Thermomagnetic and thermoelectric properties of thin films prepared by sputtering and atomic layer deposition

Gyuyheon Park[1,3]
Helena Reichlova,[2] Anna Nieman,[1] Richard Schlitz,[2] Sebastian Beckert,[2] Savio Fabretti,[2] Anastasios Markou,[4] Peter Swekis,[4] Nielsch Kornelius,[1,3] Sebastian T.B.Gönnenwein,[2] Andy Thomas[1]

[1]*Leibniz Institute for Solid State and Materials Research Dresden (IFW Dresden), Institute for Metallic Materials, Helmholtzstraße 20, 01069 Dresden, Germany*
[2]*Technische Universitat Dresden, Institut for Festkörper- und Materialphysik, 01062 Dresden, Germany*
[3]*Technische Universität Dresden, Institute of Materials Science, 01062 Dresden, Germany*
[4]*Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany*

g.h.park@ifw-dresden.de

Abstract

A temperature gradient in a ferromagnetic device can lead to a transverse voltage perpendicular to the magnetization and the heat current [1]. This thermomagnetic effects, so called anomalous Nernst effect (ANE), is considered to be equivalent to the magnetization [2]. In recent day, however, many experiments suggested various contributions to the ANE arising from the non-trivial topology of particular materials. To identify the origin of the ANE, an accurate measurement scheme need to be adopted.

Although, there are various methods to fabricate thin films and measure ANE, the values of anomalous Nernst coefficient in literature vary significantly. One of the reasons might be inaccurate estimation of the applied thermal gradient.

In this study, we demonstrate a model experiment of measuring ANE in a custom setup. We sputter ferromagnetic thin films, Co_2Fe_2B and Co_2MnGa. The fabricated devices enable generation of a well defined thermal gradient and detection of thermomagnetic properties in the same time. The described experiment allows for more accurate anomalous Nersnt coefficient evaluation. This platform for TE measurements can be applied to 2D materials in the future.

References

[1] M. Ikhlas et al., Nat. Phys., 2017 24
[2] S. Nakatsuji et al., Nature, 2015 527