

# Dielectric and Optical Properties of Amorphous Hafnium Indium Zinc Oxide Thin Films on Glass Substrates

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The dielectric and optical properties of GaInZnO (GIZO), HfInZnO (HIZO) and InZnO (IZO) thin films on glass by RF magnetron sputtering method were investigated using reflection electron energy loss spectroscopy (REELS). The band gap was estimated from the onset values of REELS spectra. The band gaps of GIZO, HIZO and IZO thin films are 3.1 eV, 3.5 eV and 3.0 eV, respectively, Hf and Ga incorporated into IZO results in an increase in the energy band gap of IZO by 0.5 eV and 0.1 eV. The dielectric functions were determined by comparing the effective cross section determined from experimental REELS with a rigorous model calculation based on the dielectric response theory, using available software package, good agreement between the experimental and fitting results gives confidence in the accuracy of the determined dielectric function. The main peak of Energy Loss Function (ELF) obtained from IZO shows at 18.42 eV, which shifted to 19.43 eV and 18.15 eV for GIZO and HIZO respectively, because indicates the corporation of cation Ga and Hf in the composition. The optical properties represented by the dielectric function  $\epsilon$ , the refractive index  $n$ , the extinction coefficient  $k$ , and the transmission coefficient,  $T$  of HIZO and IZO thin films were determined from a quantitative analysis of REELS. The transmission coefficient was increased to 93% and decreased to 87% in the visible region with the incorporation of Hf and Ga in the IZO compound.

**Keywords:** GIZO, HIZO, IZO, REELS, QUEELS