STRUCTURAL ANALYSIS OF INHOMOGENEOUS SnO_x THIN FILMS

I. Djerdj[a], D. Gracin[a], K. Juraić[a] , D. Meljanac [a], D.Balzar[c]
Igor.djerdj@irb.hr
(a) Ruđer Bošković Institute, Bijenička c.54 10000 Zagreb, Croatia
(b) Department of Physics and Astronomy, University of Denver, Denver, CO 80208 USA

SnO_x is an important material in energy-related research because of its possible application in thin film solar cells. The spray pirolysis using Atmospheric Pressure Chemical Vapor Deposition (APCVD) is becoming popular in many industrial production lines because of its low cost. The growth of solar cell structures in most cases is a “transport limited growth”, e.g. the film growth mimics the surface roughness of SnO_x surface, which is determined by the crystal structure, orientation, grain size and microstrain.

In this study, SnO_x thin films were deposited by APCD on the glass substrate in two sequential steps. In the first step the precursor that contains only Sn and O atoms is sprayed on the surface of hot glass and after that heated in oven. In the second step, the precursor contains fluorine as a dopant. The type of precursor affects the crystal size and other structural properties. As result, the films are inhomogeneous across depth. Due to the complex nature of as-deposited material, a careful analysis through the thin-film depth is needed in order to collect information about the local materials microstructure. One possible approach to accomplish this goal is XRD probing of the material at the grazing incidence angle (GIXRD), as the resulting synchrotron pattern yields information at specific depth depending on the incident angle. As-obtained GIXRD patterns are fully processed with the Rietveld refinement in order to get information about crystallite size, microstrain and preferred orientation. Such information, particularly the gradient of crystallite size distribution perpendicular to the film surface, is a valuable feedback regarding the thin film deposition conditions. Moreover, thin films were examined by GISAXS (Grazing Incidence Small Angle X-ray Scattering) using synchrotron radiation, as well as by AFM (Atomic Force Microscopy), complementing the structural characterization of material by GIXRD.