Optical properties of graphene-MoS_2 heterostructure

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In the last decade graphene has been attracting great interest in physics of condensed-matter because of exceptional mechanical and electronic properties. Their unique properties can be even further exploited by its incorporation in heterostructures made of several two-dimensional materials, other than graphene [1]. One of the materials, which recently draws the attention of researchers is molybdenium disulfide (MoS_2). In contrast to graphene, MoS_2 is a semiconductor with a natural bandgap [2]. Therefore, heterostructures of graphene with this 2D crystal may be used to obtain bipolar field-effect transistors with high on/off current ratio, which can be used in flexible and transparent electronics [3,4] and memory devices [5]. From the point of view of applications it is very important to verify how the interaction between graphene and MoS_2 modifies their properties.

The Raman scattering spectroscopy is a technique of choice to study such interactions. High sensitivity of Raman peaks to external factors combined with microscopic optical technique provides important information on the local crystalline lattice of the two-dimensional materials.

In this presentation we report optical properties of heterostructure consisting of a few MoS_2 flakes deposited on epitaxial graphene grown on SiC substrates. We have observed that MoS_2 flakes of different sizes and thicknesses show specific Raman spectrum, overlapped with characteristic luminescence depending on laser excitation wavelength. We have found that Raman spectrum of the graphene is modified by the presence of μm size MoS_2 flakes. These modifications are discussed in terms of strain as well as carrier concentration changes.

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