The Effect of Carbon Quantum Dots Derived From Yucca filamentosa on the Photosensitivity of a Dye-Sensitized Solar Cell

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Solar energy has been viewed as a potential clean energy source, but to become widely accepted, solar cells must overcome toxicity and inefficiency - issues that dye-sensitized solar cells (DSSC) can address. DSSCs utilize dyes to capture light energy, a process carbon quantum dots (CQD) can improve through co-sensitization. Hence, researching CQDs derived from new and novel sources such as Yucca Filamentosa contributes towards creating efficient solar cells. The objective of this research was to study the effect of various amounts of Yucca-derived CQD (0.5mL, 1mL, 1.5mL vs 0mL) sintered onto a TiO2 electrode doped with pomegranate juice on the photosensitivity of a co-sensitized DSSC. The research was conducted by subjecting DSSCs with various CQD amounts to a LED source while measuring open-circuit voltage and short-circuit current, as well as Voltage-Current values using different potentiometers. Using these values, the maximum power, fill factor, and efficiency of the solar cells were determined. The 1.5ml CQD group showed the greatest increase (117%) in fill factor followed by the 1ml CQD, and 0.5ml CQD groups, a trend reflected by maximum power and efficiency as well. My hypothesis was supported as the 1.5ml CQD solar cell group exhibited the highest fill factor, maximum power, and efficiency. The results of my experiment demonstrate that Yucca-based CQDs increase photosensitivity of DSSCs through effective electron transfer across the TiO2 band gap. Further improvements include incorporating techniques to layer the CQD material more evenly. Further research includes studying the effects of doping the CQDs with various functional groups.

Awards Won:
Third Award of $1,000