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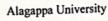
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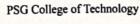














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Enhancing Performance of Dye-Sensitized Solar Cells Using Agricultural Waste-Derived Counter Electrode with Fused Silica

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Dye-Sensitized Solar Cells (DSCs) are a cost-effective alternative to traditional silicon. based solar cells, making them ideal for applications such as building-integrated photovoltaics (BIPV). Although dye-sensitized solar cells have lower efficiency than conventional solar cells, ongoing research focuses on enhancing cost-effectiveness by improving counter electrodes. Replacing expensive platinum (Pt) electrodes with costeffective materials like activated carbon has gained attention due to its high electrocatalytic activity, large surface area, and efficient electron transfer. The integration of fused-silica into activated carbon structures further enhances mechanical stability and surface area, optimizing DSC performance. This study explores a sustainable method for DSC counter electrode fabrication using agricultural waste-derived materials. Fused-silica was extracted from rice husks through washing, acid treatment, and thermal treatment at 600 °C. Additionally, activated Palmyra shell charcoal (APSC) was produced via carbonization and steam activation, followed by fine grinding. A composite counter electrode was prepared by blending APSC with fused-silica and polyvinylpyrrolidone (PVP) in isopropanol, sprayed onto fluorine-doped tin oxide (FTO) glass through spray pyrolysis and sintered at 300 °C. DSCs were assembled using N719 dye-coated TiO₂ photoanodes with 0.20 cm² mask, liquid electrolyte (I/ I3), and prepared composite counter electrode. Then solar cells were evaluated using SPD SS-25 LED solar simulator under AM 1.5 100 mW cm⁻² solar irradiance. After following series of experiments, performance analysis revealed that the APSC:Si (4:1) composite electrode achieved a power conversion efficiency (PCE) of 6.31%, slightly higher than the APSC:Si (5:0) electrode (6.01%), but lower than the Pt-based electrode (7.25%). The enhanced performance of APSC:Si (4:1) is attributed to improved electrical conductivity and electron transfer due to fused-silica. While platinum remains the most efficient option, APSC-based electrodes provide a sustainable, cost-effective alternative, demonstrating the potential of renewable materials in solar energy applications.

Keywords - Dye-sensitized solar cells, Counter electrode, Fused-silica, Activated Palmyra

