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Electronic structure of transition metals and rare-earth ions incorporated in the SnTe matrix

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The transition metal (TM) and rare-earth (RE) ions can exist as divalent, trivalent and mixed valent ions in solid state lattices. Their valence depends on chemical environment, lattice structure and physical conditions like temperature and pressure.

In the present study we investigated electronic band structure of SnTe with incorporated Mn, Cr, Gd and U ions. There are only few photoemission studies on Sn(TM)Te and Sn(RE)Te crystals[1] and the aim of this investigation was to fill this gap. On the other hand, it should be noticed that the SnTe material is of great interest recently as it was found to be a crystalline topological insulator.[2]

Pure and doped SnTe crystals were grown by the Bridgman method taking the constituent elements in the stoichiometric proportion. The amount of Cr, Gd, Mn and U ions was evaluated as about 2% as measured by the electron microprobe analysis.

The resonant photoemission (RESPES) experiment was performed at the FLIPPER II beamline at the HASYLAB synchrotron radiation laboratory in Hamburg, Germany. Angle-integrated PES spectra were recorded using a cylindrical-mirror energy analyser (CMA-type, PHI 25- 260). The overall energy resolution was about 250 meV.

The RESPES spectra were recorded for the photon energy range corresponding to the $3p \rightarrow 3d$ and the $4d \rightarrow 4f$ absorption thresholds for TM and RE ions, respectively. The RESPES experiment allows determining the 3d and 4f contribution to the valence band electronic structure of the SnTe crystal.

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References

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