Thickness dependence of time-resolved anomalous Nernst effect for L1_0-FePt thin films

IMR Tohoku Univ. [1], Tokyo Univ. of Sci.[2], WPI-AIMR Tohoku Univ.[3],
CSIS (CRC) Tohoku Univ.[4], JST-CREST[5], CSRN Tohoku Univ.[6]
○Masahiro Saito[1, 2], Satoshi Iihama[3], Himanshu Sharma[1, 5],
Shigemi Mizukami[3, 4, 6], Masato Kotsugi[2], and Masaki Mizuguchi[1, 5, 6, *]
*Email: mizuguchi@imr.tohoku.ac.jp

The effects relating with both the thermal current and electric current such as the Seebeck effect or Nernst effect attract attention for the realization of low energy consumption devices. Under the thermal gradient applied to magnetic materials, anomalous Nernst effect (ANE) arises along the vertical direction to both magnetization and the thermal gradient. Our group previously reported large ANE for materials with large magnetic anisotropy (K_u) like L1_0-FePt [1,2]. However, these reports investigated the ANE with the static thermal current and the dynamical response of the ANE is still unclear. Here, we investigated the thickness dependence of time-resolved ANE (TR-ANE) for L1_0-FePt thin films by using the pulsed laser heating.

FePt thin films with different thicknesses (5 – 100 nm) were deposited by sputtering onto MgO substrates at 300 ˚C. Then, the post-annealing was carried out at 500 ˚C for 30 min in ultra-high vacuum. The electrical contact was made by the wire bonding on samples. The thermal gradient was generated by the Ti: Sapphire laser along the normal direction to the films. Center wavelength, pulse duration, repetition of the pulse and energy density were set to 800 nm, 120 fs, 1 kHz and 0.46 mJ/cm^2, respectively. Magnetic field was applied parallel to the film. The TR-ANE signals were detected by the GHz-oscilloscope at room temperature.

Figure 1 shows the thickness dependence of TR-ANE signals. The initial strong peak was observed for all films after the irradiation of the laser. With increasing the thickness, the intensity of the peak decreased and the peak position slightly sifted. This indicates that the ANE voltage would be explained by considering the thermal diffusion in FePt. Diffusion mode of the heat current and the angle dependence of TR-ANE will be discussed in detail.

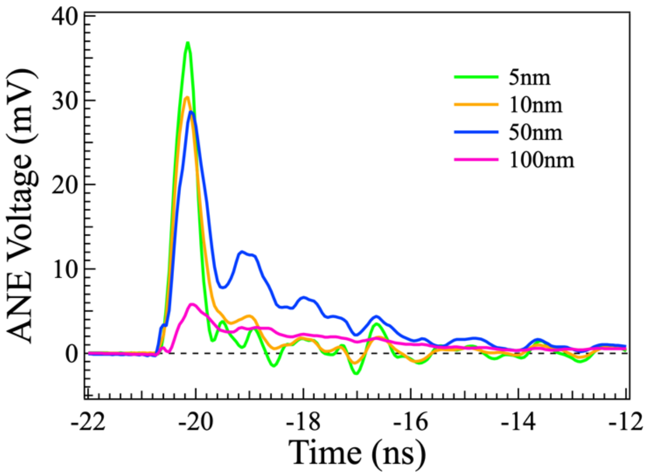

Fig. 1 The thickness dependence of TR-ANE signals for L1_0-FePt thin films.

References
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