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Resistively detected spin resonance in graphene

R. G. Mani[1*], J. Hankinson,[2] C. Berger,[2] and W. de Heer[3]

[1]*Dept. of Physics & Astronomy, Georgia State University, Atlanta, GA 30303*
[2]*School of Physics, Georgia Institute of Technology, Atlanta, GA 30349*

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Graphene is widely viewed as a future charge-based high-speed electronic material to complement– or replace–silicon due to the high carrier mobility. At the same time, it is known that graphene includes attractive features for spintronics and spin-based quantum computing due to, for example the scarcity of electron-spin-dephasing nuclear-spin in natural carbon. Thus, the detection, characterization, and transport of spin have become topics of interest in graphene. Here we report a microwave photo-excited transport study of epitaxial graphene that reveals a strong microwave induced electrical response and dual microwave-induced spin resonances in the dc resistance.

Magneto-transport measurements of the diagonal resistance were carried out on the c-face of p-type epitaxial graphene Hall bar specimens at liquid helium temperatures both in the dark, and under microwave photo-excitation, with microwaves over the frequency range $10 \leq F \leq 50$ GHz. Experiment indicated a strong non-resonant microwave induced change in the diagonal resistance, indicative of a carrier heating effect. In addition, a pair of resonant responses consistent spin resonance and pseudo-spin-split spin-resonance were observed. These resonances were followed with microwave frequency and the results were fit to extract the g-factor, $g \sim 1.93$, the zero-magnetic field pseudo-spin splitting, ~ 44 micro-eV, and the spin relaxation time, ~ 60 ps.[1]

[1] R. G. Mani, J. Hankinson, C. Berger, and W. A. de Heer, Nat. Comm. 3, 996 (2012).

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