I. Physikalisches Institut (IA)
Physik neuer Materialien

RWTH AACHEN UNIVERSITY

I. Physikalisches Institut (IA)
Phasenwechselmaterialien
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Master Thesis in Physics

Metal Insulator Transition in the System $AgSb_xSn_{1-x}Se_2$ through Tuning of the Charge Carrier Density

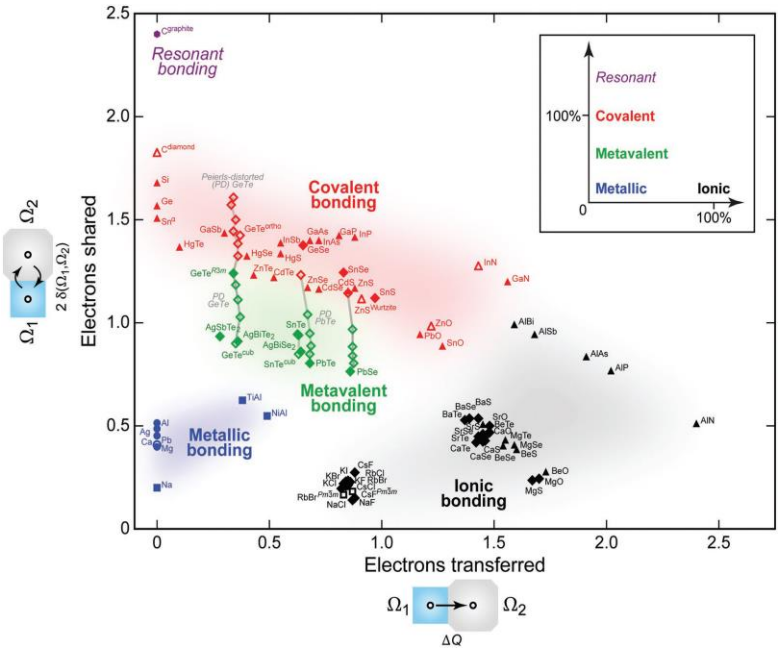

Figure 1: A 2D map that sorts different materials based on their bonding properties [1].

The chalcogenides $AgSbSe_2$ and $AgSnSe_2$ show very different electrical properties despite having the same crystal structure (rocksalt) and a similar composition. $AgSbSe_2$ is a narrow band semiconductor while $AgSnSe_2$ is a metal that superconducts below the critical temperature T_C = 4,5 K. In the materials map of our institute these two compounds are located in close proximity to each other, $AgSbSe_2$ on the metavalent side and $AgSnSe_2$ on the metallic side of the metavalent-metallic border (fig. 1). Substituting antimony with tin increases the charger carrier density in $AgSbSe_2$ to the point where it becomes metallic. Since both end points have the same crystal structure the system $AgSb_xSn_{1-x}Se_2$ is an ideal sandbox to probe properties based on charge carrier density and stoichiometry while excluding structural effects for the most part. This thesis aims to investigate the transition from metavalent to metallic and the nature of the charge carrier density induced metal insulator transition (MIT) in $AgSb_xSn_{1-x}Se_2$ through measurement of its electrical and optical properties.

During the course of this thesis various samples of $AgSb_xSn_{1-x}Se_2$ with different compositions are to be manufactured via sputter deposition. Their crystal structure will be analysed using X-ray diffraction, their optical properties through Fourier transform infrared spectroscopy (FTIR). Electrical properties are determined through the use of a cryostat by measuring the transversal and longitudinal resistances of a hall bar device at temperatures ranging from 0,5 K – 300 K at applied magnetic fields of up to 9 T.

The candidate should be highly motivated and have an interest in fundamental research in physics as well as be able to work independently. Some programming skills for data analysis is required.

[1] J. Raty, M. Schumacher, P. Golub, V. L. Deringer, C. Gatti, M. Wuttig: *A Quantum-Mechanical Map for Bonding and Properties in Solids*, Advanced Materials (2018).

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