

# Investigation of Efficiency of the Solid-state Dye-sensitized Solar Cells with Metal Centered Dye and Metal-free Organic Dye

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## Abstract

Converting solar energy into electricity provides a much-needed solution to the energy crisis the world is facing today. With continuous research studies conducted in this field, we have come across the third generation of solar cells; the dye sensitized solar cells. Several types of dyes have been individually employed to study sensitization process of TiO<sub>2</sub>|sensitizer|p-semiconductor type solar cells. Highest efficiency has been achieved from dye-sensitized solar cells using ruthenium based metal complexes as dyes on glass substrate. However, ruthenium metal complexes cause environmental issue and they are very expensive. So we are in a need to find an alternative method. In this study metal free organic dye was used to prepare DSSCs to compare the efficiency of the solar cell with metal centered dye. In this study, an environmental friendly dye, 1-(2-hydroxycarbonyl-phenyl)-5-(2-hydroxy-5-sulfophenyl)-3-phenylformazan (zincon) is used as a dye (sensitizer) to fabricate a solar cell. Zincon is an azo dye used as indicator for detection of metal ions. Zincon dye exhibits solvatochromic behavior due to enforcement of Van der Waals interaction between dye molecules and solvents depending on their polarity. Zincon was coated on titanium coated conducting glass substrate. Zincon dye has different surface chelating groups and making bonds easily with metal oxides. Coupling of zincon dye by COOH group with Ti<sup>4+</sup> was confirmed by FTIR measurements. A platinum coated plastic substrate is attached to the dye coated film and the space was filled by the I<sup>-</sup>|I<sub>3</sub><sup>-</sup> electrolyte by capillary action. I-V characteristics were measured under light illumination. Photocurrent of 1.6 mAcm<sup>-2</sup>, photo-voltage of 395 mV, fill factor 26.5 % and efficiency of 0.2 % were observed as the best performances of the cell. Performance of this DSSC is very poor when comparing this with metal centered dye used DSSC as it gives nearly 15.3mAcm<sup>-2</sup> photo current and having efficiency up to 3.8%.

**Keywords:** Zincon, Dye-sensitized Solar Cell, Azo dye