OBSERVATION OF THICKNESS DEPENDENT CONTINUOUS PHASE TRANSITION OF SnSe 2D CONFINED LAYERS AT ROOM TEMPERATURE

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Artificial crystals, created by repetitively stacked SnSe and MoSe2 layers with a thickness of only a few unit cells, exhibit physical properties different from the bulk constituents. [SnSe]m[MoSe2]n ferrocrystals are prepared by physical vapor deposition and post-growth annealing under high vacuum conditions. Due to the misfit of the lattice parameters and the preparation procedure, the individual microcrystalline layers are weakly coupled to each other and randomly oriented in the a-b plane perpendicular to the growth direction. While comparably thick layers of SnSe and MoSe2 (ca. 10 nm) have bulk-like crystal structure, SnSe shows a continuous phase transition from orthorhombic to a tetragonal-like structure with decreasing SnSe layer thickness. The thickness induced unification of the SnSe lattice parameters (a≈b<c) is similar to the “pseudo-tetragonal” orthorhombic β-SnSe phase observed at very high temperatures above 807 K [1].

In conclusion, we observe a high temperature modification of SnSe in thin turbostratically disordered layers at room temperature. Moreover, we present that polarization dependent Raman spectroscopy provides information about the crystal structure of the individual layers. Due to the lack of long range order in the layers, this type of information is difficult to obtain by conventional X-ray analysis.

Keywords: Raman Spectroscopy, nanoscience, two-dimensional layers

References


Fig. 1. Raman spectroscopy shows a phase transition of SnSe with decreasing SnSe layer thickness.