

INVESTIGATION OF THE STRUCTURE OF ALUMINUM AND GALLIUM DOPED ZINC OXIDE CHEMICAL VAPOR DEPOSITED THIN FILMS ON GLASS USING XRD AND TEM

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Doped zinc oxide based electrodes are an attractive alternative to traditional ITO thin films as transparent conducting oxides for organic light emitting diodes (OLED). Zinc presents many advantages over traditional metals used in ITO that relate to cost, and transmittance in some regions of the visible spectrum. Several routes exist to deposit doped zinc oxide electrodes on organic platforms among which chemical vapor deposition is of interest because of its high production capacity, though it also presents challenges because the typical CVD process temperatures are incompatible with organic substrates. In our research, thin films of aluminum doped and gallium doped zinc oxide were deposited on sodalime glass substrates and characterized by different analytical techniques, including four point electrical probes, atomic force microscopy, scanning and transmission electron microscopy with electron diffraction, X-ray photoelectron spectroscopy, and X-ray diffraction, both in theta-theta and grazing incidence geometry using parallel beam optics. These techniques allow determination of several parameters of interest such as electrical properties, roughness, microstructure, chemical composition, crystallinity and related parameters, texture, and grain size. In order to understand the relationship between structure and properties, we compared structural and chemical data with electrical properties of the thin films. Particular attention was given to grain size, texture, and morphology to understand the correlation with electrical conductivity. We designed a series of experiments where samples were progressively mechanically polished and characteristic properties measured as a function of depth. We observed a strong correlation between the thickness of the thin film, electrical conductivity, texture and morphology, and crystal grain size. Texture was found to have a constant evolution with thickness even with different dopants such as aluminum and gallium. Grazing incidence data, theta-theta diffraction data, pole figure analysis and TEM electron diffraction data were all taken into account to understand the morphology and microstructure of CVD deposited doped zinc oxide thin films on sodalime glass.

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