High-resolution visualization of the anomalous Nernst effect using AFM tip-induced local temperature gradients

Hironari Isshiki

Insttute for Solid State Physics, Univ. of Tokyo, Kashiwa, Japan
(Current afferiation: Advanced Science Research Center, Japan Atomic Energy Agency, Tokai, Japan)
*E-mail: h_isshiki@issp.u-tokyo.ac.jp

We have developed a novel method to visualize the anomalous Nernst effect (ANE) using an atomic force microscope (AFM) [1, 2]. In this method, a local temperature gradient is created by contacting an AFM probe with a heated sample wire, as shown in Fig. 1. We detect the voltage resulting from ANE at both ends of the sample wire, enabling magnetic imaging with a spatial resolution of ~80 nm. This method was applied to the antiferromagnetic Weyl semimetal Mn_3Sn. Figure 2 presents the results for Kagome-in-plane textured polycrystalline Mn_3Sn [3]. As seen in Figs. 2(b) and 2(c), the local ANE, corresponding to the distribution of the cluster magnetic octupoles in Mn_3Sn, was observed in both the initial and residual states. Furthermore, this method is applicable to a wide range of other materials and devices. In this presentation, we will report on these results and demonstrate the high versatility of the method.

This work was partially supported by CREST (Grant No. JPMJCR18T3) from JST, JSPS KAKENHI Grant-in-Aid for Scientific Research(C) (Grant Nos. 19H05629), Steel Foundation for Environmental Protection Technology.

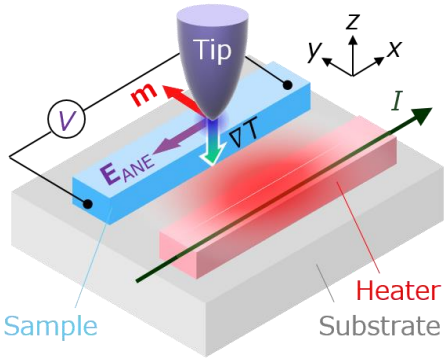

Fig. 1: Schematic diagram of the anomalous Nernst effect mapping.

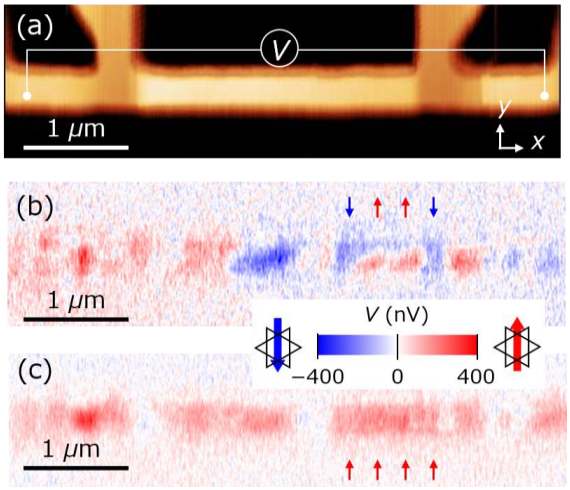

Fig. 2: Results on a Mn_3Sn nanowire. (a) Topography. (b), (c) Results of the anomalous Nernst voltage mapping in the initial and residual states, respectively.

[1] N. Budai et al. Appl. Phys. Lett. 122, 102401 (2023)
[2] H. Isshiki et al. Front. Phys., 11 (2023)
[3] H. Isshiki et al. Phys. Rev. Lett. 132, 216702 (2024)