

**UNIVERSITI TEKNOLOGI MARA  
CAWANGAN PULAU PINANG**

**RENEWABLE ENERGY SOURCE  
USING NATURAL DYE  
MOLECULAR FOR DYE-  
SENSITIZED SOLAR CELLS  
EXTRACTED FROM DRAGON  
FRUIT AND POMEGRANATE**

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## **AUTHOR'S DECLARATION**

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

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## ABSTRACT

Dye-sensitized solar cell (DSSC) is a new class of green photovoltaic cell based on photosynthesis principle in nature. DSSCs can be fabricated using different type of dyes as sensitizers which extracted from the nature and our life, such as flowers, leaves, fruits, traditional Chinese medicines, and beverages. In this project, Dragon fruit or the scientific name is *Hylocereus Undatus*, and Pomegranate with the scientific name of *Punica Granatum* were analyzed and tested for natural dye sensitizer. The natural dye extracts from these dye sensitizer were characterized Ultraviolet Visible spectroscopy and Fourier Transform Infrared (FTIR) techniques. Three different DSSCs were fabricated using these dyes along with the mixed (co-sensitize) molecular dye sensitizer. The combination of the pomegranate dye and dragon fruit dye have a highest peak of UV-Vis absorption spectra which is 534.34 nm wavelength that was recorded by UV-Vis spectrophotometer. The FTIR technique can show the chemical compound that contain in the dyes. The range between  $3000\text{ cm}^{-1}$  to  $3500\text{ cm}^{-1}$  show the Intermolecular H-bond and sharp absorption between  $1600\text{ cm}^{-1}$  to  $1700\text{ cm}^{-1}$  shows the C=O conjugate vibration. The C-O-C stretching vibration of esters acetates was found at range  $900\text{ cm}^{-1}$  to  $1100\text{ cm}^{-1}$ . The three peak that have recorded in the FTIR spectroscopy is, first peak is from  $3244.04\text{ cm}^{-1}$  to  $3252.21\text{ cm}^{-1}$  wavenumber, second peak is from  $1629.97\text{ cm}^{-1}$  to  $1638.14\text{ cm}^{-1}$  wavenumber, and the last peak is from  $1033.37\text{ cm}^{-1}$  to  $1061.97\text{ cm}^{-1}$  wavenumber. Based on all of the result that obtain from, the anthocyanins properties are exist instead exist of carbonyl and hydroxyl group. The performance of all the three natural dyes as sensitizers in DSSC was calculated by open circuit voltage ( $V_{oc}$ ), short circuit current density ( $J_{sc}$ ), energy conversion efficiency ( $\eta$ ), and fill factor (FF). The highest open-circuit voltage ( $V_{oc}$ ) is 0.65 V, the fill factor (FF) is 0.58, the power conversion efficiency ( $\eta$ ) is 0.46% and the short circuit photocurrent densities ( $J_{sc}$ ) is  $1.22\text{ mA/cm}^2$  of the mixed dyed cell that were measured using solar simulator, respectively.

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