SPIN CURRENT IN VAN DER WAALS FERROMAGNET FE_3GETE_2

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The control of spin current is pivotal for spintronic applications, especially for spin-orbit torque devices. Spin Hall effect (SHE) is a prevalent method to generate spin current. However, it is difficult to manipulate its spin polarization in nonmagnet [1]. Recently, the discovery of spin current in ferromagnet offers opportunity to realize the manipulation [2, 3]. In the present work, the spin current in van der Waals ferromagnet Fe_3GeTe_2 (FGT) with varying magnetization is systematically investigated using *ab initio* calculations [4]. It has been observed that the spin current in FGT presents a nonlinear behavior with respect to magnetization. The in-plane and out-of-plane spin polarizations emerge simultaneously, and the bilayer FGT can even exhibit arbitrary polarization thanks to the reduced symmetry. More intriguingly, the correlation between anomalous Hall effect (AHE) and spin anomalous Hall effect (SAHE) has been interpreted from the aspect of Berry curvature and spin. An effective $k \cdot p$ model illustrates that the orbital hybridization is essential for Berry curvatures. This work illustrates that the interplay of magnetism and symmetry can effectively control the magnitude and polarization of the spin current, providing a practical method to realize exotic spin-orbit torques.

References

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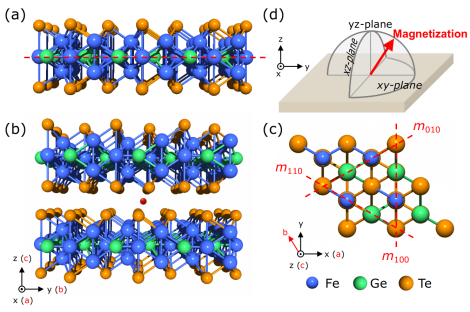

Figure 1: (a) Atomic model of monolayer FGT with a mirror symmetry (the red dashed line). (b) Atomic model of bilayer FGT with an inversion center (the red point). (c) Top view of bilayer FGT including mirror symmetries. (d) Illustration of the magnetization evolution in different planes.

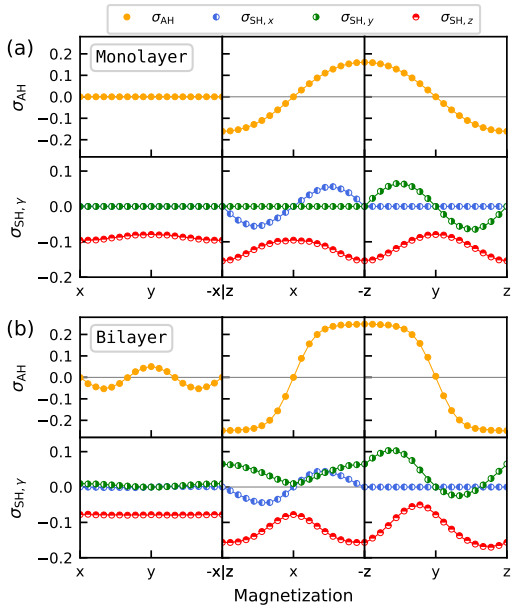

Figure 2: AHE and SHE of (a) monolayer and (b) bilayer FGT with magnetization rotating inside *xy*-, *xz*-, and *yz*-planes. σ_{AH} of *xy*-magnetization is magnified 10 times in (b).

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