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 (Voc) of 0.56 V, short-circuit current (Isc) 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%, Voc of 0.54 V, Isc of 0.3 mA/cm−2 and FF of 81.82%.

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