Spin-Orbit driven effects in graphene based perpendicular magnetic anisotropy structures

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The development of all-graphene spintronic devices requires that, in addition to its passive capability to transmit spins over long distances, other active properties are incorporated to graphene. The generation of long range magnetic order and spin filtering in graphene have been recently achieved by molecular functionalization [1,2] as well as by the introduction of giant spin-orbit coupling (SOC) in the electronic bands of graphene [3]. We have incorporated these developments by designing novel perpendicular magnetic anisotropy (PMA) nanoarchitectures with tailored SOC in graphene and large chiral exchange interaction, commonly known as Dzyaloshinskii–Moriya interaction (DMI).

To do so, we have grown in ultra-high-vacuum (UHV) condition epitaxial multilayers with asymmetric interfaces on commercially availbale oxide single crystals (MgO). We were able to tune the PMA (K_U) and the DMI, in NM1/FM/NM2 structures, where FM is ferromagnetic Co layer, sandwiched between a NM1 non-magnetic metal and NM2 graphene (gr) sheet. We demonstrate strong PMA in such epitaxial systems with up to 20 MLs Co. We have characterized in-situ the electronics, chemical and magneto-transport properties of the samples by surface sensitive analysis, like X-ray absorption spectroscopy, LEED, as well as XAS-XMCD synchrotron based measurements. In addition, we have investigated the magnetic properties of the systems ex-situ by magneto-optical Kerr effect (MOKE), proving a strong PMA anisotropy for structures with up to 20 ML Co layer underneath gr [4,5].

References

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