

Electrochemical properties of natural sensitizer from *Garcinia mangostana* and *Archidendron pauciflorum* pericarps for Dye Sensitized Solar Cell (DSSC) application

ABSTRACT

Dye-sensitized solar cells (DSSC) create imitation photosynthesis by using chemical reactions to produce electricity from sunlight. DSSC has been pursued in numerous studies due to its capability to achieve efficiencies of up to 15% with artificial photosensitizer in diffuse light. However, artificial photosensitizers present a limitation because of the complex processing of metal compound. Therefore, various types of sensitizers were developed and synthesized to surpass the artificial sensitizer performances such as natural sensitizers from bio-based materials including plants, due to simple processing techniques and low environmental impact. Thus, this study examines the potential and properties of natural sensitizers from the waste of bio-based materials from *Garcinia mangostana* (mangosteen fruit) and *Archidendron pauciflorum* (jering fruit). Both fruits pericarps have dark color pigments as dark purple and dark brown, respectively, which promise a good absorption and has potential to be used as sensitizer for DSSC. Each pericarps dye extracted using cold extraction method in methanol solvent. Electrochemical properties and photovoltaic properties of the natural photosensitizers were studied. The highest peaks of photoluminescence spectra of mangosteen and jering sensitizers were at 490 and 670 nm, respectively, due to their different types of dye pigment extracted. We also obtained the absorption spectra for both mangosteen and jering sensitizers at 380-500 and 400-600 nm, respectively, in blue shift behavior. The redox reaction was also studied using cyclic voltammetry and identify their energy levels. The DSSC device with mangosteen sensitizer achieved an efficiency of 0.38% with 35.43% (IPCE at 337 nm) and 37.75 Ω (R_s), whereas that with jering sensitizer has efficiency of 0.07% with 25.31% (IPCE at 337 nm) and 490.70 Ω (R_s). Performance studies for both photosensitizers were weak due to their HOMO-LUMO levels, but the results show that both natural dyes can be potentially applied as photosensitizer in DSSC.

Keyword: Absorption; DSSC; Efficiency; Natural dye; Photosensitizer