Spin diffusion length in LSMO–graphene spin valves

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Significant progress has been made in graphene spintronics since the first demonstration of a graphene-based spin valve [[1]]. Due to low spin-orbit coupling [[2]] and hyperfine interaction [[2]], spin diffusion lengths have been measured in the range from 1.5 μm [[3]] up to 285 μm [[4]]. Here we present spin valves formed by combining $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) electrodes and few layer graphene channels. LSMO exhibits interfacial spin-polarization close to 100% at low temperature [[5]], making it a promising material for spin valves with highly spin-polarized electrodes [[6]]. We report spin transport on a device fabricated combining a 5 layer graphene and LSMO. The electrodes show a 20% X-ray magnetic circular dichroism contrast (XMCD) asymmetry at remanence after magnetic pulses, as confirmed by photoemission electron microscopy with XMCD. The transition between parallel and anti-parallel states occurs at distinct and well defined magnetic fields. This is further confirmed by magneto-optic Kerr effect microscopy. The resistance difference between the antiparallel and parallel configurations is ΔR=1.0 MΩ, corresponding to a magnetoresistance of 5.5% at 10 K (Fig. 1), and a spin diffusion length~100 μm (Fig.2). Importantly, our analysis excludes the contribution from tunnelling anisotropic magnetoresistance (TAMR), and allows us to attribute the recorded magnetoresistance entirely to spin transport.

References

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Figures

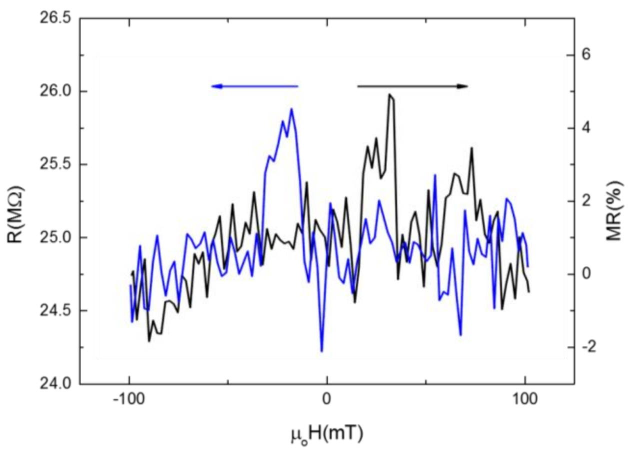

Figure 1: Magneto-transport measurements on a 5-layer graphene on LSMO electrodes. Blue and black line correspond to the directions of magnetic field sweep indicated by the arrows.

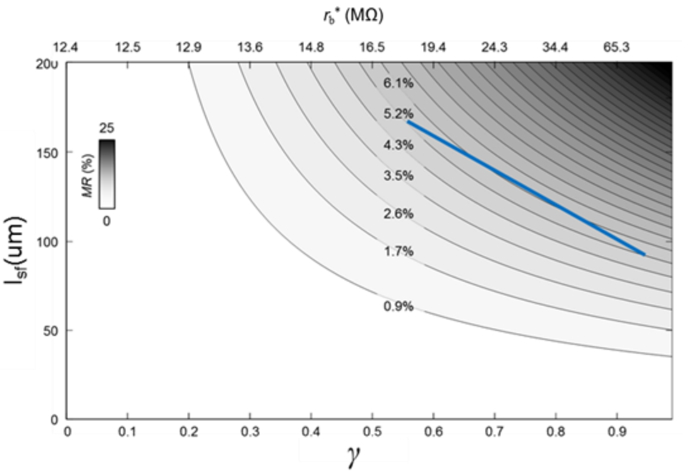

Figure 2: Simulated magnetoresistance (MR) as a function of interfacial spin polarisation *γ,* spin diffusion length l_{sf}, and interfacial resistance r_b * using the drift-diffusion model. The blue line indicates the range of values derived for our device.