The role of the spin-orbit coupling in the Transition metal dichalcogenides vertical spin valves

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Abstract
As a family of two-dimensional (2D) layered materials, Transition metal dichalcogenides (TMDCs) MX2 (M=Mo,W; X=S,Se) have been demonstrated to have potential for applications in the field of spintronics1,2 because of their strong spin-orbit coupling, spin-splitting with broken inversion symmetry3 and spin-valley degrees of freedom4,5. In our work6, the 2D MX2 were grown using chemical vapor deposition, and vertical spin valves with cross-strip geometry were constructed. the spin valve effects are measured, with layer and stacking variations. Which show the signature of the spin-valley coupling and spin-orbit torques. they pave the way for magnetic and electric control of spin and valley-polarized transport in magnetic tunneling junctions. Then, metallic behavior of the junction barrier is discussed; the temperature (50K-300K) dependence of the magnetoresistance ratio is reported; the role of the anisotropic magnetoresistance in the typical cross-strip geometry and the annealing effect on the device is discussed. Finally, the feature of the vertical spin valves based on the different TMDCs are listed and compared.

References

[1] W. Han, APL Mater., 4,3(2016), p.032401
[2] H. Yuan et al., Nature Physics, 9,9(2013), p. 563–569
[3] L. Du et al., Physical Review B, 97,11 (2018) p. 5445
[4] Z. Gong et al., Nature Comms., 4(2013) p. 2053
[5] " Valley-controlled Hanle effects in WSe2 vertical spin valve," To Be Submitted.

Figures

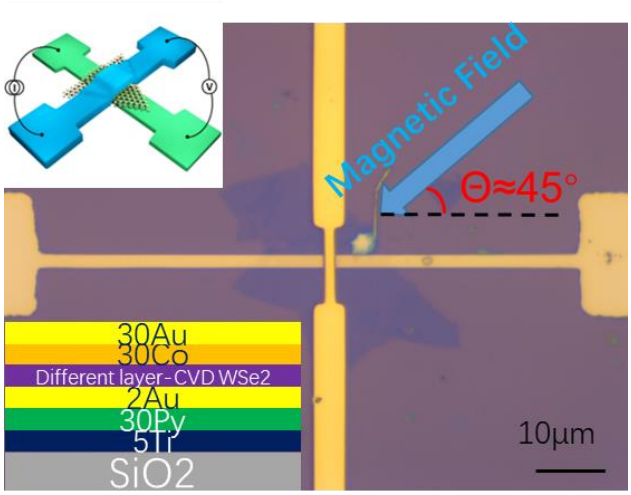

Figure 1: Device structure & measurement method

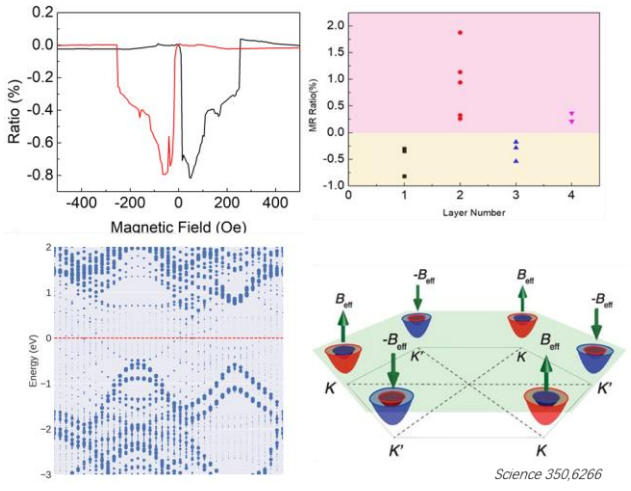

Figure 2: The spin-orbit coupling and inverse symmetry breaking induce the opposite effective field in the different valleys, resulting the distinct quantum oscillations of tunneling magnetoresistance in magnetic tunnel junctions