Optimizing Dye-Sensitized Solar Cell Efficiency Through Pre-Extraction Light Intensity Acclimation of Organic Dyes

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Dye-sensitized solar cells (DSSCs) offer solutions to the drawbacks of traditional silicon solar cells. However, research is needed to identify and harness factors that may increase their efficiencies to that of traditional silicon solar cells. Published DSSC research focuses on testing static plant factors, including pigment or plant type. No prior research has manipulated the conditions plants were grown under or experimented with plant acclimation. This research aims to determine if DSSC power efficiency can be increased by using dyes extracted from plants acclimated to low-light conditions. When moved to low-light conditions, many plants acclimate to produce more pigments or optimize their photosystem ratios. It was hypothesized that these plants will absorb light more efficiently as a dye in a DSSC. Spathiphyllum plants were exposed to low light conditions for increments of 12 hours (0 - 84 hours) and extracted as dyes for 8 DSSC experimental groups. DSSCs were constructed, and power was measured over time using a multimeter. Initial results identified the optimal acclimation period as 72 hours under low light conditions prior to extraction. Subsequent testing with a larger sample size found a 13% average increase in power from the 0 hour to 72 hour groups. This supports the hypothesis and suggests Spathiphyllum may acclimate to suboptimal light conditions, enabling increased absorption as a dye. This study reveals plant acclimation mechanisms may be harnessed in DSSCs to boost power output. There are numerous applications of this research to synthetically modify dyes mimicking acclimating structures, a critical step in increasing the efficiency and viability of DSSCs as clean energy solutions.