磁場中スパッタリング製膜を用いた無磁場中 spin orbit torque 磁化反転の観察

Observation of spin orbit torque magnetization switching without external magnetic field in wire fabricated by magnetic field applied sputtering method

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[Introduction] Controlling magnetization using spin orbit torque (SOT) has attracted significant attention because it can be applied for the magnetic random access memory (MRAM) and the logic circuit. The SOT has the higher potential for manipulating magnetization than the conventional spin-transfer torque (STT) because it realizes the small power consumption due to the faster magnetization switching than that using STT, and the small bit error rate owing to separate the writing and reading paths. To switch magnetization by SOT, an external in-plane magnetic field must be applied, which is disadvantage for the high density MRAM. Whereas, the SOT-current induced magnetization switching (CIMS) without external field in the Co/Ni wire with in-plane exchange bias field have been reported [1]. However, to obtain the exchange bias field, we have to anneal the wire in high temperature. It often leads to weaken magnetic anisotropy. In this study, to generate exchange bias field in room temperature, we used magnetic field applied sputtering process and as a result successfully observed SOT-CIMS without external field.

[Experiment] The Pt/Tb-Fe/IrMn multilayer films were deposited on a thermally oxidized Si substrates in the in-plane magnetic field of 220 Oe by using DC magnetron sputtering. The 5-μm-wide Hall bars were fabricated by Photo-lithography. The SOT-CIMS was observed by using anomalous Hall effect in the in-plane magnetic field.

[Result] The SOT-CIMS was obtained in the Tb-Fe wire with IrMn layer with applying the in-plane magnetic field (H_X). We found that the SOT-CIMS in the Tb-Fe wire also can be observed in H_x = 0 Oe as shown in Figure 1.

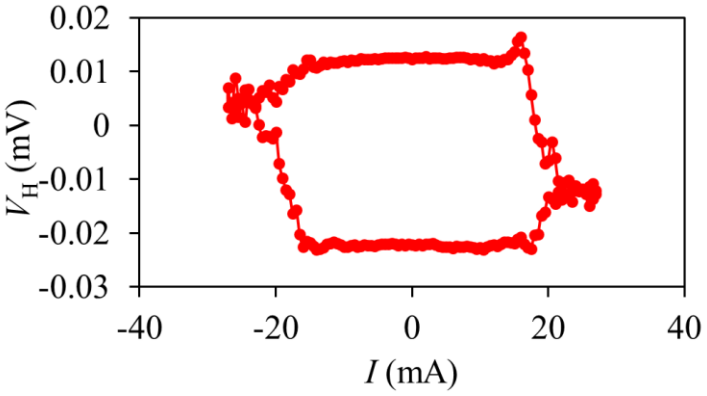

Fig. 1 Hall voltage (V_H) in the Tb-Fe/IrMn wire as a function of current (I) under H_X = 0 Oe.

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[1] S. Fukami, C. Zhang, S. DuttaGupta, A. Kurenkov, and H. Ohno, Nat. Mater. **15**, 535 (2016).