

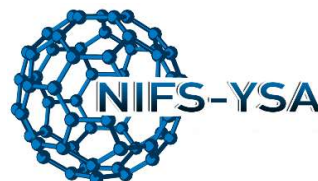
YSCMR 2021

Proceedings of the
**Young Scientists' Conference on
Multidisciplinary Research - 2021**

Virtual International Conference

21st October 2021

“Multidisciplinary Research for Tomorrow’s Challenges”



ISSN 2815-0260

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Published by:

Young Scientists' Association (NIFS-YSA),
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Cover page design & Page setup

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Comparing the effect of P3HT and Spiro-OMeTAD as hole transport material in Sb₂S₃-based solar cells

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Background: The n-i-p structured Sb₂S₃ solar cells are widely developed based on various conditions of fabrication. Generally, these types of solar cells consist of different layers. Even though a high quality of the absorber layer (Sb₂S₃) is synthesized, the compactness of each layer is beneficial to enhance the performance. In this solid-state solar cells, the Hole Transport Material (HTM) is an attractive factor due to the commercialization difficulty of liquid electrolyte solar cells.

Objectives: In this study, Sb₂S₃ solar cells were fabricated with P3HT and Spiro, which were used as HTMs to extract the holes from the absorber to find the effect of HTMs in our system.

Methods: To fabricate the device configuration of FTO/TiO₂/Sb₂S₃/HTM/Ag, a mixture of titanium isopropoxide, butan-1-ol, and 2-ethanolamine and a mixture of SbCl₃, thiourea, and 2-methoxyethanol used to deposit TiO₂ and Sb₂S₃ layers respectively. The P3HT and Spiro solutions were prepared by dissolving 2 mg of P3HT in 100 μ l of chlorobenzene and 3.6 mg of spiro-OMeTAD, 1.4 μ l of 4-tert-butyl pyridine (tBP), and 0.8 μ l LiTFSI solution (520 mg LiTFSI in 1 ml of acetonitrile) in 100 μ l of chlorobenzene respectively. The prepared HTM precursors were spin-coated separately on Sb₂S₃/TiO₂ at 3000 rpm for 30 s and heated on the hotplate at 100 °C for 15 mins.

Results: The power conversion efficiency (PCE) was obtained as $4.11 \pm 0.2\%$ and $4.01 \pm 0.18\%$ for the cell with spiro and P3HT respectively, by the current density (J)-voltage (V) measurements. A good current density (J) was received by Spiro (15.6 mA/cm²) than P3HT (14.05 mA/cm²), which enhanced the PCE. The EQE exhibited a wide range of spectrum for spiro-OMeTAD than P3HT, which was in good agreement with J.

Conclusion: In our system, the photo-generated electron-hole pairs are effectively separated by Spiro-OMeTAD than P3HT. The HTM plays a significant role to improve the PCE of solar device.

Keywords: Efficiency, P3HT, Sb₂S₃, Solid-state, Spiro-OMeTAD

Acknowledgment: financial assistance NRC (No 18-005)