Non local magnon spin transport in the 2D insulating antiferromagnetic van der Waals material CrPS4

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The magnetic ordering in insulating two-dimensional (2D) van der Waals materials opens new possibilities for magnetoelectronic devices based on 2D systems. Magnon related spin information transport and spin caloritronic effects have been greatly studied in three-dimensional magnetic insulating systems, such as Yttrium Iron Garnet [1]. However, little light has been shed on magnon spin transport in 2D (anti)ferromagnets, due to their instability in air and non-trivial device fabrication [2]. The air-stable insulating layered antiferromagnet Chromium thiophosphate ($CrPS_4$) offers an excellent platform to study magnon spin transport and the coupling between spin, charge and heat, for the inter-/intralayer coupling being (anti)ferromagnetic, respectively [3-4]. Here we experimentally probe the spin information transport in a non-local geometry (fig. 1) by the dependence of the non-local resistance on the in-plane magnetization direction of the $CrPS_4$ by manipulation of an external magnetic field up to 7 Tesla. We observe an angular dependence of the non-local resistance below the Neel temperature of $CrPS_4$ (T_N = 40 Kelvin), with the strongest modulation around 25 Kelvin. Here we demonstrates, for the first time in a 2D antiferromagnet, magnon spin transport over a distance of at least 300 nanometer [5] This work shows that 2D antiferromagnets are very promising for future magnonic devices employing 2D van der Waals materials.

References

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Figures

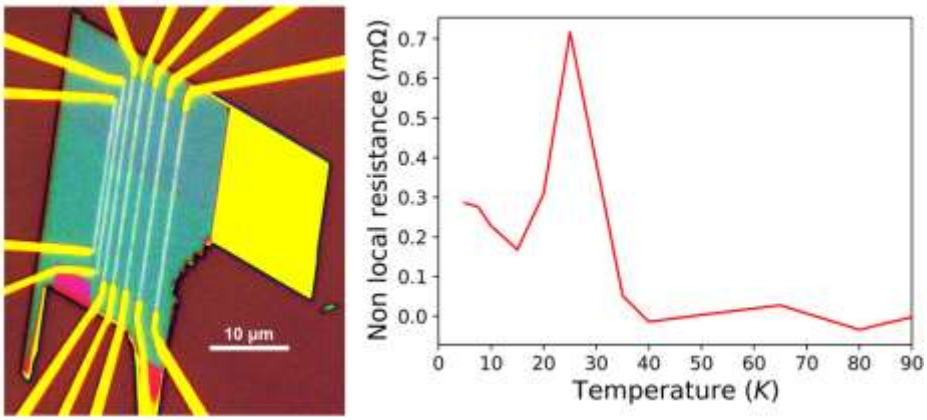

Figure 1: Left: Non-local geometry of Platinum contacts on $CrPS_4$
Right: Non local resistance between two parallel contacts, showing a peak at 25K diminishing above the T_N of 40K.