'Monolayer' tungsten oxide as a strong p-dopant for graphene

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Abstract

Though graphene has been extensively studied for the past decade for applications in high speed electronics due to its extremely high carrier mobility [1], its high conductivity relative to its atomic-layer thickness also creates opportunities for its use as a transparent electrode. The use of graphene in these applications requires the development of reliable doping methods. There have been many studies of graphene doping techniques that use electrostatic force, chemical adsorption, molecular doping, annealing, UV, plasma treatment, among other methods. [2] Many of these techniques have trade-offs such as process damage, dopant instability, and poor transparency due to thick polymer coatings. Thus, we seek to develop a doping technique that preserves graphene's atomic structure, transparency, and yields high conductivity. Here, we develop an atomic-layer of p-type doping for graphene using 'monolayer' WO_x, which is formed by the room-temperature UV-ozone oxidation of monolayer WSe_2. To demonstrate the technique, a back-gated graphene FET was fabricated with a top layer of monolayer WSe_2. The device was measured before and after room-temperature UV-ozone oxidation, and the results are shown in Figure 1. The conversion from WSe_2 to WO_x strongly p-type dopes the graphene as evidenced by missing Dirac peak in the measured range and the reduced resistance. This work demonstrates the potential of 'monolayer' WO_x as a p-type dopant for graphene for use in electronics as well as a transparent electrode.

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References

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Figures

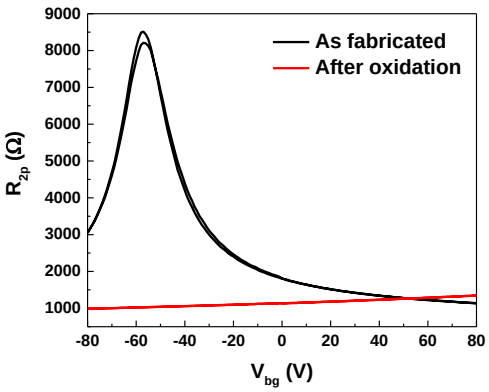

Figure 1: Two-probe resistance as a function of back-gate voltage for a graphene FET. Channel length and width are 5 and 1.5 um, respectively. The two curves correspond to an as-fabricated device of monolayer graphene with a top layer of monolayer WSe2 and the device after oxidation of WSe_2 layer.