MAR17-2016-020407

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

# Current-induced spin torques in inversion broken materials

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The spin-orbit interaction has been providing richness and greatness of magnetism and spintronics. In solid states, it couples electron's momentum and spins, which make it possible to electrically excite or detect spin accumulation/currents. Looking at localized spins, it helps magnetic anisotropies emerge (together with the magnetic-dipole interaction) where the sample's real space symmetry, such as surface-induced two-fold and crystalline-induced four-fold, is reflected on the magnetic energy landscape. Along this line, we can also think of what will happen when we lower the sample symmetry to "inversion broken". In this case, an electron propagating along one direction is, on the symmetry argument, no longer required to be on the same state as ones moving to the opposite direction. The spin-orbit interaction picks up this and causes a preferential spin direction for each electronic state, as a whole, forming spin textures in momentum space. These spin textures are a fascinating playground for developing spin-charge conversion effects. Although the electric excitation of spin textured materials has been known as the Edelstein effect [1] for more than two decades, its real spintronic use, e.g. magnetisation control [2], has been a much more recent interest. By employing microwave techniques to electrically exert magnetic torques through spin textures, we have successfully excite ferromagnetic resonance using this mechanism and characterise spin-orbit properties in our samples [3]. In this talk, I will summarise our recent results on spin torque effects using spin textures in inversion-broken materials. I will show microscopic origins of current-induced magnetisation control by the Edelstein effects in single ferromagnetic layers [3,4], as well as similar experiments by using non-magnetic inversion-broken layers [5] where we observed two spin torques, one arising from the spin-texture effect that co-exist with the other one from the spin-Hall effect. As the final part, I will present our latest results from our research. [1] Edelstein, Solid State. Comm. 73 233 (1990). [2] Chernyshov, et al., Nature Phys., 5 656 (2009). [3] Fang et al., Nature Nanotech. 9 211 (2011). [4] Kurebayashi, et al., Nature Nanotech, 9 211 (2014). [5] Skinner et al., Nature Comm. 6 6730 (2015).