A spectroscopic comparison of AOS thin films and TCO single crystals

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Amorphous oxide semiconductors (AOS) and transparent conductive oxides (TCO) represent a new class of materials with exciting optical and electrical properties. We report on comparative studies of a-GIZO and a-SnOx thin films in which we compare their electronic properties with those of In$_2$O$_3$, Ga$_2$O$_3$, ZnO, and SnO$_2$ single crystals.

A key in understanding the basic transport mechanisms is in the knowledge of the electronic structure in the valence band (VB) and conduction band (CB) regime. We use resPES to study the electronic properties of both, the single crystals and the amorphous films. We report on the core levels, the VB PES data, partial Integrated Yield (pIY), and the XAS absorption data. From these we are able to derive the elemental ratio, the partial density of states (pDOS), and the band scheme. At the O1s resonance we observe multiple Auger processes from which we deduce that a band of localized defect states is located between the Fermi energy and the CBM. Furthermore the XAS data and the resonant profiles taken at the corresponding In3d, Zn2p, and Ga2p metal edges indicate that the metal states are involved in the pDOS next to the Fermi energy.

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