Electrical and thermal generation of spin currents by magnetic graphene

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In graphene-based van der Waals heterostructures, the superior spin and charge transport properties of graphene are enriched via the proximity to other 2D materials. By the proximity effects, one can induce spin-orbit and magnetic exchange interactions in the graphene which provide strong coupling between charge and spin currents [1-3]. In particular, our recent investigation of spin transport in graphene in the proximity of a 2D interlayer antiferromagnet CrSBr has shown strong spin polarization of conductivity in graphene (~14%). The spin-dependent conductivity arises from a large induced exchange interaction that also results in the observation of spin-dependent Seebeck effect in graphene. This is the first-time experimental realization of the active role of magnetic graphene in the electrical and thermal generation of spin currents, addressing the most technologically relevant aspects of the induced magnetism. The spin-dependent conductivity and Seebeck coefficient, together with the long-distance spin transport introduce magnetic graphene as an ultimate building block for ultra-compact magnetic memory and sensory devices and can provide substantial advances in 2D spintronic/caloritronic technology [3].

REFERENCES

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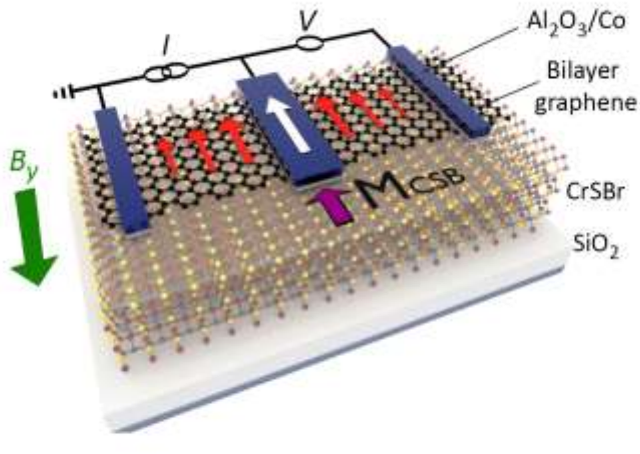

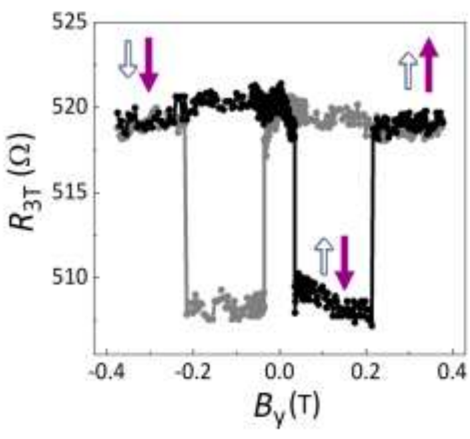

Figure 1: Schematic picture of the studied device with a bilayer graphene/CrSBr van der Waals heterostructure. The resistance measured in the three-terminal geometry (R_{3T}=*V*/*I*) with Al_2O_3/Co electrodes versus the external magnetic field (B_y) shows a considerable change, depending on the relative orientation of the Co magnetization (white arrow) and that of CrSBr (M_{CSB}, purple arrow). The induced magnetization in graphene by M_{CSB}, allows for higher conductivity of the spin up electrons (red arrows) in the graphene channel.