Comparative Analysis of Plant-Derived Dyes in Dye-Sensitized Solar Cells: Maximizing Energy Production Efficiency

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This project focuses on the development of dye-sensitized organic solar cells, which replicate the process of photosynthesis by using plant-based pigments to capture and convert light energy into electrical power. The motivation for this project was to address energy poverty, which is considered the worst type of poverty by the IEA (International Energy Association). The use of silicon in commercial solar cells is neither natural nor accessible to everyone, so the aim was to create a solar cell that is both sustainable and readily available. To construct the solar cells, different plant-based pigments were tested in conjunction with indium tin oxide and titanium dioxide. The research question was whether different pigments would affect the power output of the solar cells at a given light intensity. The experiment involved measuring the generated power output of each cell, which revealed that the Rattlesnake pigment (dark green chlorophyll) generated the largest output at 10 mV (millivolts) and 9.5 mA (milliamps), calculated to 39.14 mW (milliwatts). The solar cells constructed with the Rattlesnake pigment were then used in electrolysis, which harnessed and stored hydrogen to charge the fuel cell. The light source emission and pigment absorption plots showed significant spectral matching, indicating that the light source produced light in the entire visible spectrum, with the intensity higher for lower wavelengths. Further research will involve testing pigments in direct sunlight and studying the effects of other renewable materials in conjunction with pigments to increase efficiency. This study shows promising results for the development of sustainable, accessible solar cells that can help address energy poverty in underprivileged communities.

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