

Development of Dye-Sensitized Solar Cells using Algal-based Natural Dyes for Climate Change Mitigation

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MOTIVATION

- Generating traditional or conventional energy from fossil fuels emit greenhouse gases and cause different types of pollution resulting in 7 million deaths/yr as per WHO.
- Mining and Dumping due to energy production and consumption causes destruction of natural ecosystems and reduced protection from natural calamities.
- Minerals required for Renewable Energy alternatives are non-abundant in nature and majority non-native to Bharat making us dependent on imported fuels and crucial minerals for energy production totaling to above 80% energy import for Bharat.
- Traditional Solar entities have high water print, hazardous production and recycling in comparison to eco friendly Dye sensitized solar cells (DSSCs) developed with natural dye.

Working Mechanism of DSSC

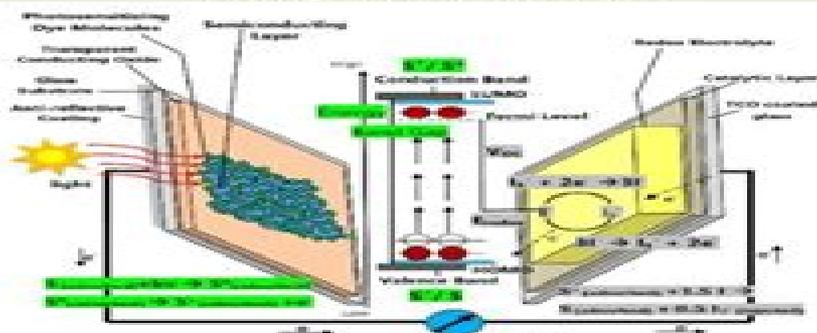


Fig. 1. A schematic Energy band diagram of DSSC operational components

Objectives

- Screening and selection of Algal species based on various process parameters.
- Fabrication/ Development of algal dye based DSSC and characterization.

Methodology

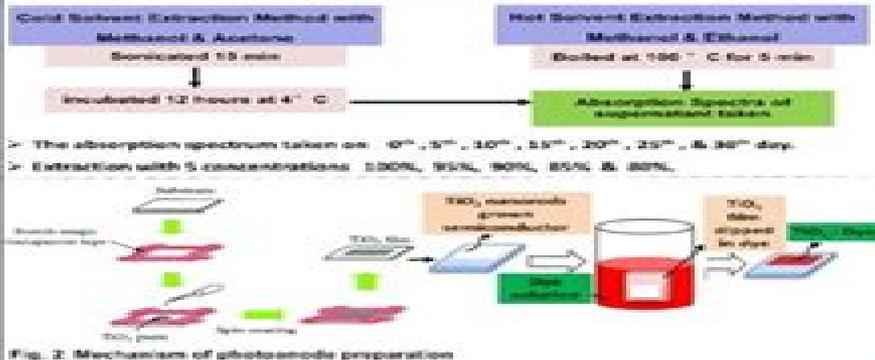


Fig. 2. Mechanism of photoanode preparation

Results

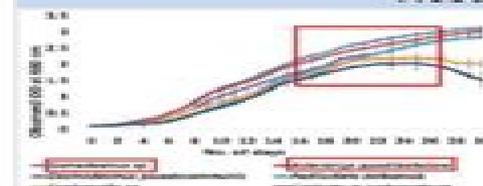


Table 1. Chlorophyll conc. (mg/L) in algal species.

Species Name	10 th day	20 th day	30 th day
Scenedesmus	42.64	77.89	84.47
Asteranocys	47.77	88.83	170.98
Scenedesmus	58.88	71.87	86.70
Pseudocostatum	12.89	18.81	19.88
Scenedesmus	34.21	54.54	65.58
Pseudocostatum	11.24	16.24	17.88

Fig. 3. OD based algal species growth pattern.

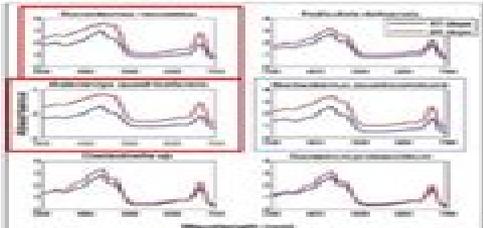


Fig. 4. Absorption spectrum of algal species

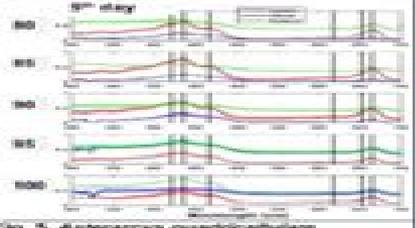


Fig. 5. Asteranocys quadricellulare absorption spectrum with various solvents

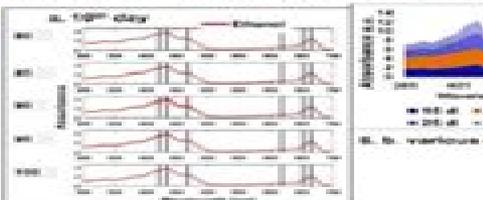


Fig. 6. Asteranocys quadricellulare absorption spectrum with various ethanol concentrations

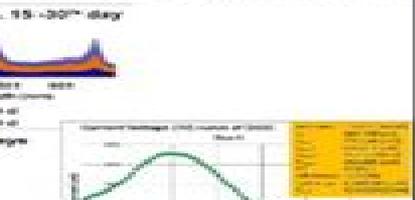


Fig. 7. Fabricated DSSC performance plot

Conclusions

- Algal species screened according to their growth, chlorophyll content & absorption spectrum rate w.r.t. efficient solvent concentrations.
- Asteranocys quadricellulare & Scenedesmus roseoventris have a better combination of test results on 20th & 15th day.
- DSSC efficiency matched well with dye fabrication process & dye's spectral efficiency.

Acknowledgement

We acknowledge EPSC for granting financial support, and appreciate IIT and IIT Indore for providing research facilities.

References

Chauhan, R. (2022). Screening prevalent technologies to promote scalable devising of DSSCs: An emphasis on dye component production with a shift to ambient algal dyes. Inorganic Chemistry Communications, 139, 109046.

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W. F. Berg



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