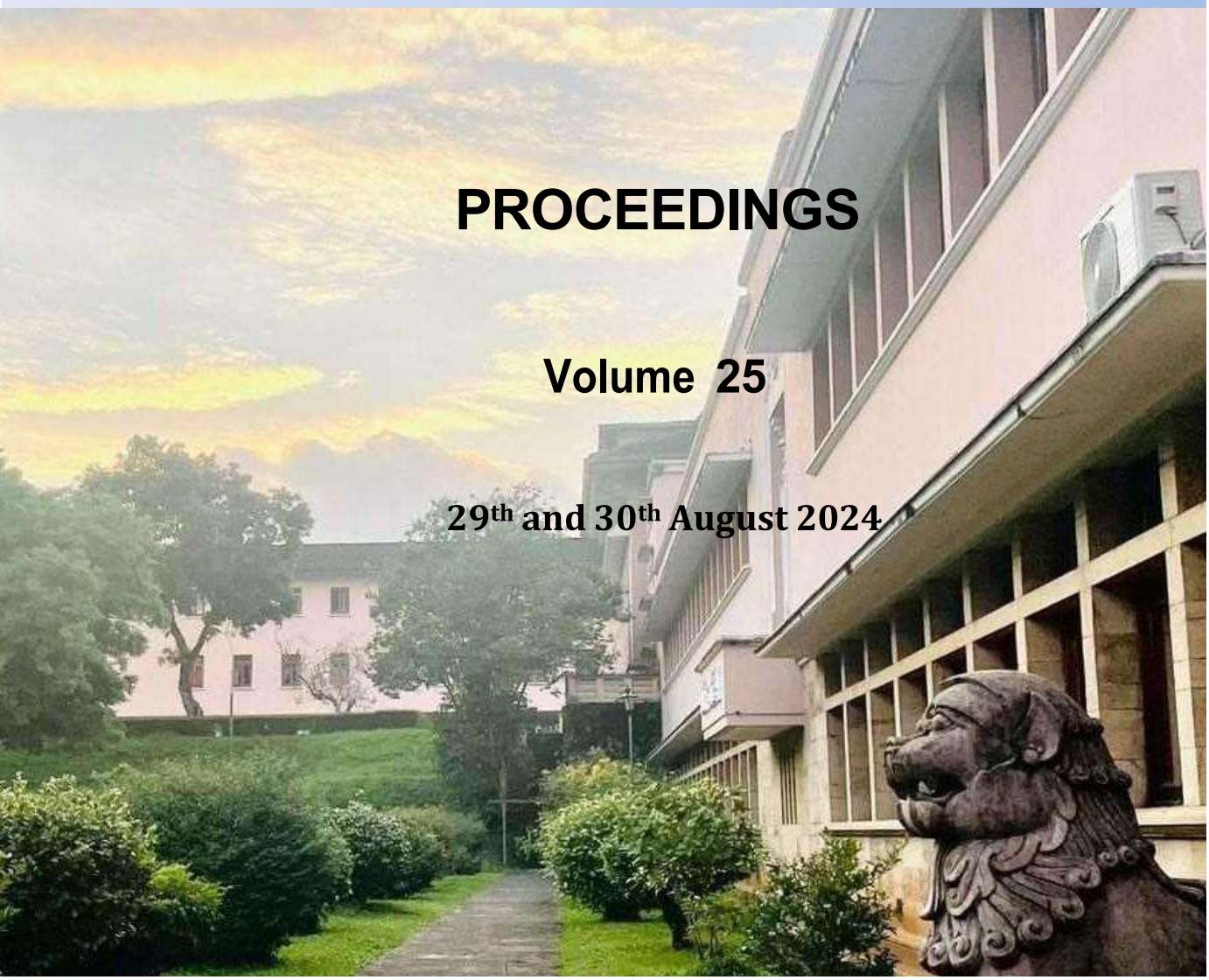
PERADENIYA UNIVERSITY INTERNATIONAL RESEARCH SYMPOSIUM AND EXPOSITION

"A Resilient and Sustainable Sri Lanka: Weaving Together Diverse Threads"



PROCEEDINGS

Volume 25

29th and 30th August 2024

Fabrication of Dye-Sensitized Solar Cells Based on Natural Pigments Extracted from the Mixture of Betel, Areca Nut, and Calcium Carbonate

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Dye-sensitized Solar Cells (DSCs) are emerging as promising alternatives to silicon-based solar cells due to their simplicity, efficiency, and cost-effectiveness. DSCs emulate photosynthesis, with the sensitizer converting absorbed solar photons into energetic electrons. Expensive organic dyes like Ruthenium-based N719 and N3 have traditionally been used, but natural pigments like Chlorophyll and Anthocyanin offer cost-effective alternatives. This study explores natural dyes extracted from betel, areca nut, and calcium carbonate ($CaCO_3$) as sensitizers. 2.5 g each of betel, areca nut, and 1 g of $CaCO_3$ were ground together, added to distilled water and ethanol, and filtered. Red tannin dye and green cocktail dye, which containing a combination of Chlorophylls and tannin, were extracted from the distilled water and ethanol, respectively. DSCs were assembled with dye-absorbed TiO_2 photoanode, prepared by drop-casting on FTO glass plates, a Platinum (Pt) counter electrode, a 0.20 cm^2 window mask, and liquid iodine/iodide (I^-/I_3^-) electrolyte. The cells achieved energy conversion efficiencies of 0.15% (Voc of 0.49 V, Jsc of 0.54 mA/cm^2, FF of 0.56) and 0.29% (Voc of 0.52 V, Jsc of 0.84 mA/cm^2, FF of 0.66) for the tannin and cocktail dyes, respectively, under standard AM 1.5 irradiation. The highest IPCE of ~8% was observed at 350 nm for the tannin dye and ~14% at 355 nm for the cocktail dye. The UV-visible absorption spectra revealed peaks at 242.00 nm for the red dye, and 663.50 nm, 434.00 nm, and 229.00 nm for the cocktail dye, indicating the presence of tannin in the red dye and both Chlorophylls and tannin in the cocktail dye. Notably, cocktail dye showed higher efficiency, while tannin dye showed lower efficiency in DSCs. This study highlights the potential of natural dyes from sustainable materials like betel and areca nut to improve DSC performance, aiming for efficient and eco-friendly solar cell technologies.

Keywords: Betel, Dye-Sensitized Solar Cells, Natural Dye, Photoanode, Platinum