GRAPHENE RAMAN SPECTRA FEATURES IN THE GRAPHENE/hBN HETEROSTRUCTURE DEPOSITED ON SiO_2/Si SUBSTRATE

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2D materials based heterostructures possess unique tunable properties [1] that can be used to develop new principles for thin-film electronics devices assembling. 2D materials such as graphene, transition metal dichalcogenides (TMD), hexagonal boron nitride (hBN), black phosphorus, silicene, germanene and etc. are of the great scientific interest today. Raman spectroscopy is one of the most effective and wide used non-invasive tools for analyzing properties of 2D materials and graphene in particular.

We used mechanical exfoliation to obtain graphene and hBN flakes. Graphene/hBN heterostructures on SiO_2/Si substrate were assembled with a dry transfer process following Wang et. al. [2]. A Certus Light V AFM atomic force microscope was used to evaluate surface morphology of the fabricated samples. Raman spectroscopy analysis and optical microscopy were performed by using Nanofinder High End (Tokyo Instruments) confocal system. Laser wavelengths were 532 nm and 473 nm, laser powers were 2 mW and 2.4 mW correspondingly. All spectra were collected using 100x objective with NA = 0.95 and the spectral resolution was around 3 cm^{-1}.

The analysis of the 2D and G peaks intensity ratio (I_{2D}/I_G) distribution showed that I_{2D}/I_G depends on the laser wavelength and increases if graphene is covered with hBN compared to the areas with uncovered graphene.

It has been shown that graphene doping level on the SiO_2/Si substrate is dependent on the power of the excitation radiation. Laser power increase leads to initial *p*-type doping, caused by interaction with substrate, change to *n*-type. But we didn't observe the same dependence in case of graphene covered with hBN.

Statistical analysis of the obtained graphene Raman spectra showed that the presence of the additional hBN layer on top of the graphene in the graphene/hBN heterostructures results in the additional graphene compression ($\varepsilon \sim -0,2\%$) and doping level decrease [3].

We showed that sample high temperature annealing (400 °C) in vacuum (10^{-6} mBar) results in the doping level decrease of the graphene on the SiO_2/Si substrate, but this effect can be reversed if the sample is exposed to the air. It should be noted that graphene G and 2D peak's position blue shift indicated the presence of the additional mechanical deformations (compression) of the graphene layer.

The results of our research are of the great interest from methodological point of view and can help one to characterize heterostructure on each stage of its assembly process.

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References

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