Spin transport studies in graphene and black phosphorus

Barbaros Ozyilmaz

Department of Physics,
Department of Materials Science and Engineering,
Centre for Advanced 2D Materials (CA2DM),
Office of Industry and Innovation (OII),
National University of Singapore (NUS), Singapore

barbaros@nus.edu.sg

The electric field effect in 2D materials is crucial for many novel device concepts including spintroncis. They are also ideal to induce complementary properties by means of the proximity effect. For example, the combination of Rashba interaction, magnetic moments and electric field control of the density, is akin to dilute magnetic semiconductors. Thus, this opens a route toward electric field control of magnetism and engineering topological magnetic states.
In the first part of my talk I will discuss efforts in inducing a large spin orbit coupling in graphene and spin transport studies in black phosphorus. Pristine graphene has negligible spin-orbit coupling (SOC). However, strong SOC can be induced, e.g. by hybridization with heavy metals. I will discuss experiments where this has been achieved with Au intercalated van der Waals heterostructures of graphene and hexagonal boron nitride [1]. The SOC of pristine black phosphorus (bP) is equally weak. In the second part of my talk I will show, based on measurements in the non-local spin valves geometry, that the spin relaxation times can be as high as ~ 4ns with spin relaxation lengths exceeding 6 µm [2]. In principle this should make bP an equally exciting material platform for proximity effect studies in 2D. I will conclude my talk with a brief discussion on potential applications of graphene explored in my group.

References

[1] O'Farrell, E. C. T., Tan, J. Y., Yeo, Y., Koon, G. K. W., Özyilmaz, B., Watanabe, K. and Taniguchi, T., Phys. Rev. Lett. 117, 076603 (2016)
[2] Avsar, A., Tan, J. Y., Kurpas, M., Gmitra, M., Watanabe K., Taniguchi, T., Fabian, J. and Özyilmaz, B., Nature Physics (2017).

Figures

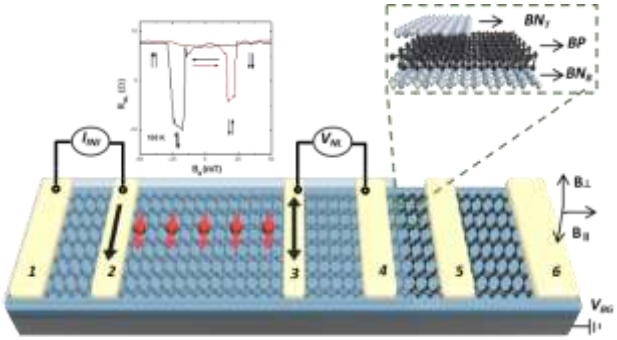

Figure 1: A lateral spin valve with semi-conducting black phosphorus [2].