Electrical detection of spin precession in high-quality freely-suspended graphene devices

Neumann, Ingmar[1, 2]; Van De Vondel, Joris[1]; Bridoux, German[1]; Costache, Marius V.[1]; Valenzuela, Sergio O.[1, 3]

1. Catalan Institute of Nanotechnology (ICN-CIN2), Bellaterra, Barcelona, Spain.
2. Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.
3. Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Barcelona, Spain.

Abstract

We achieve spin injection and detection in freely-suspended graphene using cobalt electrodes and a nonlocal spin-valve geometry [1]. The devices are fabricated with a single electron-beam-resist (PMMA) process that minimizes both the fabrication steps and the number of (aggressive) chemicals used, greatly reducing contamination and increasing the yield of high-quality, mechanically stable devices. As-grown devices can present mobilities exceeding 10^4 cm2 V^{-1} s^{-1} at room temperature and, because the contacts deposited on graphene are only exposed to acetone and isopropanol, the method is compatible with almost any contacting material. We study spin accumulation and spin precession in our nonlocal spin valves with large spin accumulation signals of the order of 10 Ω. Fitting of Hanle spin precession data (Figure) in bilayer and multilayer graphene yields a spin relaxation time of ~ 125-250 ps and a spin diffusion length of 1.7-1.9 µm at room temperature.

References

[1] Neumann, Ingmar; Van De Vondel, Joris; Bridoux, German; Costache, Marius V.; Alzina Francesc; Sotomayor Torres, Clivia M.; Valenzuela, Sergio O., Small, **9** (2013) 156–160

Figures