Interaction of epitaxial graphene with SiC substrate studied by Raman spectroscopy

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The micro-Raman spectroscopy was used to investigate interaction of two types of epitaxial graphene with 4H-SiC(0001) substrates. The first type of graphene structures were grown using classical Si sublimation from SiC. The second type of graphene was obtained by chemical vapor deposition (CVD) of carbon from propane on SiC substrate. The crucial element of the later technique is Si sublimation blocking by controlling argon pressure in the reactor .

Two type of experiments have been performed using micro- Raman spectroscopy. The first experiment based on micro-Raman maps of 2D band with submicron spatial resolution. Micro-Raman maps performed on 2x2mm area (100 points) for the CVD sample, of one monolayer thickness, showed that the average energy of 2D band is of about 2695cm^{-1}, thus only 15cm^{-1} blue shifted in comparison to freestanding graphene. On the other hand for the sublimated sample of monolayer thickness, the average 2D band energy was of about 2740cm^{-1}, which is strongly blueshifted (60cm^{-1}) with respect to the freestanding material. Thus, the blueshift for sublimated graphene is much larger than for the CVD samples. That suggests that strain in the graphene obtained by sublimation method is much stronger.

The second type of experiments were focused on temperature dependence of the 2D Raman band. The measurements were performed in the temperature range between 20^{0}C to 150^{0}C. The obtained results showed that the 2D band position is red shifting with the temperature increase for both kind of graphene samples and the observed shift rate depend on graphene thickness. For the sublimated graphene the temperature induced shift of the 2D band varied from -0.11 to -0.17 cm^{-1}/^{0}C. On the other hand, for the CVD grown graphene temperature induced shift of the 2D band varied from -0.034 (close to the value obtained for freestanding material) to -0.095cm^{-1}/^{0}C. These results confirm that graphene grown by CVD technique interacts much weaker with the SiC substrate, and is not so strongly pinned to SiC surface as graphene grown by sublimation technique.

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