Unraveling band structures of Rh_2MnGa thin films by synchrotron radiation ARPES

Tatsuya Tomida[1], K. Nakanishi[1], M. Kakoki[1], K. Kuroda[1,2], K. Miyamoto[3], T. Okuda[2,3], K. Sumida[3], B. Bairagya[4], S. Singh[4], K. Masuda[4], Y. Sakuraba[4], A. Kimura[1,2,5]

[1] *Graduate School of Advanced Science and Engineering, Hiroshima University, Higashi-Hiroshima 739-8526, Japan*

[2] *International Institute for Sustainability with Knotted Chiral Meta Matter (WPI-SKCM[2]), Higashi-Hiroshima 739-8526, Japan*

[3] *Research Institute for Synchrotron Radiation Science (HiSOR), Hiroshima University, Higashi-Hiroshima 739-0046, Japan*

[4] *National Institute for Materials Science (NIMS), Tsukuba 305-0047, Japan*

[5] *National Institutes for Quantum Science and Technology (QST), Sayo 679-5148, Japan*

The anomalous Nernst effect (ANE), in which an electromotive force is generated perpendicular to the thermal gradient in magnetic materials, has attracted considerable attention. Recently, a large ANE accompanied by a thermoelectric power of 6~8μV/K—the highest reported to date—was observed in the Heusler compound Co_2MnGa [1,2]. Theoretically, this significant ANE has been attributed to an intrinsic mechanism arising from the materials's topological band structure, namely the large Berry curvature associated with line nodes and Weyl points near the Fermi level. However, for practical applications, a thermoelectric power exceeding 10 μV/K is generally required, and the development of higher-performance materials remains a challenge. Recent first-principles calculations predict that the absolute value of the thermoelectric power in Rh_2MnGa is approximately twice that of Co_2MnGa. Moreover, it has been reported that Rh_2MnGa exhibits thermoelectric powers of opposite signs, depending on the sign of the Berry curvature in momentum space [3]. To investigate the origin of this unusual ANE in Rh_2MnGa, we performed angle-resolved photoelectron spectroscopy (ARPES) using synchrotron radiation at beamline BL-9B of HiSOR. The thin film sample, prepared at NIMS, was transferred to the ARPES system at HiSOR *via* a vacuum suitcase chamber. Isoenergy surface measurements taken at a photon energy of 55 eV revealed a V-shaped structure opening along the Γ-K direction of the Brillouin zone near the Fermi level, which reversed its opening direction when moving away from the Fermi level. This behavior indicates the presence of energy-dependent line nodes composed of linearly dispersing bands. Our findings offer new insights into the relationship between line nodes and the ANE in Rh_2MnGa, and contribute to the ongoing development of high-performance thermoelectric materials.

[1] A. Sakai *et al*., Nat. Phys. **14**, 1119 (2018).

[2] K. Sumida *et al*., Commun. Mater. **1**, 89 (2020).

[3] J. Noky *et al*., npj Compt. Mater. **6**, 77 (2020).