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Effect of Bandgap Vs Electron Tunneling on Photovoltaic Performance of Ringwood (Syzgium Anisatum) Dye-sensitized Solar Cell

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Abstract:

The quest for more energy remains vital to energy sustainability. In the wake of several adverse consequences of indiscriminate combustion of fossil fuel, there is an urgency to exploit our natural environment for ecologically benign alternatives. This search led to *S. anisatum* dye being investigated for its prospective application in dye-sensitized solar cells. Phytochemical screening revealed the presence of phenols, flavonoids, tannins, glycosides, terpenoids and protein, presenting a wide repertoire of chromophore selection for charge transport. UV/VIS spectroscopy showed that *S.anisatum* dye exhibits multiple peak absorbances of radiation within the near ultraviolet and the visible region of the electromagnetic spectrum of light. The consequent adsorption of its chromophores into titanium structure, amplitude of interatomic vibrations of the novel structures formed in *S. anisatum* dye were subject of our investigation. The outcome shows TiO_2/*S.anisatum* dye interface reveals the impact of orientation on output photovoltaic performance of *S.anisatum* dye-sensitized solar cells with a short circuit current of 0.07 mA, open circuit voltage of 68.8 mV, fill factor value of 0.84 and the output efficiency was 0.027 % using KBr electrolyte. This is a comparatively good result considering previous records of dye-sensitized solar cell photovoltaic performance. The significance of these results was re-analyzed from molecular perspective with the aid of scanning electron microscopy (SEM). A need to boost the efficiency necessitated the interpretation of SEM micrographs using Gwwydion software program. These presented possible areas for charge transport within the electron shells of *S.anisatum* dye nanocomposite, and regions where tunneling occurred providing a much needed insight for future studies. Consequently, this study was expanded to accommodate the influence of bandgap on electron occupancy in *S.anisatum* shells. This elucidation captures the molecular dynamics of charge transport versus tunneling, consequent upon output performance of dyesensitized solar cell technology explained with quantum principles. The application of this work is particularly relevant in modelling, photovoltaic simulations and building energy efficient models.

Keywords:

- Bandgap
- Energy Efficiency
- Energy Harvesting
- Electron Tunneling

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