Pseudomagnetic field engineering in graphene on GaN nanowires

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Substrates of GaN nanowires (NWs) show potential for the nonuniform elongation of graphene and induction of pseudomagnetic fields which can lead to the fabrication of field-based devices like spin filters [1]. Three samples of two-layered graphene on GaN NWs with different inter distances (id) between supporting regions were characterized by HybriD mode AFM [2], Raman spectroscopy, and contactless transport. In HybriD mode AFM, changes in local strain are reflected in the susceptibility of graphene to elastic deformation. Analysis of measured deformation enabled a precise mapping of strain-induced graphene wrinkles (Fig. 1a). An increase of id is correlated with an increase in the deformation of suspended graphene regions and strain gradient. This result is confirmed by contactless transport measurements of weak localization [3]. The coherence scattering length (L_φ) and intervalley scattering length (L_i) depend on the rate of intra and intervalley scattering. Reduction of both scattering lengths with increasing strain gradient (Fig. 1c) shows that strain-induced wrinkles could generate a pseudomagnetic field. This is also confirmed by a substantial increase of the D’ band intensity in the Raman spectrum (Fig. 1b). The presence of spectra characterized by a ratio of 2D to G band larger than 1 and the ratio of D’ to D larger than 0.77 can hardly be explained by the occurrence of natural defects or resonant scattering phenomena [4]. Our results show that the induction of pseudomagnetic fields in graphene on NWs is positively correlated with increasing inter distances between supporting NWs.

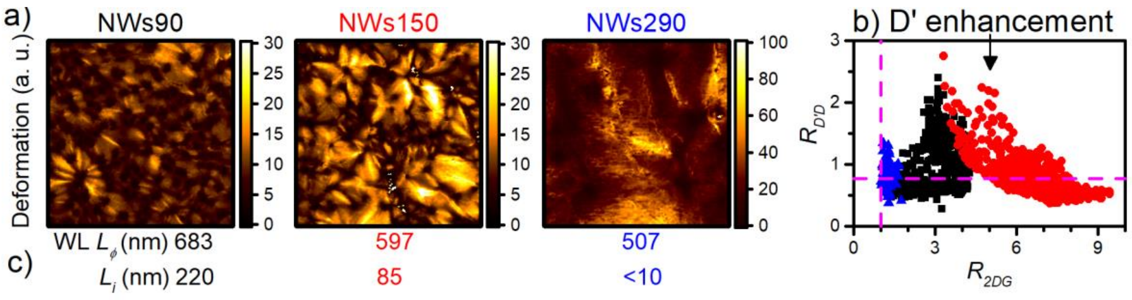

Figure 1. a) measured deformation of graphene on NWs characterized by different id between supporting regions, note that scale in NWs290 differs, b) weak localization signal measured at 5.4 K, c) L_φ and L_i scattering lengths obtained from weak localization measurement analysis.

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