Spin caloritronic effects in a magnetic van der Waals heterostructure

Tian Liu*
Julian Peiro*, Dennis K. de Wal, Johannes C. Leutenantsmeyer, Marcos H.D. Guimarães and Bart J. van Wees
Zernike Institute for Advanced Materials, Nijenborgh 4, Groningen, The Netherlands
Cotact email: tian.liu@rug.nl
*These author contributed equally to the work.

Abstract

The recently reported magnetic ordering in insulating two-dimensional (2D) materials, such as chromium triiodide (CrI_3) [1] and chromium tribromide ($CrBr_3$) [2, 3], opens new possibilities for the fabrication of magneto-electronic devices based on 2D systems. However, integrating electronic circuit with the 2D magnets is technically challenging, due to the chemical instability of these materials in ambient. Here, we overcome this issue by developing a relevant technique which combines bottom metallic contacts and hBN encapsulation. This approach allows us to study the angular dependence of the thermal spin signal of the $CrBr_3$/Pt system, for different conditions of magnetic field and heating current. We highlight the presence of a significant magnetic proximity effect from $CrBr_3$ on Pt revealed by an anomalous Nernst effect in Pt, and suggest the contribution of the spin Seebeck effect from CrBr3. These results pave the way for future magnonic devices using air-sensitive 2D magnetic insulators.

References

[1] Huang, Bevin, et al. Nature, 546.7657 (2017): 270-273.
[2] Kim, Minsoo, et al. Nature Electronics, 2 (2019): 457–463.
[3] Kim, Hyun Ho, et al. Proceedings of the National Academy of Sciences 116.23 (2019): 11131-11136.

Figures

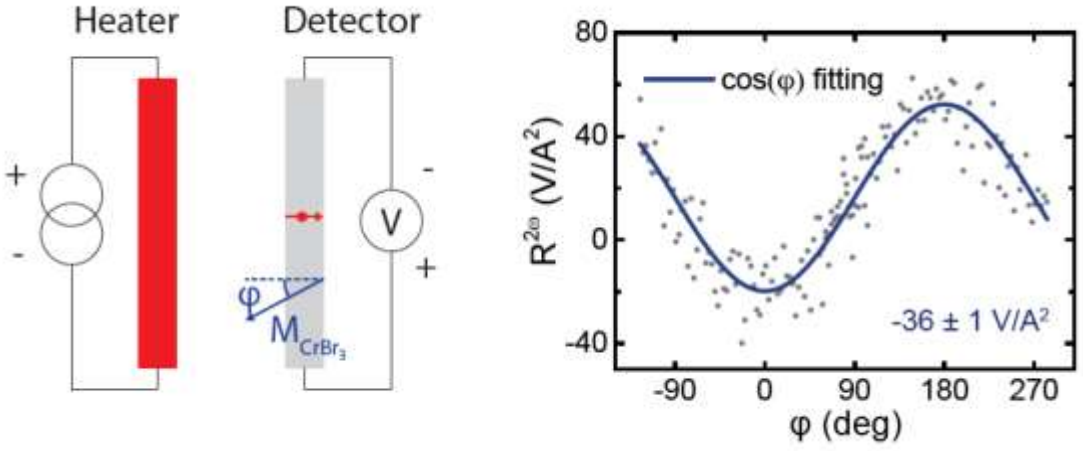

Figure 1: A schematic plot (left) of the circuit for the non-local second harmonic measurement and fitting results (right) of the data by a cosine function.