Dye sensitized solar cell application

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Dye-sensitized solar cells (DSSCs) have arisen as a technically and economically credible alternative to the p-n junction photovoltaic devices. In the late 1960s, it was discovered that electricity can be generated through illuminated organic dyes in electrochemical cells.

Dye sensitised solar cells operate as a photoanode (n-DSC), where photocurrent result from electron injection by the sensitized dye. Photocathodes (p-DSCs) operate in an inverse mode compared to the conventional n-DSC, where dye-excitation is followed by rapid electron transfer from a p-type semiconductor to the dye (dye-sensitized hole ...

The dye-sensitized solar cell (DSSC), a molecular solar cell technique, has the potential to generate solar cells for less than $0.5/Wpeak [5]. Researchers and industry professionals around the world have been drawn to DSSCs due to their favorable PCE, low-cost materials, and suitable fabrication techniques.

For indoor and outdoor dye-sensitized studies of solar cells, three novel organic dyes based on anthracene, denoted as 11, 12, and 13 were synthesized by Tsai et al.91. Further, they prepared flexible and rigid modules, as well as small cells, and their PV efficiencies were evaluated.

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Illustration of the factors affecting efficiency of DSSC

The full operating process of DSSCs consists of the following phases.53,54,55,56,57

(i) Excitation of sensitizer (absorption of photonic energy): When sunlight strikes the DSSC, the sensitizer gets excited to a higher energy state [lowest unoccupied molecular orbital (LUMO)] from their ground state [highest occupied molecular orbital (HOMO)] and subsequently produces electrons and holes.

(ii) Injection of electron: The excited sensitizer is oxidized and an electron is inserted into the conduction band (CB) of the semiconductor (TiO2), whereby electrons pass through the thin film of porous TiO2 to the transparent conducting oxide glass substrate to cathode from the anode through an external loop, creating current and completing cycles.

(iii) Regeneration of sensitizer: The redox pairs present in the electrolyte (e.g. iodide and tri-iodide [I- =I3-] redox pairs) donate the electron to oxidized-sensitizer, and thus it gets regenerated.

(iv) Electrochemical reduction: In addition, iodide and the redox mediator in the electrolyte travel to the CE and are regenerated on the cathode by reducing tri-iodide.

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