作成者: Jian WANG（東北大 CSRN）

研究プロジェクト名: Magneto-optical manipulation of magnetization in ferrimagnetic multilayers

概要: The ultrafast control of magnetism without using magnetic fields enables the integration of spintronic devices in a large scale for memory, computation, and communication in the beyond-CMOS era. Ultrafast magneto-optical interaction provides a promising approach rather than conventional charge and spin current. In this collaboration research, we will explore the all-optical magnetic switching in ferrimagnetic multilayers (e.g. $[CoGd/Pt]_n$ multilayer). By optimization of the multilayer parameters (e.g. composition, layer thickness, and number of repeats, n) and laser condition, we hope to achieve a deterministic (100%) single-laser-pulse magnetic switching in our ferrimagnetic multilayers. The sample fabrication and basic measurements will be conducted at IMR, while the magneto-optical evaluation will be carried out at NIMS.

コアメンバー: Jian Wang（東北大 CSRN）、高橋グループ（NIMS）

期待される研究成果:

The successful demonstration of single-laser-pulse magnetic switching in our ferrimagnetic multilayers will provide new perspective of the interfacial effect on the magneto-optical interaction. Moreover, it may promote an unique step toward integrated optospintronic devices that combines spintronics and photonics technologies to enable ultrafast conversion between fundamental information carriers of electron spins and photons. At the end of this FY 2020, one scientific paper and/or patent can be expected through the collaboration research.

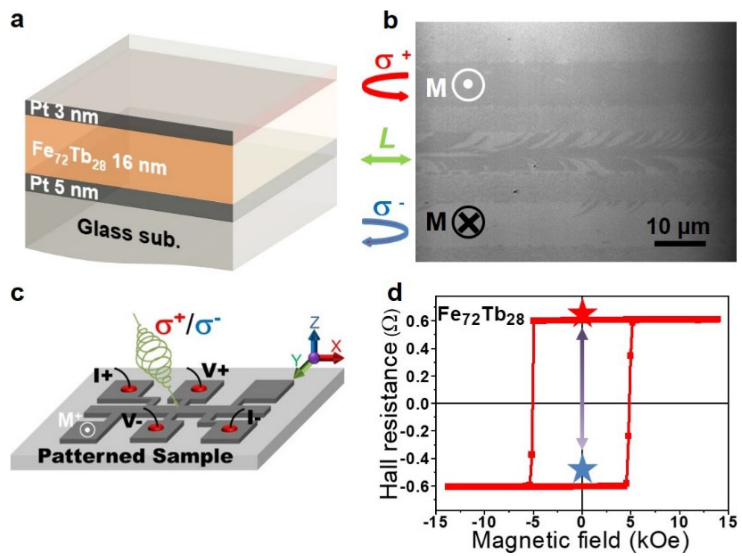

Figure. Demonstration of all-optical magnetic switching in FeTb alloy thin film: (b) MOKE image and (d) AHE loop. The start mark stands for the Hall resistance change before and after laser illumination.

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研究成果（実施状況）: The $Co_{100-x}Gd_x$/Pt multilayer studied in this project shows perpendicular magnetic anisotropy (PMA) and all-optical helicity-independent switching, which provides a promising route for ultrafast magnetization manipulation. Our study clarified that the PMA of multilayers mainly originates not from the bulk property of ferrimagnetic $Co_{100-x}Gd_x$, but from the interface magnetic anisotropy. In addition, the interfacial induced magnetic moment significantly modulates the magneto-optical response. Our findings are beneficial not only for understanding the mechanism of AOS but also for designing the spintronic devices using ferrimagnets.

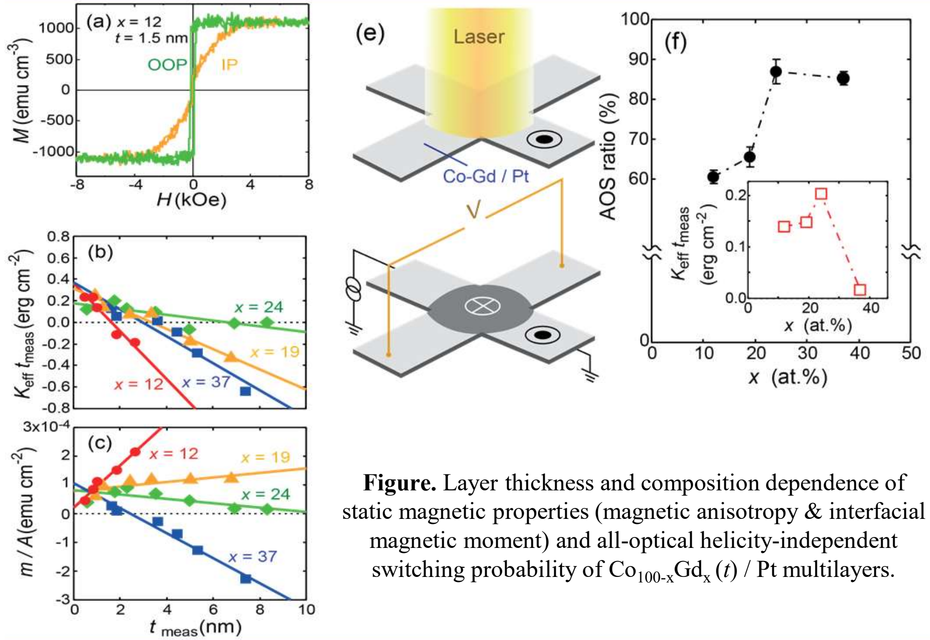

Figure. Layer thickness and composition dependence of static magnetic properties (magnetic anisotropy & interfacial magnetic moment) and all-optical helicity-independent switching probability of $Co_{100-x}Gd_x$ (t) / Pt multilayers.

主要発表論文等: [1] “Origin of Magnetic Anisotropy, Role of Induced Magnetic Moment and All-Optical Magnetization Switching for $Co_{100-x}Gd_x$/Pt Multilayers” Jian Wang, Takeshi Seki*, Yong-Chang Lau, Y. K. Takahashi, and Koki Takanashi (submitted).