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TITLE:

Extraction of Natural Dye from Plants Petal (Roses and Melastoma) for DSSC Application

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AUTHOR'S DECLARATION

ABSTRACT

Dye-Sensitized Solar Cells, or DSSCs, are an affordable and environmentally friendly alternative to silicon-based solar cells that use a photosensitive dye to absorb sunlight to generate electrons, which are transferred via semiconductor (commonly TiO2) to create direct current electricity while the dye is regenerated by a redox electrolyte. Although challenges like long-term stability and efficiency improvements remain, DSSCs are attractive options for realizing sustainable energy generation due to its simple fabrication processes, low-light operability, and flexible, transparent prospects. The present study in quest of best water-extracting methodology from these plant sources, details comparison on perspective of light harvesting, transporter and overall photovoltaic achievement for DSSC applications. These insights are necessary to enhance the green and sustainable deployment of solar energy tech using natural dyes in DSSCs.

This examination focused on four different plant types for the extraction process, which were dried roses, fresh roses, dried melastoma and fresh melastoma. For extraction, distilled water was used as a solvent under controlled conditions, with a temperature of 50°C and an extraction time of 1 day up to 3 days. The main objective of this study are to determine the best plant type and most desired extraction time to obtain the conductivity results based on the extraction process.Based on thre findings Higher temperatures and longer extraction times improved dye yield but sometimes led to color degradation and the extraction efficiency varied between Senduduk and rose, with Senduduk exhibiting a higher dye yield due to its rich anthocyanin and flavonoid content. This study concludes that melastoma provides a more effective natural dye source than roses when extracted using water. Waterbased extraction is a sustainable and eco-friendly method for obtaining natural dyes from plant waste.

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Introduction 1.1 Background of Study

Study on dye-sensitized solar cells have captivated much attention recently, primarily due to their low cost of manufacturing, easy fabrication and high conversion efficiency. Difficulties associated with the way of handling environmental concerns have prevail researchers worldwide on exploring the alternative green sources of dye extracts from plant parts like roots, bark, leaves, flowers, and fruits. Natural dye-sensitized solar cells (N-DSSCs) transfered using natural dye extracts of fruits, vegetables and flowers have taken quick strides in recent times. The advantages of natural dyes over synthetic ones include their plentiful availability, easily extracted using organic solvents which away cheaper, environmental friendly fabrication and fully biodegradable. Research in N-DSSCs is still in its newly era. Moreover, low efficiency of DSSCs when sensitized with green dyes as compared to that of synthetic dyes presents huge scope for the search of new and efficient dye sensitizers. Reports exist on improvement in the efficiency of DSSCs to a great proportions using dye mixtures, increased dye concentration and different extracting

(**Performance of fruit extract of *Melastoma malabathricum* L. as sensitizer in DSSCs** Lakshmi K. Singh, T. Karlo, A. Pandey)

Due to their toxicity, metal complexes in cell design and the sustainability implications for further rapid proliferation provide the most problems. The dyes are taken from bionatural sources such plant flowers, fruits, bark, petals, roots, leaves, and beans in order to get around the issues with metal complexes. These organic dyes are widely applicable for DSSC since they are nontoxic, economical, plentiful, eco-friendly, and simple to extract.

(**Performance enhancement of dye-sensitized solar cells via cosensitization of euthanized Z907 and organic sensitizer SQ2 ,** M. Younas, M.A. Gondal, U. Mehmood, K. Harrabi, Z.H. Yamani, F.A. Al-Sulaiman)

One alternative to fossil fuels is to use renewable energy sources, such as solar energy. This is due to the fact that solar energy is among the most environmentally friendly, abundant, and sustainable energy sources. Since the sun is the main source of solar energy, it can produce valuable, efficient, and clean energy. Solar energy utilization has quickly spread to a number of industries, including the environment. Furthermore, modern technology makes it possible to convert sunlight into power more effectively and efficiently. Dye-sensitized solar cells (DSSC) and photodegradation processes are two examples of advanced applications that have drawn interest due to their potential to solve environmental and energy-related issues.

A form of photovoltaic technology called dye-sensitized solar cells (DSSC) uses dye from flowers or leaves as sensitizers to absorb solar radiation and turn it into electrical energy. Like chlorophyll, dyes act as sensitizers by collecting sunlight, starting an electron transfer, and producing an electrical current. The low cost, mechanical flexibility, ease of fabrication and assembly, and environmental friendliness of DSSC have drawn attention. According to the theoretical and empirical data, the highest conversion energy efficiency that may be achieved is 32% and 13%, respectively. (Snaith, 2010, Mathew et al, 2014).

1.2 Literature Review

1.2.1 Plant Waste as a Source of Natural Dyes for DSSC

ROSE

The dye from natural plants has been traced a long time ago. In India, 450 plants were found to be good sources of natural dye. For the extraction of natural dye different plant parts are used such as seeds, flowers, leaves, and barks. In the present study, an alternative dyeyielding plant red rose flower was studied for its potential for obtaining natural dye. The red rose is one of the most attractive and cut flowers which is mainly used as an ornamental flower and it really suitable for a dye source. **(Extraction of natural dye from rose flower for dyeing cotton fabrics, August 2016 , Dhairyasheel Bajarang Patil , Shivaji University)**

The red rose (Rosa centifolia) is one of the most important ornamental plants mainly growing in gardens and is rich in red and pink colors. In the present study, the dyeing pigments present in the petals of red rose were extracted by using aqueous methods. The physical properties (pH, specific gravity, viscosity) of the selected dye solution were determined by using respective types of equipment. The four different mordants were used to isolate dye on cotton yarns by the together-mordanting method. The results revealed that different shades of pink and bluish color were obtained from the dye when subjected to mordant. On dyed cotton, the together-mordanting method gave an attractive and uniform color **(Thu Zhar Tant & Patil,**
D.B. K.N. Patil, P.V. Gaikwad, P.J. Patil, U.L. Shewale and S.B. Bhamburdekar, (2016) "Extraction of natural dyes from rose flower for dying cotton fabrics", International Journal for Innovative Research in Multidisciplinary Field, ISSN – 2455-0620, Vol. 2, Issue-8)

MELASTOMA

Natural dyes are plant-sourced materials derived from flower, fruit, and leaves, which are sustainable, biodegradable, and abundant, making them suitable for utilization on dyesensitized solar cells (DSSCs). There are colored dyes, which have pigments such as anthocyanins, carotenoids, and chlorophylls, which effectively absorb light in the visible spectrum. Anthocyanins among them, is very effective owing to intense absorption of the light and capacity to interface with semiconductor materials like titanium dioxide (TiO2) The extraction process has a great impact on the performance of natural dyes in DSSCs. Common methods of extraction use water, as they are easy and environmentally safe. The concentration and stability of the pigments are highly influenced by factors such as extraction duration, as well as fresh or dried material. As example pigments derived from the flowers of Lantana repens and Solidago canadensis were studied, showing the effect of chemical composition on light harvesting, with conversion efficiencies of 0.13% and 0.12% respectively. Natural dyes are known to be eco-friendly, but their low conductivity and stability are challenging. Doping and extraction efficiency optimization are effective at improving DSSCs durability and efficiency.