Investigation of graphene films grown on SiC substrate subjected to original pre-growth treatment

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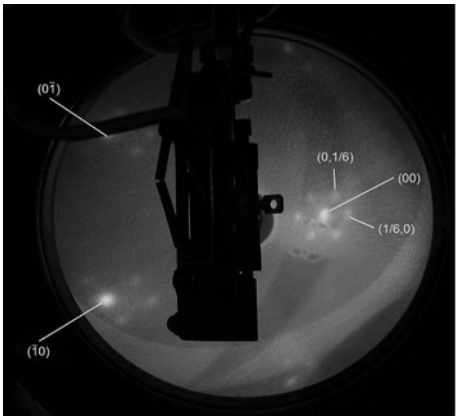
At present time only the epitaxial growth technology based on high temperature annealing of SiC substrates has a real potential for mass production of wafer-scaled and high quality graphene films [1]. Despite the quickly increasing number of publications developing fundamental and applied aspects of this technology, it is still far from being accomplished. In this work we demonstrate that our original technique of substrate pre-growth treatment may promote considerable progress in this field. To this effect we investigated graphene films grown on a high quality commercial 6H-SiC (0001) substrates which were preliminary subjected to pre-growth treatment, that is, were annealed for 30 minutes in a high-vacuum chamber in a quasi-closed growth cell at a temperature about 1300°C. Then, the substrate was again annealed for 30 minutes, but at an ambient argon pressure of 1 atm. and at temperature 2000°C [2].

Properties of the film thus grown were studied by atomic force microscopy (AFM), low energy electron diffraction (LEED), x-ray photoelectron spectroscopy (XPS), and near edge x-ray absorption fine structure (NEXAFS) spectroscopy. AFM study showed that substrate surface consists of flat and wide (~1 μm) terraces covered with sufficiently large and continuous graphene domains. Numerous LEED patterns (see example in the figure) obtained from different points of the sample demonstrate concurrent presence of a well-ordered graphite (1×1) pattern and (6√3×6√3)R30 pattern inherent to the underlying buffer layer [1] and, thereby, evidence mainly bilayer character of the grown film. XPS and NEXAFS data obtained on synchrotron BESSY II (Berlin) allowed us to specify a chemical composition and electron structure of grown graphene film and confirmed its high quality and mostly bilayer nature.



LEED pattern of graphene film grown on SiC substrate subjected to pre-growth treatment.

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