Controlling spin transmission and the Dzyaloshinskii-Moriya interaction at interfaces in magnetic heterostructures

[1]National Institute for Materials Science

Masamitsu Hayashi[1], Jacob Torrejon[1], Junyeon Kim[1], Peng Sheng[1] and Seiji Mitani[1]

E-mail: hayashi.masamitsu@nims.go.jp

Strong spin orbit effects in magnetic heterostructures consisting of a perpendicularly magnetized ultrathin magnetic layer sandwiched between a heavy metal (HM) layer and an insulating oxide layer have opened new paradigms to control magnetic moments electrically. We have studied current induced magnetization switching[1] and domain wall motion[2] in HM/CoFeB/MgO based heterostructures (HM=Hf, Ta, W). We find that the HM layer generates large enough spin current via the spin Hall effect that enables manipulation of the CoFeB layer magnetic moments. Interestingly the torque acting on the magnetic moments depends on the degree of spin transmission at the HM/CoFeB interface[3, 4]. We also find that chiral magnetic order of the CoFeB layer emerges owing to the Dzyalonshinskii-Moriya interaction (DMI) at the HM/CoFeB interface[2]. Here we show results from W/X/CoFeB/MgO (X=Ta, Hf, Re) heterostructures to reveal the role of the interface layer on the spin transmission and DMI. Depending on the interface layer X, we find that the degree of spin transmission and DMI changes considerably.

Acknowledgment: MEXT Grant-in-Aid, MEXT R & D Next-Generation Information Technology

References

[1] J. Torrejon, J. Sinha, T. Taniguchi, S. Mitani, and M. Hayashi, arXiv:1410.7473 (2014).

[2] J. Torrejon, J. Kim, J. Sinha, S. Mitani, M. Hayashi, M. Yamanouchi, and H. Ohno, Nature Comm. **5**, 4655 (2014).

[3] J. Kim, J. Sinha, M. Hayashi, M. Yamanouchi, S. Fukami, T. Suzuki, S. Mitani, and H. Ohno, Nat. Mater. **12**, 240 (2013).

[4] J. Kim, J. Sinha, S. Mitani, M. Hayashi, S. Takahashi, S. Maekawa, M. Yamanouchi, and H. Ohno, Phys. Rev. B **89**, 174424 (2014).