Fe_3GeTe_2 System for Spin Orbit Torque Application

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Abstract

The spin-orbit torque (SOT) technique has opened new horizons for the development of innovative magnetic devices beyond memories and data storage [1]. We investigate interfacial spin texture and SOT at Fe_3GeTe_2 monolayer, a system that is a ferromagnet and has recently been examined to possess the symmetry-broken, (shown in the figure below) [2]. Due to this symmetry broken, the spin orbit coupling (SOC) can result in SOT, even in the bulk case without requiring additional spin-polarization elements [3]. Using density functional theory, we show both band structure and spin texture for this system, which proves the existence of SOC. This special spin texture promotes current-driven SOT. We then project the band structure obtained by first principles onto Wannier orbitals to get the tight-binding Hamiltonian. Non-equilibrium properties then are calculated using the Kubo formula. Our results show that the SOT can be used to electrically control the magnetization switching of this ferromagnet system and to realize fast non-volatile data reading and writing.

References

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[2] Øyvind Johansen, et al., Phys. Rev. Lett., 112 (2019) 217203-217208
[3] A. Manchon and S. Zhang, Phys. Rev. B, 78 (2008) 212405-212408
[4] X. Qiu, et al., Phys. Rev. Lett., 117 (2016) 217206-217210

Figures

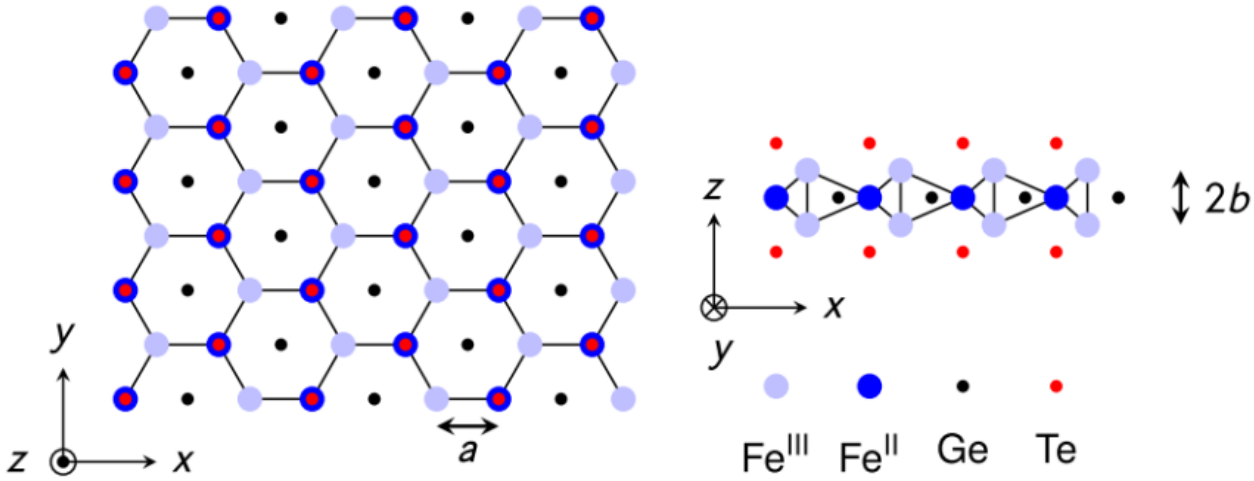

Figure 1: Structure of Fe_3GeTe_2 monolayer with top and side views in left and right figures respectively. Inset shows different colours corresponding to different atoms