Gd-Fe 垂直磁化膜を用いた無磁場中でのスピンオービットトルク磁化反転の観察

Observation of spin-orbit torque magnetization switching in Gd-Fe perpendicular magnetized wire without external magnetic field

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[Introduction] Magnetization switching using spin orbit torque (SOT) has been paid much attention because it is available for Magnetic Random Access Memory (MRAM). The critical current density of current-induced magnetizaiton swithing (CIMS) using SOT is lower than that using spin transfer torque(STT), which indicates that SOT has the advantage over STT. However in the case of CIMS using SOT, it is necessary to apply the external in-plane magnetic field. In this study, in order to achieve SOT-CISM in zero magnetic field, we fabricated Ta/Gd-Fe multilayered magnetic wire with IrMn/FeCo cap layer which can apply effective in-plane magnetic field to Gd-Fe layer, and investigated SOT-CIMS.

[Experiment]Ta/GdFe/IrMn/FeCo multilayer films were deposited on a thermally oxidized Si substrates by using DC magnetron sputtering. The 5-μm-wide Hall bars were fabricated by electron beam lithography. The SOT-CIMS was observed by using anomalous Hall effect in the in-plane magnetic field.

[Result] In the in-plane magnetic field, the Hall voltage in Ta/GdFe/IrMn/FeCo multilayered wire greatly changed at the critical current density. It indicates that the CIMS was led by SOT generated from the Ta layer. We found that Hall voltage slightly changed at critical current density even if the observation performed in zero magnetic field. It means that the magnetization switching was partially occurred without an external magnetic field. To investigate the device operation, we applied the 1 sec pulse current of ±8mA periodically in the zero magnetic field. Figure 1 shows the Hall voltage (V_H) as a function of time when the periodically pulse current was applied. As shown in Fig.1, the V_H was clearly changed by the pulse current. It indicates that 1 bit information can be written in Ta/GdFe/IrMn/FeCo multilayered wire by SOT under zero magnetic field.

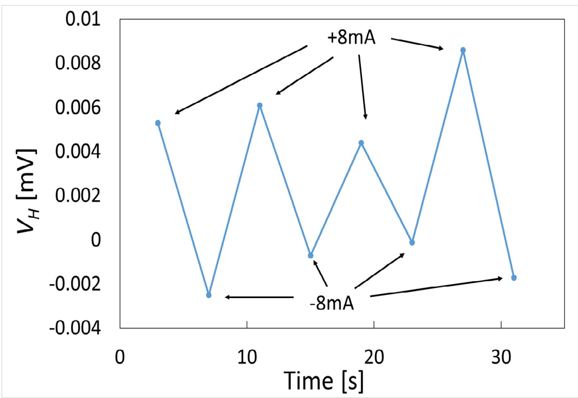

Fig. 1 Hall voltage (V_H) as a function of time under periodically pulse current.

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