The Preparation and Characterization of an ITO/Silicon Solar Cell

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Abstract

This thesis reports the performance of ITO/Si solar cells that were produced by the sputter deposition of 400 nm thick films of indium tin oxide (ITO) on silicon.

High quality films of ITO were prepared by RF magnetron sputtering onto heated glass substrates. Hall effect studies on ITO film samples have been used to determine charge carrier concentration, mobilities and the type of carriers involved. Electrical sheet resistance measurements were made using a home-made four point probe. The best film was found to have a high luminous transmittance (greater than 80%), carrier concentrations of about 7.5×10^{20} cm^{-3} and a sheet resistance of about 13 Ω/□. The absorbtion coefficient for the samples was computed from the transmittance data in the near UV region and band gap energies of about 4.0 eV were obtained.

Assuming the classical Drude model for metals can be adapted for degenerate semiconductors like ITO, both the dielectric function and the complex refractive indices have been computed from the carrier concentration, mobility and the effective mass of the charge carriers.

ITO/Si solar cells were subsequently fabricated by depositing a thin transparent conducting film of ITO onto a 100 Ωcm *p*-type silicon wafer. The

technique used is promising in the production of solar cells. Since ITO exhibits an index of refraction in the right range (~1.9), it provides an inherent antireflection coating for silicon. Due to the high optical transparency and low electrical resistivity of ITO, the making of the front contact is greatly simplified. However, the initial solar conversion efficiencies are low ($\eta_s \sim 1\%$).