Strain analysis of CVD graphene by in situ Raman spectroscopy

Gerald V. Troppenz, Marc A. Gluba, Jörg Rappich, Norbert H. Nickel

Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Institut für Si-Photovoltaik,
Kekuléstr. 5, 12489 Berlin, Germany

gerald.troppenz@helmholtz-berlin.de

High quality large scale graphene was grown on copper foil via chemical vapor deposition (CVD). Because of its unique optoelectric properties, graphene is suitable as a transparent contact to silicon based semiconducting devices. Since it can not be deposited on silicon directly, an adequate transfer process is required. The conductivity of the resulting layer depends strongly on strain, which can be characterized by Raman spectroscopy. It is shown that the application of transfer support materials, such as polymers and foils, causes tensile strain in graphene.

In situ Raman spectroscopy is a powerful tool to investigate strain in graphene during the transfer from its growth substrate to other materials (e.g. SiO_2 or Si). We employed this technique to monitor the strain of graphene at the polymer/graphene/copper interface via the 2D band vibrational frequency during removal of the substrate. Our results show that the strain relaxes due to the etch-back of the copper foil. As a reference we investigate the strain in graphene by mechanical stretching experiments.

These experiments aim to evaluate different transfer methods and -materials for graphene from copper to other substrates.

Figures

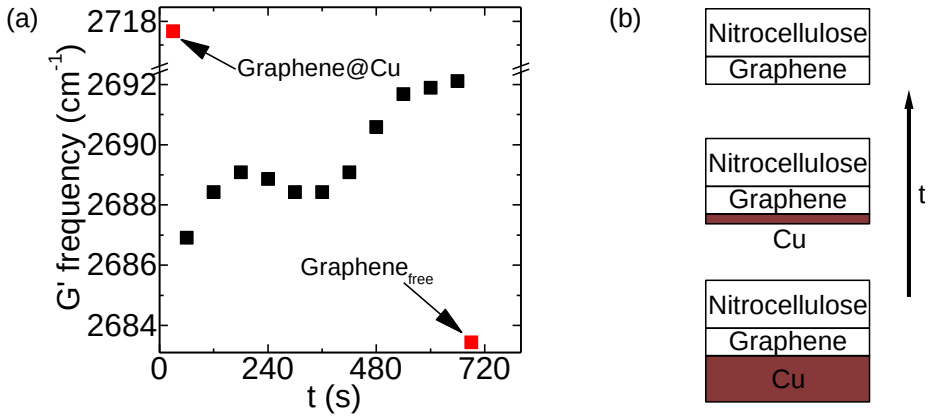

Fig. 1: Time dependence of G' frequencies of the nitrocellulose/graphene/copper interface during etching of the copper foil by aqueous 0.25 M $FeCl_3$ solution. Excitation wavelength 514.5 nm (2.41 eV). Arrows pointing to the G' frequencies of graphene on copper and free floating graphene on etching solution, respectively (a). Schematic illustration of copper back-etching (b).