フェリ磁性 CoGd 薄膜における一方向性スピンホール磁気抵抗の符号反転

Sign reversal of unidirectional spin Hall magnetoresistance in ferrimagnetic CoGd films

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The recently discovered unidirectional spin Hall magnetoresistance (USMR) in a heavy metal/ferromagnet heterostructure is a nonreciprocal phenomenon, in which the longitudinal resistance depends on the current direction. The resistance change due to USMR relies on the relative angle between the magnetization and the spin polarization direction of the transverse spin current induced by the spin Hall effect. As a plausible origin of USMR, the spin-dependent scattering has been proposed in analogy to the giant magnetoresistance (GMR). Although the close similarity between USMR and GMR has been pointed out since the discovery of USMR [1], there have been few reports that experimentally confirm this similarity [2]. In this study, we investigate the composition and temperature dependences of USMR in W/$Co_{100-x}Gd_x$ heterostructures since the ferrimagnetic Co-Gd alloy is known to cause a sign reversal of the GMR around its magnetization compensation point [3].

Fig. (a) shows the Gd concentration dependence of the saturation areal magnetic moment, and the compensation composition is found to be x~33%. As shown in Fig. (b), the harmonic longitudinal resistance measurement reveals that USMR reverses its sign across the compensation composition. In addition, we confirm that USMR undergoes the sign reversal also at the compensation temperature. The observed sign reversal highlights the crucial role of the spin-dependent scattering in determining USMR.

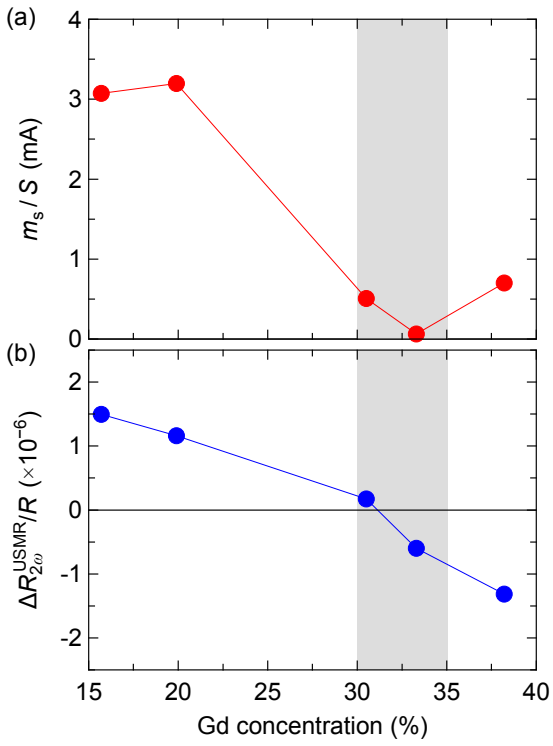

Figure. (a) The Gd concentration dependence of the saturation magnetic moment per area and (b) the normalized USMR at a current density of 0.3×10^{11} A/m^2.

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[1] C. O. Avci *et al.*, *Nat. Phys.* **11**, 570 (2015). [2] K. Hasegawa *et al.*, *Phys. Rev. B* **103**, L020411(2021). [3] X. Jiang *et al.*, *Phys. Rev. Lett.* **97**, 217202 (2006).