Spin Hall Conductivity of Ferromagnetic Fe_3GeTe_2 Monolayer

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Abstract

Over the past decades, the study of spin Hall effect (SHE), a source of spin current, focused on nonmagnets with spin-orbit coupling (SOC). Very recently, SHE in ferromagnets (FMs) with SOC stimulates interests [1]. It has been claimed that SHE is independent of the FM magnetization [2,3]. Here, we demonstrate that the anisotropy in crystal structure would build the relationship between SHE and magnetization. We studied the ferromagnetic Fe_3GeTe_2 monolayer through *ab initio* calculations, present the magnetization-dependent intrinsic spin Hall conductivity (SHC), and report the spin conductivity enhancement which is attributed to the spin anomalous Hall conductivity (SAHC). Spin Berry curvature was employed for analysis. Our work provides insights into the realization of anisotropic SHE.

References

[1] T. Taniguchi *et al.*, PHYSICAL REVIEW APPLIED 3 (2015) 044001.
[2] K. S. Das *et al.*, PHYSICAL REVIEW B, 96 (2017) 220408(R).
[3] V. P. Amin *et al.*, PHYSICAL REVIEW B, 99 (2019) 220405(R).

Figures

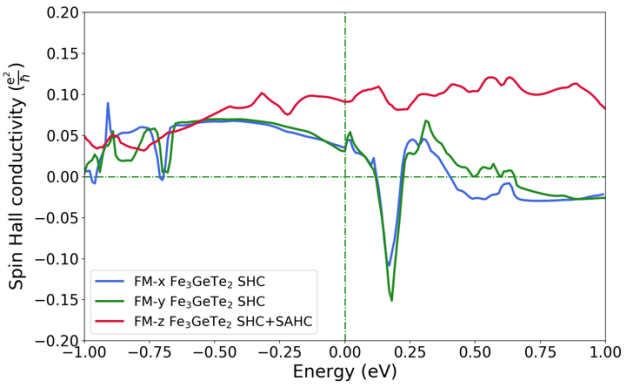

Figure 1: Spin Hall conductivity of ferromagnetic Fe_3GeTe_2 monolayer with different magnetization. Fermi energy is set as zero.

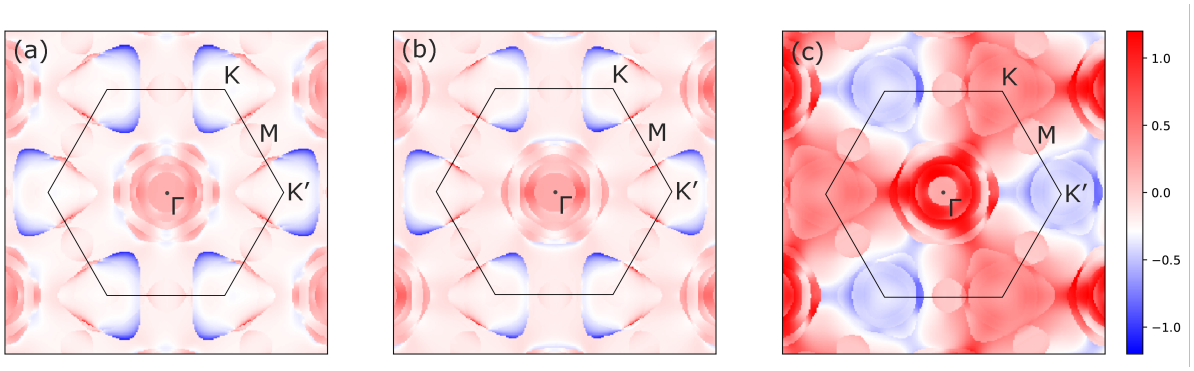

Figure 2: Spin Berry curvature in log scale of ferromagnetic Fe_3GeTe_2 monolayer with magnetization along (a) x-direction, (b) y-direction and (c) z-direction. Unit is $Å^2$.