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COMPUTATIONAL ANALYSIS OF EFFICIENCY FOR NON-TOXIC PEROVSKITE SOLAR CELL WITH INORGANIC HTMs

Arnab Das, Ashish B Deoghare

National Institute of Technology, Silchar, India

*Corresponding author

ABSTRACT

The solar cell has emerged as an eco-friendly and cost-effective and a relatively sustainable energy source. In the current scenario the production of the economic and high-power conversion efficiency photovoltaic devices without degradation of materials are desired in larger scale for the generation of electricity. For the manufacturing and production of silicon-based solar cells, sophisticated fabrication techniques are required which makes the solar panel costlier. Manufacturing of photovoltaic film is economical than silicon-based solar cell technologies. Perovskite solar cells utilizing methyl- ammonium lead iodide (CH3NH3PbI3) material is the most favorable replacement of the silicon absorber. But the presence of Lead (Pb) in the cell, makes it toxic in nature. However, methyl-ammonium tin iodide (CH3NH3SnI3) can be used as a replacement. According to the Shockley-Queisser efficiency limit, it is possible to achieve 32 percent of photo-conversion efficiency using perovskites as absorber layer in a solar cell. But still, it is not experimentally possible to achieve. For a better understanding of device characteristics, numerical modeling is invoked. It enables understanding of the device structures. In the present research work, numerical modeling was carried out using SCAPS-1D software for estimating and analyzing the effect of physical parameters such as thickness and defect density of absorber on thperformance of the solar cell. To reduce the degradation caused by organic Hole Transport Material (HTM) Spiro-OMETAD, various inorganic materials are used like Cu2O, CuSCN, CuI, NiO. A comparative study using all these materials has been carried out. Through analysis, it had been found that solar cell performance was affected by variation in absorber thickness and defect density. Based on different device structure modeling, it was found that solar cell with structure (Cu2O/CuI)/CH3NH3SnI3/TiO2/FTO can exhibit an efficiency of 22.5%, which was found to be more than the efficiency with the Spiro-OMETAD HTM cell. The proposed results will give a valuable guideline for the feasible fabrication and designing of high-power conversion efficiency solar cells.

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