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Psudogap formation at the β to β᾽phase transition in the Chalcogenide As2Te3

Thursday, 9 June 2022 11:00 (15 minutes)

The chalcogenides are a family of layered compounds that exhibit interesting properties. As2Te3 is a layered chalcogenide that has α, β and β′ polymorphic phases. β-As2Te3 exhibits significantly different electronic properties when compared to α-As2Te3, with the former metallic with significantly lower resistivity and the latter behaving as a typical semiconductor. Below a temperature of ≈200K, β-As2Te3 undergoes a structural phase transition to β′-As2Te3. Within the region of this transition a strong signature can be detected in the resistivity beyond which it resumes a metallic behaviour[1]. The driving mechanism behind this structural phase transition is currently unidentified.

We have employed a phenomenological fit on the resistivity of the βand β′ phases of As2Te3 to better characterize the nature of this transition. Most notable is the occurrence of cross-transition invariance in the slope of the resistivity, a topic of considerable interest in other materials[2]. The magnitude of the β-As2Te3 to β′-As2Te3 transition anomaly as well as the width of the transition can be effectively modelled using this approach. Parameters acquired from fitting both warming and cooling measurements will be used to better investigate the hysteresis observed in this transition. Additionally, Drude and gapped Drude model fits to temperature-dependent infrared reflectivity data within the β and β′phases have revealed the formation of a concomitant pseudo-gap. The reflectivity spectra and Drude-model fits will be used to aid in the analysis of the the phase transition and provide context on the underlying mechanisms driving the electronic properties in the system.

References

[1] Cedric Morin, Serena Corallini, Julie Carreaud, Jean-Baptiste Vaney, Gaelle Delaizir, Jean-ClaudeCrivello, Elsa Branco Lopes, Andrea Piarristeguy, Judith Monnier, Christophe Candolfi, Vivian Nassif, Gabriel Julio Cuello, Annie Pradel, Antonio Pereira Goncalves, Bertrand Lenoir, and Eric Alleno. Poly-morphism in Thermoelectric As2Te3.Inorganic Chemistry, 54(20):9936–9947, 2015. PMID: 26418840.

[2] Peter Cha, Aavishkar A. Patel, Emanuel Gull, and Eun-Ah Kim. Slope invariant T-linear resistivity from local self-energy. Phys. Rev. Research, 2:033434, Sep 2020.

Primary authors: Mr DION, Jeremy; Dr REEDYK, Maureen

Presenter: Mr DION, Jeremy

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