Adsorption site - dependent mobility response in graphene exposed to gas oxygen

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Abstract

In this study transport characteristics of graphene field-effect transistors were measured in-situ in different atmospheres and at different temperatures. Mobilities of holes were extracted from transport characteristics as well as the doping level in dependence on the time of graphene exposure to oxygen/nitrogen mixture at different temperatures. Mobility of holes showed significant decrease and simultaneously the Dirac point was upshifted during exposure to gas oxygen. However, after few hours of the exposition the hole mobility did not change further despite the increase of doping by oxygen was still observed via the upshift of the Dirac point. We explain this by a presence of sites with different adsorption energy. The low-energy adsorption sites represent surface of graphene containing sp2 carbon and adsorption of oxygen to them is accompanied by the shift of the Dirac point and decrease of the hole mobility. Further adsorption of oxygen to high-energy adsorption sites of graphene (defects, impurities, transfer residuals, edges, functional groups) did not lead to a change in the hole mobility even though the Dirac point was continuously upshifted.

Figures

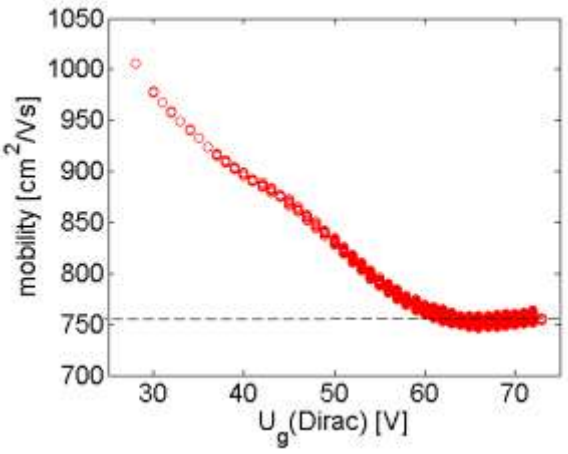

Figure 1: Correlation of the hole mobility and the Dirac point position in the graphene upon oxygen adsorption

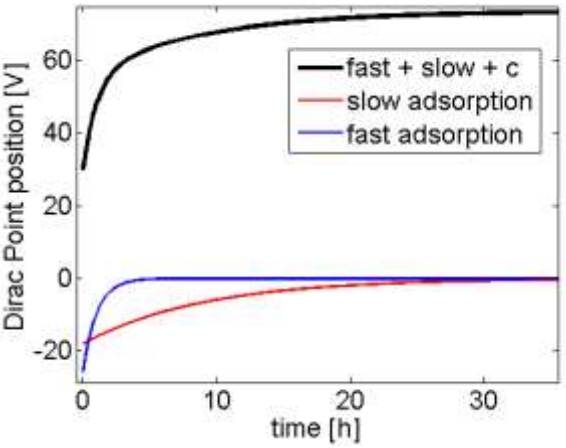

Figure 2: The Dirac point position upshift during oxygen adsorption to graphene