



Final Exam Abstract

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Thesis Title: Doping Evolution of Magneto-Transport Properties in the Layered Magnetic Semimetal $\text{Cr}(1+\delta)\text{Te}_2$

Exam Abstract:

Layered magnetic materials are important both from the fundamental perspective of understanding charge, heat, and magnetism as well as from the technological perspective of magnetically enhanced thermoelectric energy generation. $\text{Cr}(1+\delta)\text{Te}_2$ is a recently rediscovered magnetic transition metal chalcogenide (TMC) wherein controlling the fraction of $\text{Cr}(\delta)$ systematically tunes the electronic and magnetic properties of this simple binary system. This thesis reports mainly on modulating δ to tune the longitudinal thermopower S_{xx} for different $\text{Cr}(1+\delta)\text{Te}_2$ compositions. We show that as the fraction of doped $\text{Cr}(\delta)$ increases between $\delta = 0.3$ and $\delta = 0.68$, the sign of S_{xx} changes from positive to negative at a critical doping level of $\delta_C \approx 0.5$. The observed doping-dependent trend in the thermopower is consistent with the evolution of the semimetallic band structure in this material from ARPES, corroborating the electronic tunability of $\text{Cr}(1+\delta)\text{Te}_2$ using multiple characterization techniques. Next, an anomalous enhancement in thermoelectric response is also reported around δ_C , stemming from strong charge-spin coupling. Antiferromagnetic magnons are uncovered as the origin of this thermopower enhancement from analyses of the temperature-dependent magnetothermopower. This picture is further supported by the correspondence of the doping trend of the magnetothermopower with that of the magnetic anisotropy. The findings of this thesis point collectively to the critical nature of the doping level δ_C in magnetic semimetal $\text{Cr}(1+\delta)\text{Te}_2$. Around δ_C , near-Fermi-energy pseudogap formation and antiferromagnetic magnons combine to enhance thermoelectric energy conversion in $\text{Cr}(1+\delta)\text{Te}_2$.

*Note: OIST Policy Rules and Procedures (extract)

5.3.13.3 Appointment of the Thesis Examination Panel

After receiving the Notice of Intent to Submit a Thesis, the Curriculum and Examinations Committee (CEC) will appoint thesis examiners from within and outside the University, to form a Thesis Examination Panel, as follows:

- i. Two Examiners selected from two different working-countries, who are expert in the field of the proposed thesis and external to OIST. The CEC appoints the examiners taking into account nominations provided by the Thesis Supervisor. The CEC is responsible for determining if the nominated examiner is expert in the field of the proposed thesis research, taking into account the publications of the examiner in international peer reviewed journals.

- ii. A Chair selected from the OIST faculty members with knowledge OIST standards and regulations concerning PhD thesis examinations.

The Thesis Supervisor is responsible for ensuring that the nominated examiners meet the specified conditions. The Academic Services Section of the Graduate School is responsible for checking that the specified conditions are satisfied. If the conditions are not satisfied, the nomination shall not be submitted to the CEC, and the Supervisor shall be advised on the grounds for declining the examiner and asked to nominate a new examiner by the Academic Services Section.

The CEC may alternatively appoint an examiner who has not been nominated by the Supervisor.