PERFORMANCE OF METAL-FREE ORGANIC DYES WITH COMPLEMENTARY ABSORPTION IN ZINC OXIDE DYE-SENSITIZED SOLAR CELLS

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Ability of low-cost conversion of photovoltaic energy, Dye- Sensitized Solar Cells (DSCs) have achieved important place in research field. Co-sensitization can be used to extend the absorption range and the performance of the device.

In present work, Dye-sensitized solar cells (DSCs) were fabricated using two metal-free organic indoline dyes coded as D131 and D149, with complimentary absorption bands in the visible region, with ZnO mesoporous semiconductor in order to compare the performance of the DSCs sensitized with different dyes/ dye mixtures and identify the most suitable molar ratio to fabricate a high-efficiency solar cell. The thickness of the ZnO mesoporous layer was optimized. Then the optimized ZnO mesoporous electrodes were immersed in (a) D131 dye solution (0.3 mM, in a 1:1 solvent mixture of acetonitrile and tertiary-butyl alcohol) (b) D149 dye solution (0.3 mM, in a 1:1 solvent mixture of acetonitrile and tertiary-butyl alcohol) (c) dye mixture of D131 and D149 (1:1 molar ratio) (d) dye mixture of D131 and D149 (2:1 molar ratio) (e) dye mixture of D131 and D149 (1:2 molar ratio) for 12h. The cell of configuration was FTO/ZnO buffer layer/ZnO mesoporous layer/dye/electrolyte/Pt electrode. The power conversion efficiencies of 3.71%, 3.67%, 4.19%, 3.68% and 3.42% were obtained for ZnO based DSCs sensitized with dyes (under AM 1.5 solar radiation), for D131, D149, dye mixture of D131 and D149 (1:1 molar ratio), dye mixture of D131 and D149 (2:1 molar ratio) and dye mixture of D131 and D149 (1:2 molar ratio) respectively. According to the UV-visible spectroscopic studies, a broad spectrum of radiation has been absorbed by the dyes desorbed from the ZnO electrode which had been immersed in both D131 and D149 (1:1 molar ratio) (370 nm to 570 nm) than individual dyes. Due to the ability of the higher light harvesting of co-sensitized dyes, the corresponding J_{sc} has also been increased (12.23 mA cm^{-2}) than J_{sc} of D131 (11.25 mA cm^{-2}) and J_{sc} of D149 (11.14 mA cm^{-2}). As a result of that the power conversion efficiency of 4.19% has been obtained for DSCs sensitized with both D131 and D149 (1:1 molar ratio). An enhancement of power conversion efficiency has been observed, because of the co-sensitization.