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Spin transfer torque in antiferromagnet and toward the applications

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Spin transfer torque (STT) has been an efficient and promising technique to control magnetizations of ferromagnetic materials in modern spintronic devices. This novel technique is based on an interaction between electron spin and local magnetic moments. The same interaction should be conserved in antiferromagnets (AFMs), in which there are microscopic local magnetic moments that compensate each other to exhibit no net magnetization.

In this work, we prepared MgO(001) substrate/Pt 5nm/NiO 10nm/FeNi 3nm/SiO_2 5nm multilayers, in which the films are epitaxially grown until the NiO layer, and performed a spin torque ferromagnetic resonance (ST-FMR) measurement to quantify the anti-damping spin torque transported between the Pt and the FeNi through the antiferromagnetic NiO layer. A pure spin current is created by the spin Hall effect of the Pt and injected into the NiO. The schematic layer structure of the injection scheme is shown in Fig. 1(a). As shown in Fig. 1(b), it is found that the FMR linewidth monotonously varies with the d.c. current flowing in the structure. As the ST-FMR measurement is only sensitive to the linewidth (i.e. damping) of the FeNi layer, this change in the linewidth in Pt/NiO/FeNi can be interpreted in a way that the spin current is transferred through the NiO and interacts with the FeNi. This intriguing spin current transport can be explained by the angular momentum transfer mediated by the antiferromagnetic magnons [1,2]. Our results assure that the spin current exerts a torque on the NiO magnetic moments and excites their dynamics. In the talk, recent results will be also discussed.

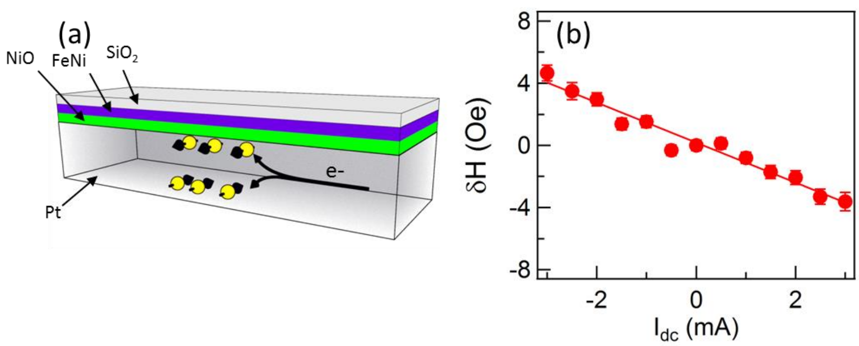

Figure 1 (a) Schematic illustration of the sample structure. (b) FMR linewidth change as a function of the d.c. current flowing in the sample.

[1] Moriyama, *et al.*, *APL* **106**, 162406 (2015) [2] Takei *et al.*, *PRB (R)* **92**, 020409 (2015)