Ferromagnetic van der Waals contacts for efficient spin injection in graphene

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Abstract

Two dimensional (2D) materials are suitable for low energy spintronic devices.[1] However, efficient spin injection into 2D materials is challenging. Here, we realize ferromagnetic (FM) van der Waals (vdW) contacts [2] with Indium/Cobalt (In/Co) for efficient spin injection and collection. STEM shows vdW contact with a thin (2 – 4 Å) vacuum gap between graphene and In/Co. We find that the thin vacuum vdW gap is sufficient for efficient spin injection in graphene at room temperature without the need for dielectric tunnel barriers that are routinely used in state-of-the-art lateral spin valves (LSVs). Magneto-optical Kerr microscopy was used to confirm ferromagnetism in In/Co contacts. Transport on 2D LSVs with FM vdW contacts exhibit magnetoresistance (MR) values of ~2% (spin signal ~ 50 Ω), while pure Co contacts show MR < 0.1% (spin signal < 5 Ω). FM In/Co vdW contacts possess low contact resistance (2 – 5 kΩ), making them compatible for integration with contemporary transistors for electrical control of magnetism. Our results demonstrate direct deposition of In/Co vdW contacts for facile fabrication of reproducible and scalable spintronic devices.

References

[1] Lin, X. et al., Nature Electronics, 2 (2019) 274 - 283
[2] Wang, Y. et al., Nature, 568 (2019) 70 -74

Figures

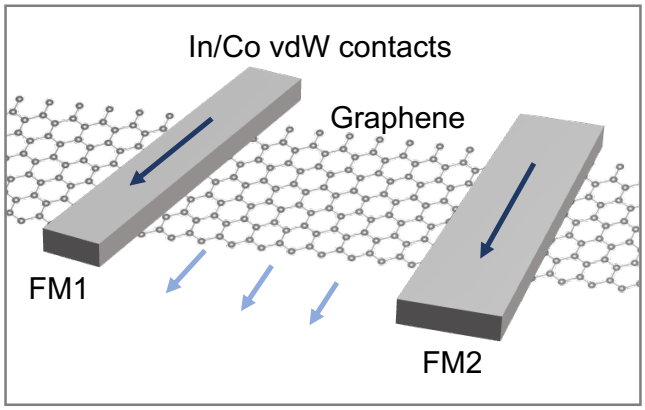

Figure 1: Schematic of a graphene lateral spin valve with ferromagnetic van der Waals contacts that can enable room temperature spin injection without dielectric tunnel barriers.