UNIVERSITI TEKNOLOGI MARA
CAWANGAN PULAU PINANG

SYNERGISTIC EFFECT OF ZN-ANTHOCYANIN ORGANIC DYE MOLECULES SENSITIZER FOR DSSCS

WAN AKMAL FEISAL BIN WAN AIZAL RASHIDIN

BACHELOR OF ENGINEERING (HONS) ELECTRICAL AND ELECTRONIC ENGINEERING

February 2025

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Wan Akmal Feisal Bin Wan Aizal Rashidin
Student I.D. No.	:	202112
Programme	:	Bachelor of Engineering (Hons.) Electrical and Electronic Engineering (CEEE200)
Faculty	:	Electrical Engineering Studies
Thesis	:	Synergistic Effect of Zn-Anthocyanin Organic Dye Molecules Sensitizer for DSSCs
Signature of Student	:	....
Date	:	February 2025

ABSTRACT

Dye-sensitized solar cells are attracting considerable attention for their capacity to convert sunlight into power. They do this by employing dye molecules to absorb light and linking them to distinctive materials referred to as wide-bandgap semiconductors. To solve this problem, in addressing the critical issue of poor dye attachment to the semiconductor surface, which negatively impacts both functionality and stability. This work investigated Zn (SO4)-hydrate as a prospective additional dye for the treatment of dyes utilised in dye-sensitized solar cells (DSSCs). The research investigated the properties of the anthocyanin-based dye molecule sensitiser sourced from blackberry (R. fructus) with different concentrations of ZnSO4 additive (Zn-Ant dye molecules) that resulted in the optimal power conversion efficiency (PCE). The FESEM, EDS, FTIR, UV-Visible Spectroscopy, I-V, and IPCE analyses were performed to investigate the DSSC cells and their constituents for diverse features, encompassing structure, chemistry, and electrical characteristics. The results revealed that the 0.8-Zn-Ant cell achieved the best photovoltaic efficiency of approximately 0.58%, whereas the untreated 0-Zn-Ant cell exhibited a significantly lower efficiency of 0.13%. The solar efficiency of the 0.8-Zn-Ant cells is superior to that of the other Zn-treated cells analysed in this work. The incorporation of $ZnSO_4$ can substantially enhance photovoltaics by elevating the sensitiser pH via protonation. This technique enhances anthocyanin photocatalytic activity and conductivity, while simultaneously reducing interfacial resistance. Consequently, electron transport is augmented, recombination losses are reduced, and solar absorption is optimised, facilitating more efficient use of photon energy.

ACKNOWLEDGEMENT

First, I would like to extend my gratitude to all those who helped me in completing this final year project. Then, I would like to thank my supervisor, Dr. Mohd Hanapiah Abdullah, for his great help, smart ideas, and useful feedback during this research. Their knowledge and support have been very important for my progress. I could not have done this project without using the chemical laboratory. I sincerely thank senior student Muhammad Safwan Mohd Shukri for teaching me important lab processes and the lab technician for getting the equipment and procedures ready.

I am also thankful to the Faculty of Electrical Engineering at UiTM for giving me the resources and support I needed, and to my friends for their ideas, views, and encouragement that helped me on this journey. Finally, my deepest gratitude goes to my parents for their unwavering support, motivation, and belief in me. Their guidance has been the foundation of my growth and the successful completion of this project.

TABLE OF CONTENTS