MAR11-2010-003072

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Atomically Thin Graphene Hall Cross Devices as Sensitive Magnetic Field Probes

JANICE WYNN GUIKEMA, Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD 21218

Experimentally realized in 2004, graphene has ignited great interest in physics, material science, chemistry and engineering. Graphene is a one-atom thick sheet of carbon atoms arranged in a hexagonal lattice. This elegantly simple material has excellent electronic and mechanical properties, as well as remarkable physics resulting from its relativistic Dirac electrons. Graphene is a highly promising material for many applications, including sensors. One of my research projects has been investigating graphene for use as a nanoscale magnetic sensor. Such sensors could be used to measure small magnetic particles or as a scanning probe to map out magnetic fields. The Hall cross geometry of the devices gives a noninvasive and straightforward magnetic field probe. I fabricated Hall crosses from mechanically exfoliated single-, bi-, and multi-layer graphene with cross junction widths down to a few hundred nanometers. The devices were tested in a small applied field and the noise spectra of the Hall signal as a function of bias current and back gate voltage was measured at room and cryogenic temperatures. The best field sensitivity at room temperature obtained for a 400 nm graphene Hall cross was 15 $G/Hz^{1/2}$ at 1 Hz and 1 $G/Hz^{1/2}$ at 4 kHz, which is on par with similar crosses made from other materials in the literature. In addition, because they are made from graphene, graphene Hall probes have further advantages such as tunability with a gate, being extremely thin and at the surface, and having mechanical stability for ultra-small device fabrication.