Characterization of multilayer graphene obtained by SiC sublimation on C surface by far infrared magnetospectroscopy and Raman spectroscopy

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Multilayer graphene obtained on C face of SiC substrates is composed of differently stacked layers [1]. It is not obvious that there are patches of differently stacked multilayer graphene (MLG) on the surface or those layers are stack one on another with diverse orientation. The far infrared magnetospectroscopy combined with micro-Raman (MR) spectroscopy is a perfect tool to study the problem. The observation of almost neutral graphene and highly doped graphene in FIR spectroscopy is well known [2]. Also MIR spectroscopy is helpful showing the existence of bilayers in such systems [3].

We investigated two sets of samples “grown” on 6H SiC C-face substrate in the same conditions. The sets differ by the time of the sublimation process. The thickness of MLG was checked by means of optical transmission measurements allowing estimation of number of layers in MLG. The magnetospectroscopy measurements reveal not only the structure typical for free carriers in MLG and strong transition from ground state to the first landau level (0 → 1 or -1 → 0 transition) with classical √B dependence of position energy but also weaker structures with linear dependence on B. Part of such lines can be explained in terms of transitions between Landau levels in bilayers. However the most intriguing one (see figure), the satellite of the main graphene line can be hardly explained within this model.

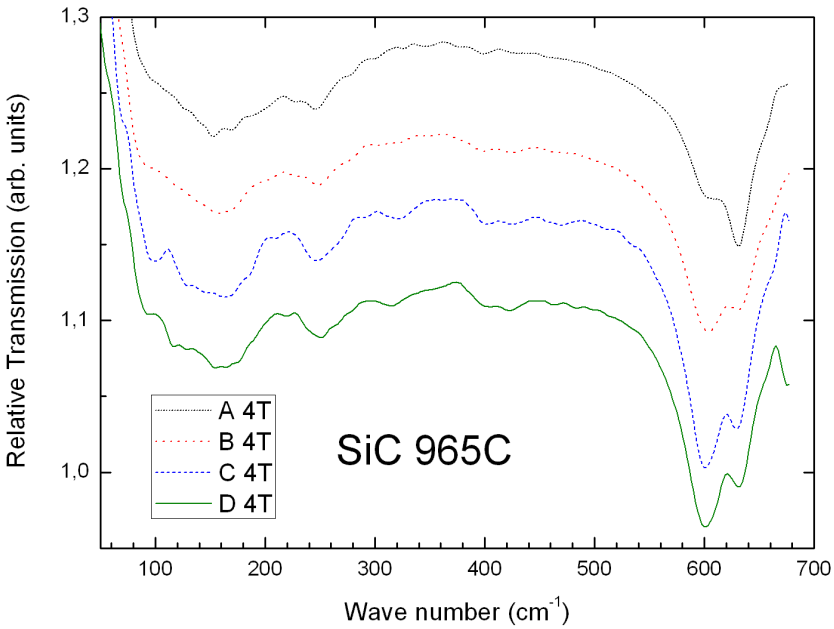

Figure 1.

Relative magnetotransmission (T(B)/T(0)) for 4 different samples at 4T obtained in the 965 process. The splitting of the main graphene line at about 620 cm^{-1} is clearly visible.

In different samples the oscillator strength of the satellite line is almost the same in spite that the main line changes noticeable. The width is also almost two times smaller than the width of main line. We suggest that this is one of the spitted lines in trilayer system (ABA stacking) [4]. The second line is hidden in the graphene one (0 → 1 or -1 → 0 transition).

The idea of observation of the trilayer is additionally supported by existence of week lines linearly dependent on magnetic field, suggesting the transitions between parabolic levels predicted by the theory [4].

The Raman experiments done on the same samples show that in the same spot exist differently oriented layers.

Therefore one can conclude that sublimation take place making the dominant AA' orientation. However, in certain conditions, parts of the sample with trilayer system are obtained.

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