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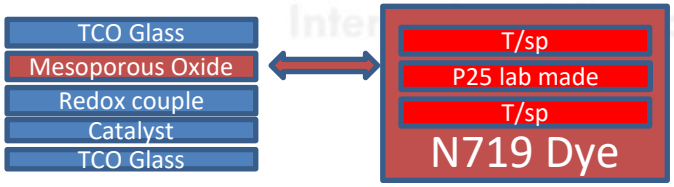
# Enhancing the Power Conversion Efficiency of Bifacial Dye-Sensitized Solar Cells by Using a Transparent Sandwich Layer Structure

Organised by: UPM Universiti Putra Malaysia; Institut Nanosains dan Nanoteknologi, Institute of Nanoscience and Nanotechnology

P02

## INTRODUCTION

Dye-sensitized solar cells (DSSCs) are a promising technology for solar energy conversion. They are relatively inexpensive to manufacture, have a high-power conversion efficiency, and are flexible and lightweight. However, the power conversion efficiency still not as high as it's predictors 2nd gen silicon based solar cells due to several aspects most notably is the electron hole recombination issue that accrued when electrons fail to reach the LOMO after energizing from HOMO due to Photons-electron excitation. This work aims to address this issue by investigating bifacial DSSCs photoanode's structural enhancement. The electrode layer for this work is consist of lab synthesized TiO2 based of P25 filling inside a transparent titanium dioxide (T/sp) sandwich. The layering structure of active area will enable both front and rare collection of light to further enhance the power conversion efficiency.




## MATERIALS

Titanium dioxide P25 Nanopowder, < 25 nm particle size, 99.7 trace metals basis, ethanol 95% purity with denatured properties, acetic acid acs reagent ≥ 99.7%. alpha-terpineol technical grade, 90% ethyl cellulose 5% in toluene/ethanol 80:20(lit.). FTO transparent conductive glass 10 cm x 10 cm. Ruthenium-based Dye N719 solaronix 1g platinum solaronix Platisol T 50 ml, electrolyte iodide/ triiodide arbor scientific 15ml, T/sp $TiO_2$ commercial solaronix.

## Method

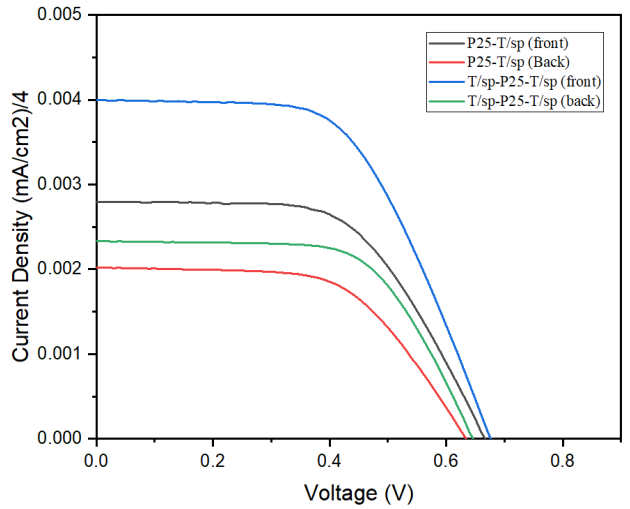
The FTO substrates cut into suitable dimensions and cleaned with DI water, Ethanol, Isopropanol, and Acetone respectively for 10 minutes each. the electrode consist of T/sp, P25, and T/sp receptively with each layer applied using screen printing and sintered in 450 $C^0$ for 30 minutes. The resulted electrode immersed in N719 dye for 24 hours in room temperature. The counter electrode consist of standard platinum nanoparticles that depositing into FTO glass and sintered in 450 $C^0$ for 30 minutes. Standard redox couple have been used iodine/triiodide injected inside the cells after fabrication between the electrode and the counter electrode and sealed with epoxy to prevent the solution evaporation and the cell is ready to be tested..

## RESULTS & DISCUSSION

the testing of the cells was under air mass (1.5 mW) light conditions in front and backside. Initially we have tested the T/sp-P25 layers then afterwards we have conducted full stack of T/sp-P25-T/sp electrode. The results of the power conversion efficiency was **4.4%** for the 2 layers stack and **6.1%** for the 3 layers stack with back illumination of **3.1%** and **3.8%,** respectively. The high power conversion efficiency was result of large light illumination abruption due to the transparent nature of T/sp that allow the photos to reach more dye particles inside the active area and the distributional of light nature of the P25 that redirect and reflect photons throughout the active area rapidly.

## CONCLUSION

The combination of transparent sandwich layers and Lab made P25 paste proved to be a great enhancement for both front and back illumination effect. This attributed to the greater light harvesting and increase in over all energy production. In the second Poster of (iSAMN2023) we will introduce the effect of Graphene on the stack structure.




| Jsc [mA/cm$^2$] | Voc [V] | FF [-] | PCE [%] | $J_{max}$ [mA/cm$^2$] | $V_{max}$ [V] |
|---|---|---|---|---|---|
| 15.99 | 0.680 | 0.566 | **6.1564** | 13.99 | 0.44 |
| 9.32 | 0.650 | 0.629 | 3.8138 | 8.48 | 0.45 |
| 11.74 | 0.660 | 0.578 | **4.4741** | 10.17 | 0.44 |
| 8.09 | 0.640 | 0.581 | 3.0101 | 7.00 | 0.43 |


## ACKNOWLEDGEMENTS

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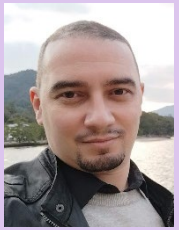


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