I. Institute of Physics
Physics of New Materials

RWTH AACHEN UNIVERSITY

Institute of Physics IA
Phase Change Materials Group
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Bachelor Thesis in Physics (German/English)

Defect Tuning in the Phase Change Material PbTe

Phase change materials (PCMs) are renowned for their pronounced optical and electrical property changes upon crystallization and have played an important role for optical storage devices in the past. Recently they enjoy renewed interest for their applicability in novel electronic storage devices.

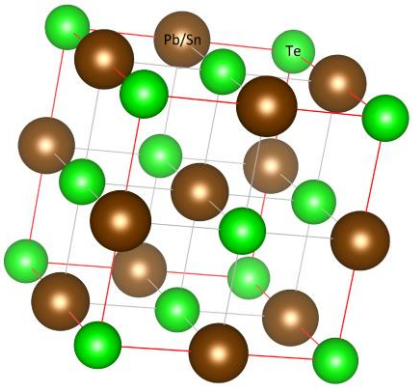

Figure 1: Rocksalt structure of PbTe

The electrical properties of PCMs, consisting primarily of group IV-VI elements, show a unique dependence on the disorder of the system.

Besides the well-known changes of optical reflectivity and electrical resistance at the amorphous-crystalline transition the order of lattice defects in crystalline phase change materials has a huge impact on the transport properties of the material. Theoretical calculations suggest that the carrier concentration in PbTe is very sensitive to even small changes in stoichiometry and even shows a transition from n-type to p-type conduction. Furthermore, a reduction of resistivity is observed upon annealing, which is usually accompanied by ordering of stoichiometric vacancies in related materials. As these are not present in PbTe, this indicates that the existence and curing of defects play a major role in this materials' behavior.

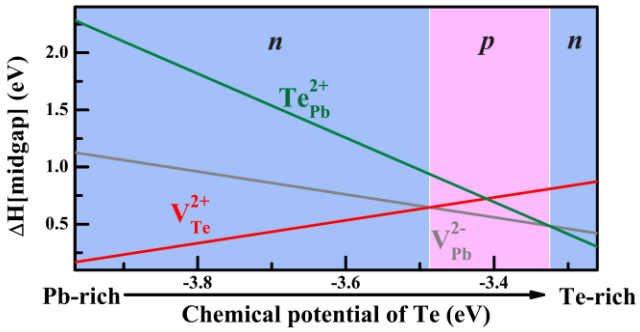

Figure 2: Vacancy formation energies in PbTe. [3]

In the scope of this thesis PbTe with varying deposition parameters will be characterized using low temperature transport measurements. The effect of defects on the sample properties will be examined by annealing at different temperatures. We are looking for a motivated student with good communication skills that is interested in working with unique materials and electronic devices.

Resources:

[1] Disorder-induced localization in crystalline phase-change materials, *Nature Materials*, T. Siegrist et al., 2011

[2] Candidates for topological insulators: Pb-based chalcogenide series, *Physical Review B*, H. Jin et al., 2011

[3] Microscopic origin of the p-type conductivity of the topological crystalline insulator SnTe and the effect of Pb alloying, *Physical Review B*, N Wang et al., 2014

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