The influence of aqueous solutions on electronic and optical properties of epitaxial graphene grown on SiC

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Graphene is a two-dimensional material with excellent mechanical and electronic properties. It is also very stable under harsh chemical conditions. It shows a linear dispersion dependence for electrons at K point of the Brillouin zone. This results in high carrier mobility, even for highly doped samples. Owing to such features, graphene may be used in different kinds of sensors and biosensors. Graphene flow sensors are developed to work in aqueous solutions. Thus, it is important to verify how they affect the optical and electronic properties of graphene.

In this presentation, we show the results of Raman μ-spectroscopy and Hall effect measurements on graphene samples immersed in different aqueous solutions. The Raman scattering measurements provided us with microscopic data about concentration and strain of the graphene sheets in varying conditions, which can be observed as relation between G-peak positions and 2D-peak positions [1]. Moreover, D-peak intensity provided information about the change in defect concentration [2]. Hall effect measurements resulted in macroscopic information about concentration and carrier mobility.

The graphene samples used in our study were grown using sublimation technique and chemical vapor deposition (CVD) on SiC [3]. In order to acquire statistical information, spatial Raman maps, and Hall measurements were performed for all investigated graphene samples before and after being immersed in aqueous solutions for some time. Here, we focus only on the immersion in NaCl solution.

We have found that the impact of the solution depends strongly on the method of graphene fabrication. In the case of sublimated material, average positions of the G and 2D band were shifted towards lower values, which could be understood in terms of simultaneous relaxation of strain and decrease in carrier concentration. On the other hand, for the CVD sample, substantial increase of carrier concentration, leading to the increase of the G-peak position was observed. The observed averaged changes of the carrier concentrations are in a good agreement with the Hall data.

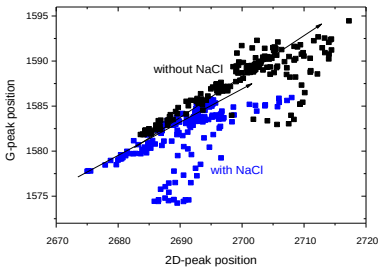

Figure 1. G-peak and 2D-peak relation for sublimated graphene sample before and after immersion in NaCl

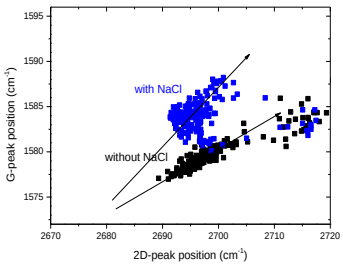

Figure 2. G-peak and 2D-peak relation for CVD graphene sample before and after immersion in NaCl

The obtained result is discussed in terms of differences in chemisorption, physisorption, as well as intercalation of sublimated and CVD graphene resulting from different growth methods.

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