INVESTIGATIONS OF THE DEFECT STRUCTURE OF TRANSPARENT CONDUCTORS USING X-RAY AND NEUTRON SCATTERING TECHNIQUES

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Transparent conducting oxides (TCOs) are an essential component in a host of opto-electronic devices such as flat-panel displays, photovoltaics and smart windows, which are used to reduce energy consumption. TCO materials are attractive and scientifically interesting due to their use in energy-efficient devices that utilize their unique combination of electrical and optical properties. Introducing small quantities of favorable defects in the atomic-scale structure can improve the material properties that are desired for industrial applications. Therefore, understanding TCO defect structure is required for their further development. X-ray and neutron scattering techniques are crucial for the determination of the structure of these materials.

Anomalous X-ray diffraction, extended X-ray absorption fine structure, and time-of-flight neutron diffraction techniques have been combined to study powders of indium-oxide-based transparent conductors. The defect structures of bulk and nano-indium-tin oxide were investigated for oxidized and reduced materials. The results were correlated with theoretical calculations, *in situ* electrical conductivity, and thermopower measurements, as well as existing defect models. High-energy, *in situ* X-ray diffraction and X-ray fluorescence techniques were also utilized to study the different phases of TCO compounds found in the indium oxide-tin oxide phase diagram.