DIELECTRIC FUNCTION OF ε-$(In,Ga)_2O_3$ THIN FILMS

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The large band gap energy of about 4.8eV makes Ga_2O_3 interesting as transparent conductive oxide (TCO) since even in the presence of impurities a high transmissivity is sustained in the visible and even in the UV-A/B spectral range. The dielectric function for the β-phase of Ga_2O_3 was recently presented and discussed [1–3]. However, the dielectric function of the ε-phase, being interesting due to its spontaneous polarization, and its alloys with In and Al, which are used for tuning the band-gap energy, is not explored in great detail so far.

Here, we present a detailed analysis of the dielectric function of an ε-phase $(In,Ga)_2O_3$ thin film with lateral In composition spread for In concentrations between 1% and 35% in the infrared (350cm^{-1} – 1500cm^{-1}) and NIR-VUV (0.5eV – 8.5eV) spectral range. By means of a parametric model dielectric function approach, we derive the refractive index dispersion and the properties of the electronic band-band transitions and phonons. We observe a red shift of the fundamental band-gap energy with increasing In concentration which results in an refractive index increase in the transparent spectral range.

The thin film samples have been grown by means of pulsed laser deposition (PLD), with the use of segmented PLD targets (consisting of half-segments of binary indium oxide respective indium oxide and binary gallium oxide). This resulted in films with a continuous composition spread [4].

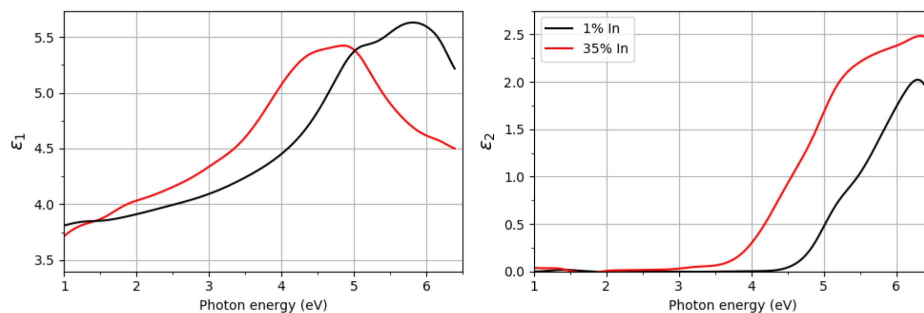

Fig.1. Real (left) and imaginary (right) part of the dielectric function of ε-Ga_2O_3:In for an In concentration of 1% (red line) and 35% (black line).

Keywords: dielectric function; Raman tensor; Ga_2O_3; wide band-gap oxide

References

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