High-yield spin devices with a long spin lifetime in chemical vapor deposited graphene

Z. M. Gebeyehu , S. Parui, J. F. Sierra, M. Timmermans, M. J. Esplandiu, K. Garello, M. V. Costache and S. O. Valenzuela

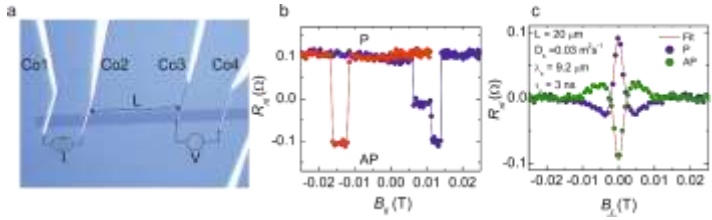
Catalan institute of nanoscience and nanotechnology,
08193 Bellatera, Barcelona, spain
zewdu.messele@icn2.cat

Abstract

We demonstrate a high-yield fabrication of non-local spin valve devices with room-temperature spin lifetimes of up to 3 ns and spin relaxation lengths as long as 9 µm in platinum-based chemical vapor deposition (Pt-CVD) synthesized single-layer graphene on SiO_2/Si substrates. The spin-lifetime systematically presents a marked minimum at the charge neutrality point, as typically observed in pristine exfoliated graphene. However, by studying the carrier density dependence beyond n ~ 10^{13} cm^{-2}, it is found that the spin lifetime reaches a maximum and then starts decreasing, a behavior that is reminiscent of that predicted when the spin-relaxation is driven by spin-orbit interaction. The spin lifetimes and relaxation lengths compare well with state-of-the-art results using exfoliated graphene on SiO_2/Si, being a factor two-to-three larger than the best values reported at room temperature using the same substrate [1]. As a result, the spin signal can be easily measured across 30-µm long graphene channels. These observations indicate that Pt-CVD graphene is a promising material for large-scale spin-logic applications.

References

[1] M. V. Kamalakar, C. Groenveld, A. Dankert, and S. P. Dash, "Long distance spin communication in chemical vapour deposited graphene," *Nat. Commun.*, vol. 6, no. 1, p. 6766, Dec. 2016.



a, Optical image of a CVD graphene non-local spin device **b,** Non-local resistance R_{nl} *as a function of an in-plane magnetic field $B_{\parallel}$ **c**, Spin precession measurements