TT-P054

Changes in Electrical and Optical Properties and Chemical States of the Amorphous In–Ga–Zn–O Thin Films Depending on Growth Temperature

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We investigated electrical and optical properties and chemical states of amorphous In-Ga-Zn-O (a-IGZO) thin films deposited at different substrate temperatures (from room temperature to 300°C). a-IGZO thin films were fabricated by radio frequency magnetron sputtering using In_2O_3 : Ga_2O_3 : ZnO = 1 : 1 : 1 target, and their electrical and optical properties and chemical states were investigated by Hall-measurement, UV-visible spectroscopy and x-ray photoelectron spectroscopy (XPS), respectively. The data showed that as substrate temperature increased, carrier concentration increased, but mobility, conductivity, transmittance in the shorter wavelength region (>350 nm), and the Tauc-plot-estimated optical bandgap decreased. XPS data indicated that the intensity of In 3d peak compared to Ga 3d peak increased but the intensity of Zn 3d peak compared to Ga 3d decreased, and that, from the deconvoluted O 1s peak, defects or oxygen vacancies and non-quaternary contents increased as the temperature increased. The relative intensity changes of the In, Zn, and O 1s sub-component are suggested to explain the changes in electrical and optical properties.

Keywords: Amorphous In-Ga-Zn-O, a-IGZO, InGaZnO, Substrate temperature, Optical property, Electrical property, XPS