The Influence of Field Effect Doping on the Optical Properties of Bilayer Graphene

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Graphene is currently one of the most intensively investigated materials due to its unique properties like linear dispersion at the K-point of the Brillouin zone and the presence of 2D electron system [1]. The carrier concentration of graphene can be controlled by field effect doping [1] leading to changes in the optical reflection in the mid-infrared range by applying a back gate voltage as demonstrated recently [2]. We show here that this effect which is important from an application point of view also markedly affects the visible range. We thus demonstrate the tuning of the optical properties of bilayer graphene on a Si/SiO_2 substrate in both the visible and near-infrared range by applying a back gate voltage. The bilayer graphene sample was prepared by mechanical exfoliation and transferred onto a highly n-doped Si substrate covered with a 300 nm thick SiO_2 layer. The electrodes consisting of a 10 nm NiCr / 30nm Au bilayer were prepared by electron beam lithography. The measurement of the dielectric function was performed by a microscopic imaging ellipsometer nanofilm_ep4 (Accurion GmbH) under ambient conditions. The experimental geometry is shown in Figure 1(a). The dielectric function of graphene was modelled using an anisotropic model including one Lorentzian oscillator, corresponding to a transition at the Γ point, and the Drude function accounting for the free carrier contributions. The evolution of the real and imaginary parts of the in-plane dielectric function of bilayer graphene as a function of applied back gate voltage is shown in Figure 1(b). The changes in the carrier concentration and the related changes in optical reflectivity and Drude model in 2D system will be discussed.

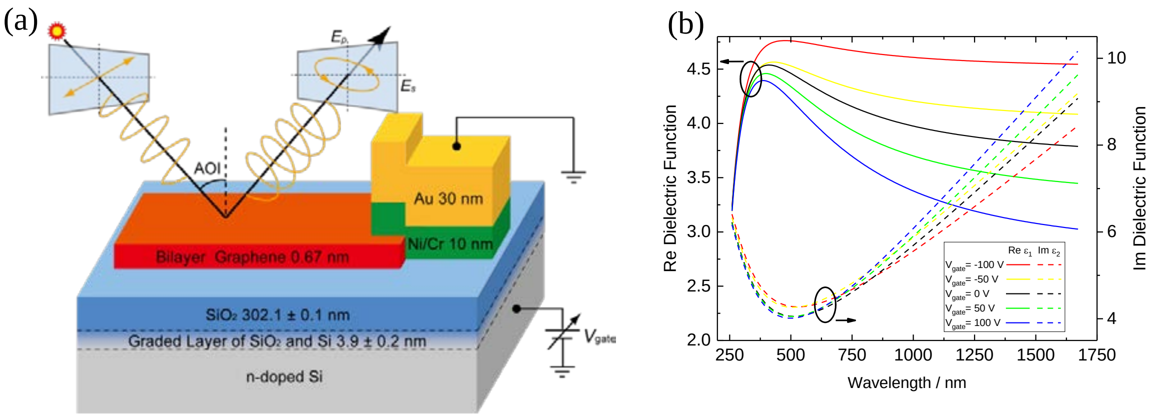

Figure 1: (a) Sketch of the experimental geometry. (b) Evolution of the real and imaginary parts of the in-plane dielectric function of the bilayer graphene as a function of back gate voltage.

[1] K. S. Novoselov, *et al. Nature* **438**, 197-200 (2005).

[2] F. Wang, *et al. Science* **320**, 206 (2008).