Structural Analysis of Tin-doped Indium Oxide (ITO) Thin Film by XAFS Spectroscopy

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Tin-doped indium oxide (ITO, for Indium Tin Oxide) exhibit high electrical conductivity (up to $10^4 \Omega^{1} \bullet cm^{-1}$), high transparency in the visible range, and high infrared reflectivity for wavelengths higher than 1•*m*. ITO films are used as transparent electrodes in liquid-crystal displays and heat reflection filters. ITO is a wide-gap, degenerate semiconductor where electrons are the major charge carriers. The Sn atoms are considered to substitute for in, without ordering. The difference of valence between In^{3+} and Sn^{4+} results in the donation of a free electron to the lattice. For most applications, ITO films must be as conducting as possible, which requires a high carrier density (*N*) and a high carrier mobility (μ).

To obtain an accurate knowledge on the tin donor compensation effect, we should understand a structural study of ITO thin films by using X-ray absorption fine structure (XAFS) spectroscopy, so that the local order around Sn and In might be correlated with the electrical properties of these layers.

In the present study, the local environment of tin in the ITO thin film with 20wt% Sn has been investigated by XAFS spectroscopy. XAFS experiments were performed at BL01B1 XAFS beamline of SPring-8. Fig. 1 shows the XAFS spectra of K-edge (27.940*keV*).

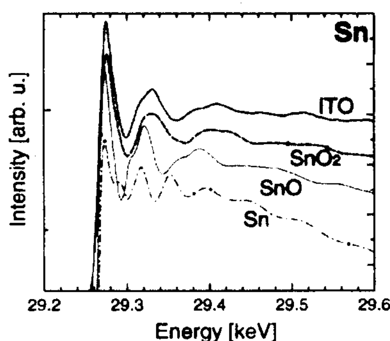

Fig. 1 XAFS spectra of Sn K-edge for ITO with 20% Sn, SnO_2, SnO and Sn.