Using the TPF-Probe 3.3 software, a Tauc-Lorentz dispersion model was applied to obtain the optical functions of the In2O3 films. The imaginary part of such dielectric function ε, was developed by Jellison and Medine in 1996, by multiplying the Tauc joint density of states with the Lorentz oscillator:

\[ \varepsilon(E) = \epsilon_{2}(E) = \frac{\epsilon_{3}}{E^{2} + \epsilon_{4}^{2}} \]

where ε2 is the transition energy, C is the broadening term, ε0 is the optical band gap, and A is proportional to the transition probability matrix element.

The real part of the dielectric function ε1 is calculated then by Kramers-Kronig integration:

\[ \varepsilon_{1}(E) = \frac{\pi}{4} \int_{0}^{\infty} \frac{C}{E^{2} + \epsilon_{4}^{2}} \left( \frac{1}{E^2 - E^2} - \frac{1}{E^2 + \epsilon_{4}^{2}} \right) dE \]

The fitting parameters in the software utilizes the variables A, C, ε0, and ε4, from the Tauc-Lorentz model.

When studying optical property over a very wide wavelength range, especially for TCO films, a Tauc-Lorentz dispersion is insufficient to characterize the dielectric response completely. Therefore, one or more Lorentz type oscillators were added into the total dielectric function in the analysis:

\[ \varepsilon(E) = \epsilon_{0} + \sum \frac{\varepsilon_{4}}{E^2 + \epsilon_{4}^{2}} \]

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