

DEVELOPMENT OF LOW-COST DYE-SENSITIZED SOLAR CELLS USING ACTIVATED COCONUT SHELL CHARCOAL COUNTER ELECTRODE

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ABSTRACT

The dye-sensitized solar cell (DSC) plays a major role in third generation solar cell devices. Due to its fabrication easiness, comparable low costs with other solar cell fabricating methods and high energy conversion efficiency, the DSCs have been vital on research. The basic structure of DSC consists of transparent conducting oxide (TCO) electrode/ meso porous TiO₂ layer/ dye/ electrolyte/ counter electrode. Platinum (Pt) is widely used as the standard counter electrode (CE) for DSCs. But Pt is the most precious rare material with good catalytic activity which responsible for more than 30% of the total cost of solar cell device. However, the high cost, requirement of high processing temperatures and stability problems in corrosive electrolytes limit the usage of Pt as a CE and demand the discovery of alternative CE materials. Therefore this Pt CE should replace with an abundant material having good catalytic activity, high electrical conductivity and thorough chemical stability with low-cost. Activated coconut shell charcoal (ACSC) is a promising CE material for DSCs due to its excellent conductivity and high catalytic activity.

The TiO₂ working electrode (WE) is prepared by spray pyrolysis technique and it is immersed in a N719 dye solution. This work has been focused on preparation of low cost ACSC CE using doctor-blade coating method with good catalytic activity to replace the standard Pt electrode. The CE is made using ACSC, carboxyl- methylcellulose (CMC) ammonium salt as binder and Triton X-100 as a surfactant. The space between the WE and CE is filled with a liquid electrolyte (I/I₃⁺) and solar cell performance is measured. Under simulated sunlight (AM 1.5 at 100 mW cm⁻²), ACSC CE based DSC showed conversion efficiency of greater than 6% which is comparable efficiency to 8.7% of the cell with the Pt CE at the equal experimental conditions.

Keywords: dye-sensitized solar cell, activated coconut shell charcoal, counter electrode, working electrode.