Fabrication of Ga-doped ZnO transparent conducting film and well-aligned ZnO nanorods (ZnO:Ga/ZnO) **photoelectrode for dye-sensitized solar cells applications**

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Since a power conversion efficiency of 10.4% was demonstrated by Grätzel in 1991 using TiO_2 Dye sensitized solar cell (DSSC), DSSC photovoltaic (PV) device is studied as a promising and low-cost alternatives for the conventional p-n junction based solar cells. One advantage of DSSCs over p–n junction cells is that materials choice is not fixed; tunability of PV properties is possible due to numerous components that can be optimized. In the cell design, the selection of semiconductor oxide and corresponding transparent conducting oxide (TCO) layer to form photo electrode is critical to achieve efficient light harvesting, charge separation and extraction. To this end, Ga-doped ZnO TCO and ZnO semiconductor photo anode sequentially grown on a low-cost substrate at low temperature are reported to provide a formidable combination for fabrication of a low cost and highy efficient photo electrode for increased power conversion efficiency of the DSSCs to replace TiO_2 DSSCs which pose high cost of fabrication among other limitations that made attempts to increase conversion efficiency difficult. However, researchers are yet to fabricate ZnO-based DSSCs with efficiencies similar or higher than TiO_2 nanoparticle-based DSSCs mainly due to electron recombination or electron back transfer referred to as the most crucial limitation of dye sensitized solar cells as it severely affects its performance by short-circuiting the cell. The ultimate goal of the study is to fabricate Ga doped ZnO NPs for preparing TCO film with high transmittance in the visible region, low electrical resistivity and high thermal/chemical stability that can be used as a seed layer for growth of long and highly dense arrays of ZnO NRs photo anode to produce an efficient and stable photo electrode for DSSCs. It is reported that a homogenous ZnO:Ga(TCO)/ZnO(SC) interface may largely enhance the electron transfer property, and hence improve the cell performance.

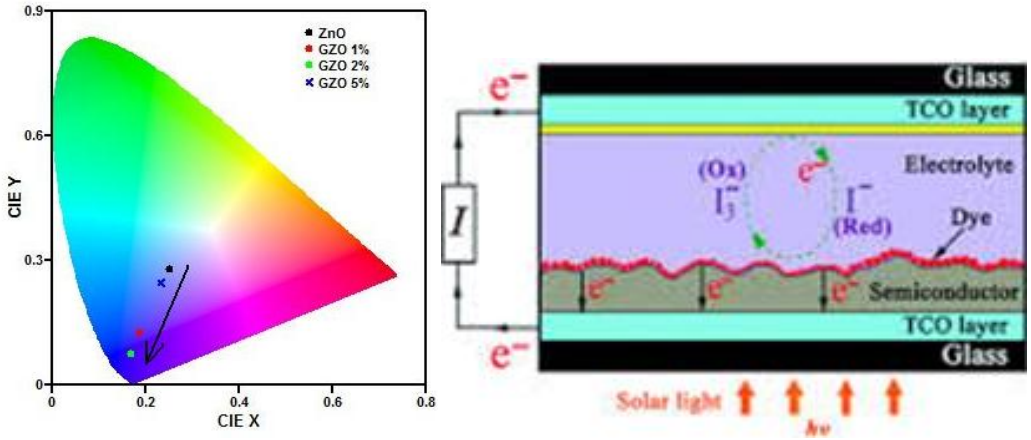

Fig (Left): Chromaticity diagram depicting CIE colour co-ordinates for GZO NPs at various Ga doping concentrations. (Right) device structure of Dye-sensitized Solar Cell