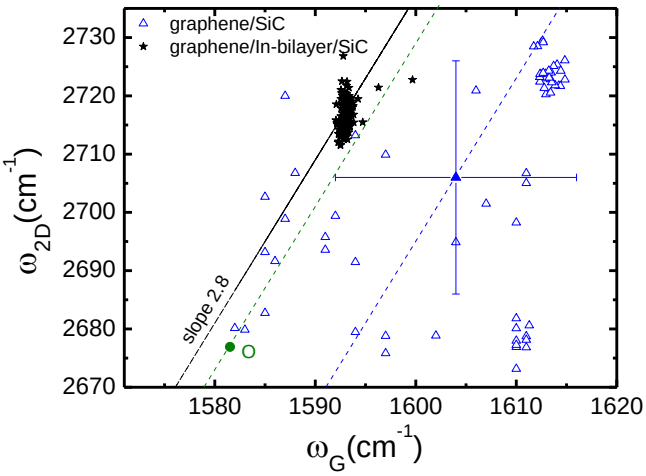

Figure 2: Variation of the 2D peak frequency as a function of the G peak frequency for different samples. The green dot (denoted O) corresponds to intrinsic free-standing graphene.