Fabrication of Natural Dye-Sensitized Solar Cells Using Barbados Cherry Fruit and Purple Shamrock Leaves

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Dye-sensitized solar cells (DSSCs) have received a significant attraction due to their simple structure and low manufacturing cost. Generally, ruthenium-based compounds are used as the effective sensitizers in DSSCs due to their higher absorption and efficient metal-to-ligand charge transfer. However, ruthenium-based compounds are relatively expensive and rare. In recent years, natural dyes have gained attention due to non-toxicity, low cost, environmental friendliness, and availability. In this work, DSSCs were fabricated using natural dyes extracted from Barbados cherry fruit *(Malpighia emarginata)*, and purple shamrock leaves (*Oxalis triangularis)*. These extracted dyes were characterized by UV–VIS absorption spectra and FTIR spectroscopy. The photovoltaic parameters of the DSSC using Barbados cherry dye recorded with a power conversion efficiency of 0.936% along with an open circuit voltage (V_{OC}) of 429 mV, a short circuit current density (J_{SC}) of 4.258 mA cm^{-2} and a fill factor of 0.512. DSSC using purple shamrock leaves recorded as 372 mV of Voc, 1.624 mA cm^{-2} of J_{SC} and a fill factor of 0.561 with a power conversion efficiency of 0.339%. A DSSC formed with a Ruthenium-based dye under the same conditions obtained 588 mV of Voc, 20.120 mA cm^{-2} of J_{SC} and 0.352 fill factor along with 4.162% power conversion efficiency. This research highlights the potential of natural dyes as viable alternatives to ruthenium-based dyes in DSSCs.

Keywords: Barbados cherry *(Malpighia emarginata)*, Dye-sensitized solar cells, Purple shamrock *(Oxalis triangularis)*

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