Optically induced oxygen desorption from graphene measured using femtosecond, two pulse correlation

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Abstract

Absorbed gas molecules on the surface of graphene can have a large effect on its electrical properties [1]. Understanding the underlying mechanisms that cause this effect is essential to many technological applications such as sensing.

Recently, there has been a great deal of interest in the effect of atmospheric gases [2,3]. However, so far the techniques used to investigate it have not provided any temporal information about the binding, which is key to determining the mechanism. We investigate the electrical and optical response of graphene-based field effect transistors that have been exposed to high purity oxygen gas. High energies and temperatures generated from femtosecond pulses of light are used to desorb the surface bound oxygen. To study the effect on the graphene, we use a unique combination of two-pulse correlation to give high temporal resolution and low frequency transport measurements to monitor the photo-induced changes in the Fermi level. By measuring the Fermi level shifts, we are only sensitive to the oxygen atoms that interact directly with the graphene surface. We show the timescale of the oxygen desorption to be ~100 fs suggesting the desorption proceeds through hot electron generation in the graphene rather than heating of the lattice through hot phonon generation.

References