Transparent conductors for thin film solar cells

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A brief review of the role of TCOs as diffusion barriers, electrical blocking layers, antireflection and as transparent electrodes will precede recent results. In a combinatorial study of doped ZnO, each sample yielded up to 289 data points for conductivity, carrier concentration and optical transmission. Optimum dopant concentration was established and the dopant efficiency measured e.g. Si is a double donor. Plotting the plasma frequency vs carrier concentration yielded quantitative information about the non-parabolicity of the bands and carrier effective mass. The carrier dependence of mobility allowed for the development and verification of mobility models in TCOs. The combinatorial method was also used to study the influence of ‘high resistive transparent’buffer layers in the series ZnO-SnO2 for CdTe/CdS solar cells. The composition giving the highest increases in Voc and FF was identified. Knowledge of the dispersion relations for the component layers of a thin film solar cell allows for the modelling of its optical utilisation. Here we report on the optimisation of the short circuit current in some solar cell designs by tuning of the transparent conductor, the high resistant transparent layer and the n-type layer, with the CdTe solar cell design being used as an exemplar.