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Optimization and performance evaluation of dye-sensitized solar cells using cockscomb flower extract as a natural sensitizer

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Dye-sensitized solar cells (DSSCs) have gained significant interest due to the increasing global demand for sustainable and renewable energy. The use of natural dyes as sensitizers in DSSCs is becoming more popular due to their numerous advantages, including easy availability, non-hazardous nature, and relatively lower costs compared to synthetic dyes. This research focuses on the use of cockscomb flower (*Celosia Cristata*) extract, which contains anthocyanin and betacyanin pigments, as a natural sensitizer for DSSCs to enhance device efficiency while optimizing the dye absorption time. DSSCs were fabricated using a nanocrystalline TiO_2 layer deposited on fluorine-doped tin oxide (FTO) glass via the doctor-blade technique, then sensitized with the cockscomb flower extract. UV-visible spectroscopy analysis of the dye extract showed an absorption peak in the 500-600 nm range, attributed to anthocyanin, betacyanin, or a combination of both. The effects of varying the dye absorption time on the photovoltaic performance were studied and optimized. Key device parameters, including Open Circuit Voltage (V_{OC}), short Circuit Current Density (J_{SC}), Fill Factor (FF), and Efficiency (η) were measured. The highest efficiency of 0.25% was achieved with a photoanode that had been immersed in the dye for 1 hour. The obtained experimental data indicate that the dye extract from the cockscomb flower achieved a photoelectric conversion efficiency of up to 0.25%, with a V_{OC} of 0.55 V, and J_{SC} of 0.88 mA/cm^2.

Keywords: Dye-sensitized solar cell, Natural Dye, Photoanode, Photosensitizer, Photovoltaic characteristics

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