Atomic Force Microscopy cleaning of graphene deposited on SiO_2 substrate

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Monolayer graphene (MG) is a new two-dimensional form of carbon material, which possesses unique electronic properties due to mass less Dirac fermion character of carriers derived from the conical dispersion relation close to the Dirac point (E_D). It has been shown that this type of dispersion relation leads to the presence of quantum Hall effect, ballistic transport of electrons, electronic spin transport, micron scale coherence length, single electron tunnelling, evidence of Klein tunnelling and scattering, or for instance existence of the optics-like focusing of electron rays in the p-n graphene junctions.

However it has been demonstrated that the presence of chemical adsorbates on MG leads to the significant modifications of the electronic transport properties of this material. Mainly, these adsorbates left after graphene production processes [1], and electron beam lithography procedures required in the fabrication of MGD [2]. That’s way the electronic devices based on graphene require clean and perfect carbon honeycomb layer deposited on different substrates. It seems to be that the experimental controlling of the presence of impurities on the graphene sheet is still far from the understanding and require further theoretical and experimental studies.

Recently, different cleaning methods of graphene have been proposed. The most popular is annealing of graphene in UHV condition or heating with argon/hydrogen atmosphere [3]. Thought, it has been proved that annealing modify graphene surface considerably [4]. It has been also shown that high density of electric current remove contamination adsorbed on the graphene surface [5].

We report on a cleaning method of MG deposited on SiO_2 substrate based on repetitive scanning process with atomic force microscope (AFM) and subsequent electron beam irradiation. This process leads to removal of adsorbates and exposing clean graphene layer. In this method contaminations are accumulated at the edges of scanning area and we can immobilize them. In Fig.1 we present AFM topographies showing differences between clean and dirty regions. Measurements show that new cleaning procedure is very effective, and can be used not only for cleaning graphene surface but also in lithography process. This method can lead to production a new type of graphene devices.

References

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Figures

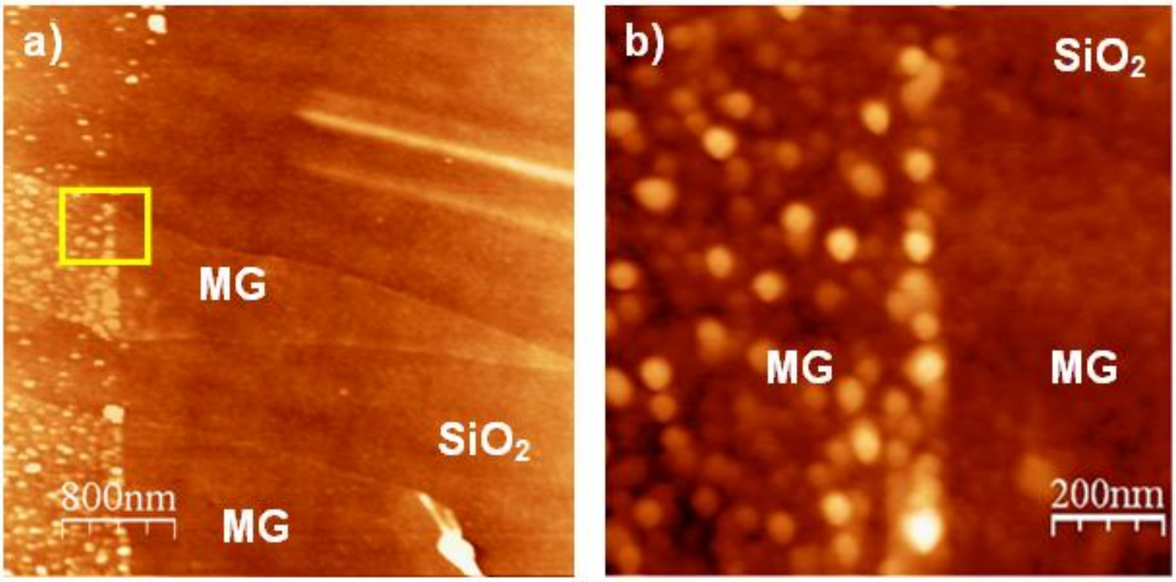

Fig. 1 AFM topography showing SiO_2 and MG regions after cleaning procedure. (b) The AFM topography showing the details of the interface between clean and dirty regions