Optical and electrical studies of graphene deposited on GaN nanowires

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Graphene has been shown to be an interesting material with various possible applications. Since graphene is transparent and has good conductivity, it is considered to be a good candidate for replacing ITO in solar cells. On the other hand, it has been shown recently that nanowire structures can substantially increase efficiency of solar cells. Therefore, possibility of using graphene as a transparent electrode on GaN nanowires (NWs) is very attractive. In this paper we focus on experimental studies of graphene grown by Chemical Vapor Deposition method, and transferred onto GaN NWs grown by Molecular Beam Epitaxy. Electron Spin Resonance (ESR) and Raman spectroscopy have been used to study the properties of graphene.

ESR was measured as a function of temperature. Observation of the characteristic peak related to weak-localization allowed us to estimate the coherence length changes from about 150 nm at 5 K to 120 nm at 25 K (Fig.1). Interband and intraband scattering lengths were found to be independent of temperature and equal 150 nm and 31 nm, respectively. Interestingly, the obtained coherence length was shorter, whereas elastic scattering lengths were similar to those obtained for graphene transferred to other substrates. It was found, that presence of GaN NWs substantially increases intensity of graphene Raman spectra, by more than one order of magnitude compared to as grown CVD material. Besides, as can be seen from Raman mapping, the observed changes of spectrum parameters (energy shifts and intensity) correlated with positions of individual NWs (Fig. 2). The intensity ratio of D to G peak was high, however could not be correlated with GaN NWs pattern, which suggested large enhancement of defect spectrum rather than defect generation by NWs. The obtained results are discussed in terms of the interaction of graphene with a polar medium (GaN, with free carrier distribution along NWs).

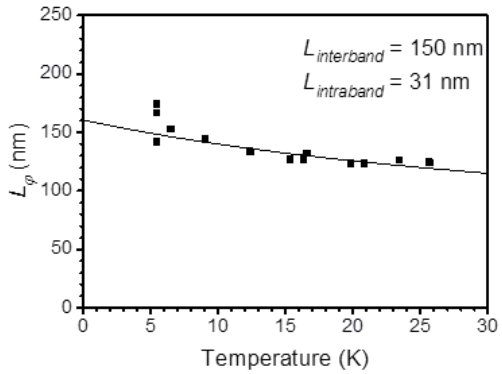

Figure 1. Temperature dependence of coherence length.

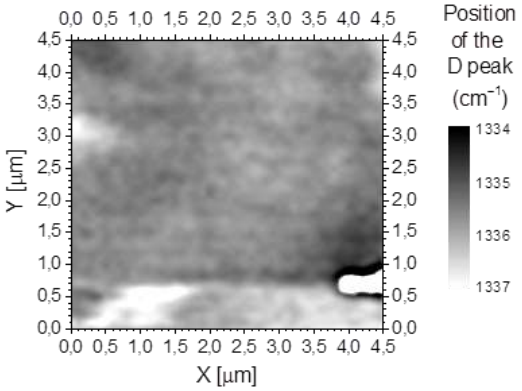

Figure 2. Map of D peak position in graphene Raman spectrum with visible distribution reproducing NWs surface density.

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