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Thickness dependence of the structural, electrical, and optical properties of amorphous indium zinc oxide thin films

Du-Cheng Tsai and Fuh-Sheng Shieu[*]

Department of Materials Science and Engineering, National Chung Hsing University, Taichung 40227, Taiwan, Republic of China, R.O.C.

Abstract

Indium zinc oxide (IZO) films were grown by direct current magnetron sputtering from vacuum hot-pressed ceramic oxide targets of In_2O_3:ZnO with a weight ratio of 7:3 onto glass substrates. No external heating of the substrate was used during deposition. The thickness dependences of the structural, optical, and electrical properties of IZO films were characterized. The IZO film structure remained amorphous with low roughness as its thickness increased but showed an increased degree of short-range order. The thick IZO film contained relatively high carrier concentration and mobility but exhibited low transmittance in the visible region and high reflectance in the IR region. The smallest electrical resistivity was 5.44×10^{-4} Ω-cm for the 800 nm-thick IZO film. The optical band gap shifted to a higher energy with thickness as the carrier concentration and Urbach energy increased. An inverse linear relation was found between band gap energy and Urbach energy. In consideration of the figure of merit values, the optimized thickness of the IZO film was 800 nm due to the effect of IZO film thickness on sheet resistance. Given its low temperature process and good optoelectronic properties, the IZO film has a wide range of potential applications in various optoelectronic devices.

Keywords: amorphous materials; oxide materials; microstructure; electronic properties; optical properties.

* Corresponding author at: Department of Materials Science and Engineering, National Chung Hsing University, Taichung 40227, Taiwan. Tel.: +886 4 2284 0500; Fax: +886 4 2285 7017.

E-mail address: fsshieu@dragon.nchu.edu.tw (F.-S. Shieu).