PROCEEDINGS

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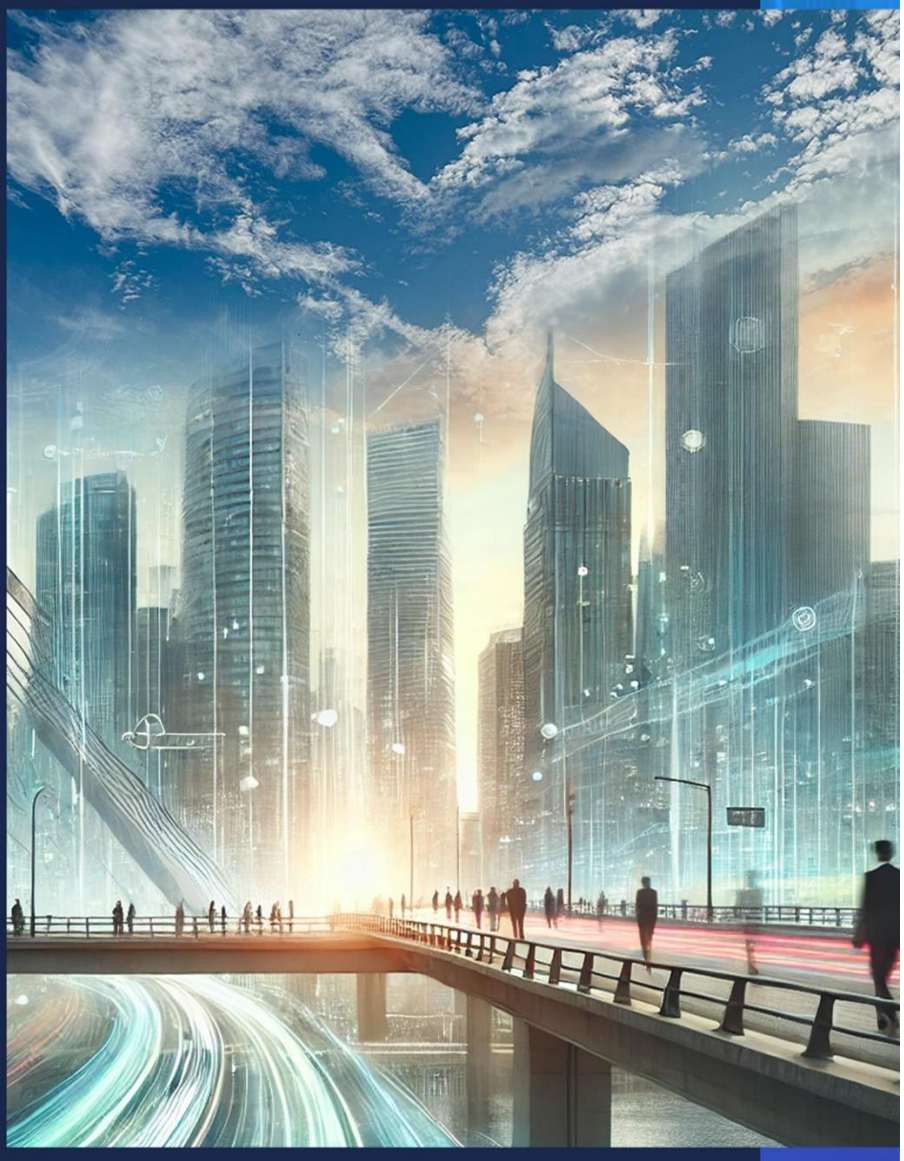

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ENHANCED EFFICIENCY IN DYE-SENSITIZED SOLAR CELLS USING LANTHANUM OXIDE AND TIN OXIDE COMPOSITE PHOTOANODES SENSITIZED WITH AN N719 DYE

Dayarathne BANYP[1], Weerasinghe MIU[1,2] and Kumara GRA[1*]

[1]National Institute of Fundamental Studies, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
grakumara2000@yahoo.com

Abstract

Dye-sensitized solar cells with a SnO_2/ZnO composite photoanode have proven to be a viable alternative to the cells with a TiO_2 photoanode as they exhibit photoconversion efficiencies viable for electricity generation. This paper investigates the performance of a similar SnO_2/La_2O_3 composite photoanode. Metal-oxide films were prepared using a colloidal solution containing a fixed mass of SnO_2 and masses of La_2O_3 ranging from 0 g to 0.10 g with 0.02 g increments, which was sprayed onto clean FTO (Fluorine-Doped Tin Oxide) glass plates preheated at 80℃ using the spray pyrolysis technique, and these films were sensitized with N719 dye. *J-V* curves were obtained for each cell while exposed to 1 sun illumination, with photo-voltaic parameters obtained from each graph: short circuit current, open circuit voltage, fill factor, and photoconversion efficiency. The Best-performing photoanode achieved an efficiency of 2.10%, which is a 31% improvement in efficiency compared to the photoanode consisting of only SnO_2, which achieved an efficiency of 1.60%. This was further supported by IPCE (Incident Photon-to-electron Conversion Efficiency) spectra obtained for each type of cell: the optimum SnO_2/La_2O_3 photoanode demonstrated a higher IPCE of 48% at wavelength 530 nm compared to the SnO_2-only cell IPCE value of 34 % at wavelength 515 nm. We conjecture that the La_2O_3 nanoparticles formed a thin-film barrier at the photoelectrode/electrolyte interface similar to the ZnO thin-film barrier formed in the SnO_2/ZnO composite photoanode, which created a potential barrier between the two types of nanoparticles due to the conduction band minimum of the La_2O_3 being higher than that of the SnO_2. We surmise that an electron recombination-suppression effect caused by the potential barrier preventing electrons in the photoanode recombining with the dye-cation or electrolyte produces these higher efficiencies. These findings expose the potential utility of using lanthanum oxide to enhance efficiencies of Dye-Sensitized Solar Cells.

Keywords: Photoanode, Lanthanum oxide, Tin oxide, Composite photoanode, Dye-Sensitized solar cell