

Utilization of natural dyes from *Zingiber officinale* leaves and *Clitoria ternatea* flowers to prepare new photosensitisers for dye-sensitised solar cells

ABSTRACT

Chlorophyll and ternatin were extracted from *Zingiber officinale* leaves and *Clitoria ternatea* flowers respectively. These natural dyes were applied as sensitisers in TiO₂-based dye-sensitised solar cells (DSSCs). Among 10 different solvents, the ethanol extracts revealed the highest absorption spectra of natural dyes extracted from *Z. officinale* and *C. ternatea*. A major effect of temperature increase was the increased extraction yield. High chlorophyll and ternatin yields were obtained under extraction temperatures of 80 °C and 70 °C, respectively. A notable decrease in *C. ternatea* dye concentration at temperatures >70 °C was also observed. High dye concentrations were obtained using acidic extraction solutions, particularly those with a pH value of 4. Experimental results showed that the DSSC fabricated with chlorophyll extracted from *Z. officinale* leaves exhibited a conversion efficiency of 0.30%, open-circuit voltage (V_{oc}) of 0.56 V, short-circuit current (I_{sc}) of 0.8 mA/cm⁻² and fill factor (FF) of 57.93%. The DSSC sensitized with ternatin from *C. ternatea* flowers displayed a conversion efficiency of 0.13%, V_{oc} of 0.54 V, I_{sc} of 0.3 mA/cm⁻² and FF of 81.82%.

Keyword: DSSC; *Zingiber officinale*; *Clitoria ternatea*; Natural dyes; Chlorophyll; Ternatin