

## TCO-less Tandem dssc featuring enhanced spectra with new architectures

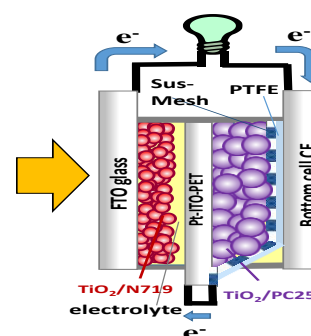
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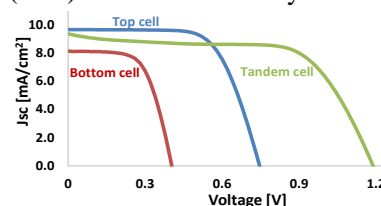
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Dye Sensitized Solar Cell (DSSC) has been investigated as a promising 3<sup>rd</sup> generation photovoltaic devices due to its ecological and economical fabrication process. Promising DSSC performance realization is possible by extending photo harvesting spectra and covering NIR region. Tandem DSSC utilizing 4 TCO plates are very common approach towards extension of photo harvesting region. Usage of superfluous intermediate TCO plates of Tandem DSSC are hindrance towards light availability at bottom cell and affects the photovoltaic performance. TCO-less Tandem dssc architecture are known towards enhanced light intensity availability at bottom cell.[1] Here we report light efficient, novel TCO-less Tandem dssc architecture capable to



**Fig.1:** novel TCO-less Tandem DSSC architecture

avoid further optical losses, bearing ITO-Polyethylene Terephthalate (PET) as intermediate layer. The cell harvests NIR wavelength region (till 900nm) while incorporating newly synthesized Phthalocyanine dye (PC25) in bottom cell. It has been proved that the resulting novel architecture shows around 10% enhanced light (700-900nm wavelength region) at bottom cell than conventional TCO-less Tandem DSSC.



**Fig.2:** IV characteristics of TCO-less Tandem dssc with ITO-PET as intermediate layer

The architecture consist of FTO glass/N719 stained  $\text{TiO}_2$  /

semitransparent ITO-PET/PC25 stained  $\text{TiO}_2$ / SUS-MESH/PTFE/Pt-Ti foil.

The fabricated TCO-less Tandem DSSC with flexible bottom cell under simulated condition exhibits the photovoltaic parameter of 7.19% efficiency ( $\eta$ ) with 1.19V Voc, 0.65 FF and 9.34mA/cm<sup>2</sup> Jsc. On the other hand top cell shows 4.82%  $\eta$ , 0.67 FF, 0.75V Voc, 9.65mA/cm<sup>2</sup> Jsc and bottom cell 2.04%  $\eta$ , 0.62 FF, 0.40V Voc, 8.13 mA/cm<sup>2</sup> Jsc respectively. The obtained efficiency (7.19%) (greater than sum of top cell and bottom cell), Voc (sum of top cell and bottom cell Voc) demonstrates the concept proof of novel TCO-less Tandem DSSC formation utilizing ITO-PET as intermediate layer. Here we will discuss the fabrication process and the details of TCO-less Tandem DSSC bearing different intermediate layers, along with its effect on photovoltaic performance.

**References:** A.K. Baranwal, T. Shiki, Y. Ogomi, S.S. Pandey, T. Ma, S. Hayase, “Tandem dye-sensitized solar cells with a back-contact bottom electrode without a transparent conductive oxide layer”, RSC Advances, 2014,4, 47735-47742.