Nanoscale physics

Electrophysical properties of the graphene/SiO_2 structures subjected to the electron beam irradiation.

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Modifying the properties of the carbon structures by radiation treatments attracts scientific interest as a promising method for tuning of the electronic properties of further nanoelectronic devices. This paper dedicated to the research of the electronic properties of the single layer graphene (SLG) subjected to the medium-energy electron-beam irradiation.

The SLG films had been grown by the chemical vapor deposition and transferred on the SiO_2 (300 nm) / p-Si wafer. The Ni contacts (transfer length measurement set) had been deposited on the SLG by the DC magnetron sputtering.

In order to create defects in the SLG films "ZBA-21" electron lithography system (20 keV e^- beam with 1 A/cm^2 current density focused on an area of 2.5x 10^{-7} cm^2) had been used. Irradiation doses were in $1x10^{-3}$ – $7x10^{-3}$ Q/cm^2 range.

The micro-Raman spectra depicted the changes for our samples are indicative of the disorder and defects introduced due to the e-beam irradiation: 2D/G lines ratio was reduced from 2.5 to 1.0; D/G lines ratio was raised from 0.1 to 0.35; the 2D line FWHM was broadened from 25 cm^{-1} to 35 cm^{-1}.

Both of the temperature and frequency depended resistivity measurements have been conducted. The resistivity of the sample has increased with irradiation dose up to 1.5 times. The irradiation impact on the non-linear resistivity temperature dependence in 290K – 390K range (explained by the optical phonon modes of graphene or the remote interfacial phonon scattering by the polar optical phonons of the SiO_2 substrate) has been observed.

Additionally, the frequency dependent capacitance of the samples has been measured. The logarithmical decreasing of the capacitance in range from 5 kHz to 0.3 MHz has been observed and explained theoretically.

The work was partially supported by Ministry of Education and Science of Ukraine (Project F2904).