Anomalous Nernst and Hall effects in Ge-doped Co thin films

Nagoya Univ.

○**Takuya Tsujimoto, Toshio Miyamachi, Masaki Mizuguchi**

Email: mizuguchi.masaki@material.nagoya-u.ac.jp

The anomalous Nernst effect (ANE) is expected as the new energy harvesting technology[1,2]. The effect is defined as a generation of an electric field in the vertical direction to the magnetization of the sample and the applied temperature gradient. It is possible to generate large electric field even by a tiny temperature difference in the ANE, thus application for temperature sensors is also expected. However, the ANE conversion efficiency is presently limited to ~1.0 μV/K, and searching materials which have large ANE conversion efficiency and studying the thermoelectric transport property have attracted significant attention. Recently, we have reported the enhancement of the ANE depending on the composition of Co and MgO in Co-MgO granular films. Properties of the ANE in ferromagnetic thin films doped with semiconductors are also interesting because the scattering of thermally-excited electrons may have a positive effect for the ANE. In this study, we investigated the ANE and AHE (anomalous Hall effect) in Ge-doped Co thin firms with different Co-Ge compositions.

Ge-doped Co thin firms were fabricated by the co-sputtering method on MgO substrates at 323 K. Co_{1-x}-Ge_x thin firms were deposited by changing the sputtering powers for Co and Ge targets. The composition for each film was estimated by energy dispersive X-ray spectrometer. Nernst voltage and Hall resistivity were measured by a physical property measurement system (PPMS) at room temperature. To examine the ANE properties for Ge-doped Co thin firms with various compositions, the anomalous Nernst coefficient (Q_s) was estimated for each film.

Seebeck coefficient changed by adding Ge into Co and Q_s substantially changed with the Ge composition (x). This tendency resulted in the large change of the anomalous Nernst angle. Details of the composition dependence on the ANE and AHE will be also discussed.

Acknowledgement

This work was partially supported by a Grant-in-Aid for Science Research S (Grant No. 21H05016).

Reference

[1] M. Mizuguchi *et al*., Sci. Tech. Adv. Mater, **20**, 262 (2019).

[2] M. Mizuguchi, Oyo Buturi, **90**, 78 (2021).

[3] P. Sheng, M. Mizuguchi *et al*., Appl. Phys. Lett., **116** 142403 (2020).