Doping control of graphene using Self-assembled monolayers

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Abstract

Graphene is very suitable as a charge sensing device thanks to its high transconductance and relatively low 1/f noise. These special properties have led to successful implementation of bio-, gas- and light sensors [1-3]. The signal in this type of sensors can be optimized by tuning the carrier density to the point where the transconductance is largest. In a lab environment this tunability can be easily implemented using a back gate. However, in real life applications this third terminal to the device increases the complexity and cost of the system.

Built-in doping control of graphene is critical for successful implementation of high performance graphene based sensors. To this end, self-assembled monolayers (SAMs) have shown to manipulate carrier type and concentration in a deterministic way without compromising the intrinsic performance of graphene [4].

In this work we tuned the doping level of graphene field effect transistors (GFETs) using SAMs. GFETs were fabricated inserting tailored silanes between SiO_2 substrates and graphene. Specifically, a (3-Aminopropyl)trimethoxysilane (APTMS) was anchored to SiO_2 substrates, showing an n-doping effect on graphene compared to non-silanized GFETs (see Fig.1). The electron-rich amine terminal group of APTMS donates an electron to the carbon atoms of graphene, consequently n-doping graphene.

In summary, here we demonstrate the benefit of using the APTMS modification of SiO_2 surfaces as non-destructive doping technique for controlling graphene doping and tuning the operation point of graphene sensors.

References

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Figures

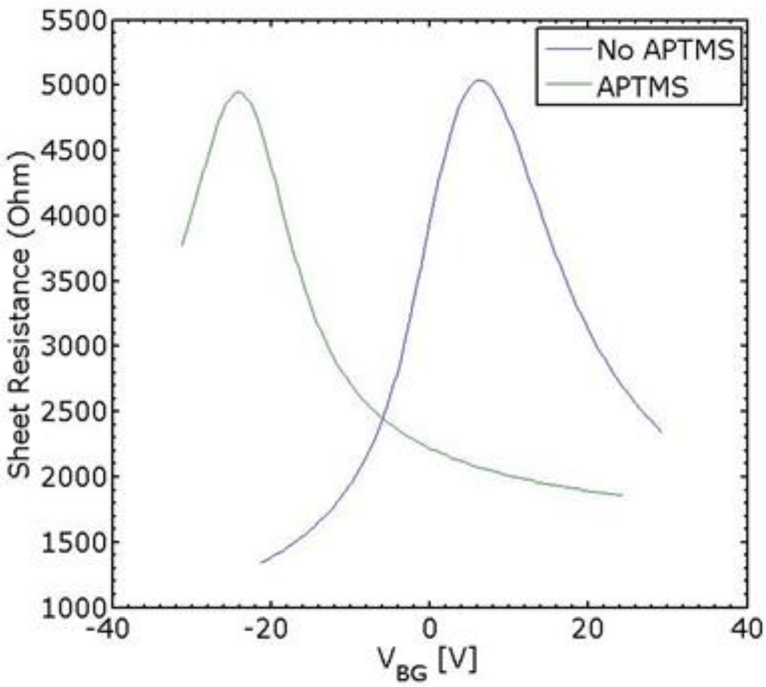

Fig. 1. GFET sheet resistance dependence on backgate voltage. APTMS-treated GFETs (green line) show n-type doping compared to non-treated GFETs (blue line).