Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Internal Webinar

Engineering Hysteresis-Free Carbon-Based Perovskite Solar Cells for Efficient Indoor Applications

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This study systematically investigates performance optimisation, indoor energy harvesting capability, and stability of carbon-based perovskite solar cells (C-PSCs). Initially, hole transport layer (HTL) free $MAPbI_3$ devices employing SnO_2 as the electron transport layer (ETL) showed optimum performance at 0.07 M SnO_2 precursor concentration, attributed to reduced defect density and suppressed recombination, as confirmed by photoluminescence spectra, Electrochemical Impedance Spectroscopy (EIS), and simulations. Further to improve the efficiency Poly(3-hexylthiophene) (P3HT) HTL was used, which improved fill factor in C-PSCs. To address stability and hysteresis issues, CsFAMA ($Cs_{0.05}FA_{0.8}MA_{0.15}Pb(I_{0.85}Br_{0.15})_3$) was explored as an alternative absorber and demonstrated superior efficiency, lower trap density, reduced recombination, lower hysteresis and enhanced moisture resistance compared to $MAPbI_3$. Further interface engineering using a self-assembled monolayer (SAM) (2PACz) effectively minimised hysteresis and enhanced built-in potential, open circuit voltage (V_{OC}), and carrier lifetime. As a result, optimised SAM/P3HT bilayer devices achieved indoor efficiencies of 25% under 1000 lux and 27.8% under low-light intensity of 50 lux warm white LED illumination, highlighting the potential of C-PSCs for indoor energy harvesting under very low light conditions.

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11:00 Hrs