研究プロジェクト名：　Charge and spin-dependent transport phenomena in Weyl semi-metals for topological antiferromagnetic spintronics

概 要：The interplay of relativistic spin-orbit interaction, magnetism and strong electronic correlations in antiferromagnetic Weyl semi-metals (WSMs) manifests in novel properties prospective for antiferromagnetic spintronics. We aim to quantify the magnetotransport properties of antiferromagnetic WSM and WSM/non-magnet heterostructures. Our experimental results, supported by theoretical models will provide a convenient approach for understanding of the effects of band topology in WSMs and its utilization for antiferromagnet-based spintronic devices.

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期待される研究成果：
The results obtained from this research entails the clarification of charge and spin-dependent transport phenomena associated with non-trivial topological band characteristics and spin-structures in WSM heterostructures. This will provide considerable insights into understanding and tailoring of the exotic properties exhibited by WSMs (intrinsic anomalous Hall, quantum oscillations, chiral anomaly etc.). The proposed experimental and theoretical investigations unveils new physics and device concepts for topological antiferromagnetic spintronics.

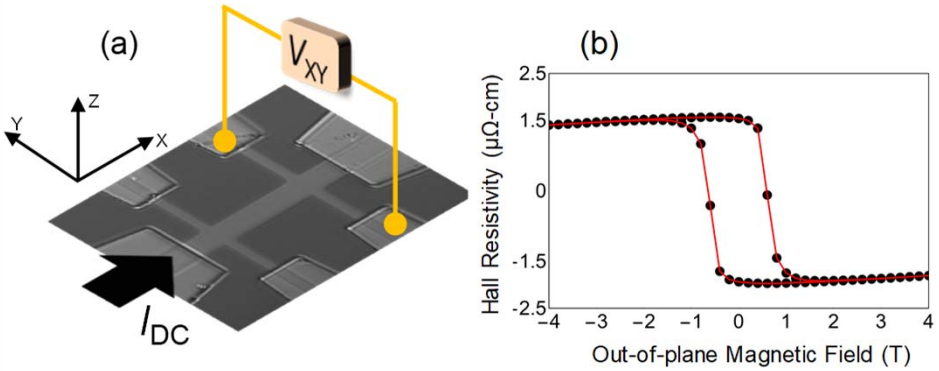

Figure: (a) Optical micrograph of an antiferromagnetic Weyl semi-metal Hall-bar structure. I_{DC} refers to the applied current while V_{XY} is the measured voltage. (b) Experimental results of Hall resistivity (obtained from V_{XY}) vs applied out-of-plane magnetic field demonstrates the interplay of band topology with spin-structure manifesting in intrinsic anomalous Hall effect.

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概要：　The interplay of relativistic spin-orbit interaction, magnetism and topology in antiferromagnetic Weyl semi-metals (WSMs) manifests in novel properties prospective for antiferromagnetic spintronics. We aim to clarify the impact of the topology of the band structure and magnetic ordering on the magnetotransport properties of antiferromagnetic Mn_3Sn thin films as a function of crystallographic orientations.

研究成果（実施状況）： We utilized C-plane (0001) and M-plane (1-100) oriented MgO sub./under-layer/Mn_3Sn (40 nm)/MgO/Ru thin films patterned into Hall-bar structures for the investigation of magnetotransport properties.

In accordance with previous studies, we observe a large anomalous Hall effect for M-plane orientations, while is zero for C-plane oriented structures. Planar Hall effect measurements show a considerable anisotropic behavior among C and M-plane orientations. Future investigations with varying Mn_3Sn thickness and temperature is expected to shed light on the anisotropic magneto-transport properties, beneficial for topological antiferromagnetic spintronics.

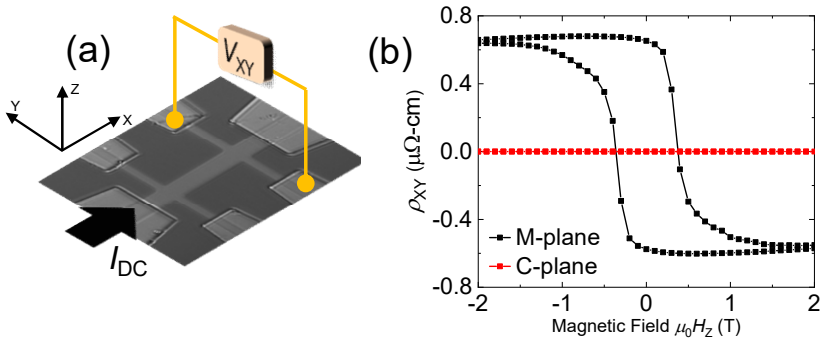

Figure: (a) Optical micrograph of an antiferromagnetic Weyl semi-metal Hall-bar structure. I_{DC} refers to the applied current while V_{XY} is the measured voltage. (b) Experimental results of Hall resistivity (obtained from V_{XY}) vs applied out-of-plane magnetic field for C-plane and M-plane Mn_3Sn structures.

主要発表論文等：