Long distance all electrical magnon transport in the van der Waals antiferromagnet $CrPS_4$

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Magnon spintronics studies the transport of spin currents through an insulating and magnetically ordered material using magnons [1]. Electrically and thermally induced magnons can be transported in insulating ferromagnetic[2] and antiferromagnetic materials [3]. In particular, antiferromagnetic materials have interesting properties for future spintronic applications: they possess no net magnetic moment and are therefore robust against magnetic perturbations and have ultrafast dynamics. We demonstrate for the first time all electrical long-distance magnon spin transport in the electrically insulating antiferromagnet chromium thiophosphate (CrPS4) with perpendicular magnetic anisotropy. The spin currents are injected electrically, via the spin Hall effect and detected via the inverse spin Hall effect using the nonlocal geometry (see Fig. 1) as described in Ref.[2]. We monitor the non-local resistance as a function of an in-plane magnetic field up to 8 Tesla. We observe a non-local resistance over distances up to at least a micron below the Neel temperature (T_N = 38 Kelvin) close to magnetic field strengths that saturate the sublattice magnetizations [4]. These results herald the potential of 2D van der Waals magnets for scalable magnonic circuits.

References

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Figures

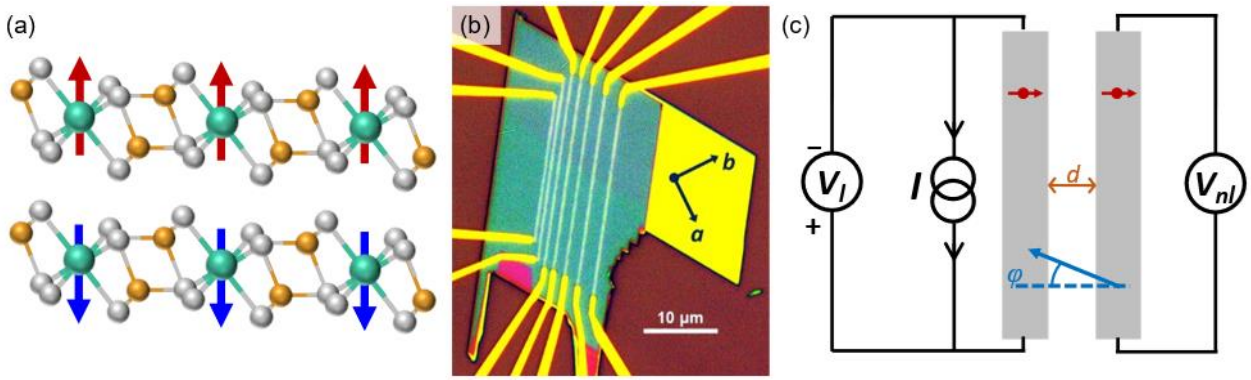

Figure 1: a) Bilayer of CrPS4, arrows representing magnetic moments, b) optical image of device with Pt contacts on CrPS4 flake, c) Circuitry of non-local measurements.