The Study of Physical Properties of Self-Assembled Graphene

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Currently, intensive research taking place in the world to develop simple low-temperature methods for the synthesis of graphene and related materials. This paper considers a synthesis of graphene using colloidal solution of graphite powder (dissolved in water). Also, ultrasonic vibrations were used in the process of synthesis. Obtained layers were substituted on the silicon, amorphous sapphire, monocrystal salt and plastic surface. Scanning electron and atomic force microscopes are used to study surface profile (Fig. 1) and surface potential (by Kelvin-probe method) of samples. The results of surface potential measurements (-400 ÷ -600 mV) are typical for graphene [1]. We also study the change in the surface potential at the graphene-quartz boundary.

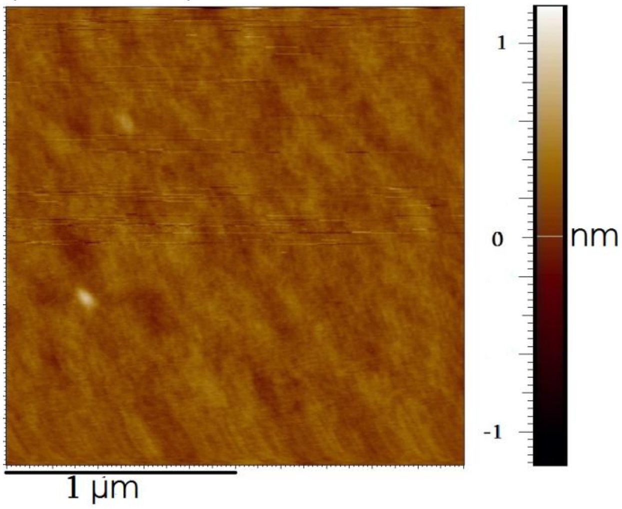

Figure1. AFM image of surface profile of the self-assembled graphene.

In order to elucidate the internal structure of formed films, the Raman scattering and optical absorption spectrums are studied. The joint analysis of the results and reviews the literature [2, 3] indicates the presence of graphene and graphene oxide. When change the substrate (from salt to amorphous sapphire) characteristic absorption peak for graphene shifts to higher energy range, due to the dielectric confinement effect. It happens, because in our case, in addition to the quantum confinement, there is also the so-called dielectric confinement, which is due to the fact that the lines of elektric field between the Coulomb pair (exciton) penetrate to the barier zone and are redistribute. The influence of the effect of dielectric confinement on exitonic absorption mechanism in graphene is discussed too. Also, the current-voltage characteristics of these films are obtained for different values of resistance (Fig. 2). The results are discussed in comparison with the results already published articles [4, 5].

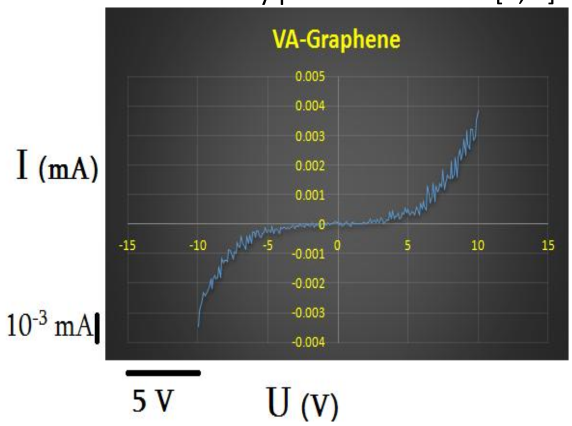

Figure 2: Current-voltage characteristic (for R≈700 kΩ).

References

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