

ENHANCING DSSC PERFORMANCE THROUGH CHLOROPHYLL AND PORPHYRIN DYE INCORPORATION ON TiO₂-ZnO: AL COMPOSITES

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Abstract. This research systematically investigates the impact of porphyrin and chlorophyll dyes derived from *Syzygium Paniculatum* on Dye-Sensitized Solar Cells (DSSC) performance, aiming to achieve maximum solar cell efficiency. This investigation involved the use of Fluorine-doped Tin Oxide (FTO) coating with TiO₂-ZnO composite, incorporating Al doping, and introducing variations in the concentration of chlorophyll SP and porphyrin (2:2:0.1 and 2:2:0.2). Synthesis of Al-doped ZnO was carried out via the sol-gel method, which involves mixing and heating at 65°C, followed by degradation at 150°C. TiO₂ and ZnO: Al composites were formed using the sonication method at 45°C for 60 minutes. This study evaluates the impact of dyes on the growth of TiO₂ and ZnO: Al composites, DSSC efficiency, and solar cell characteristics using EDX and FTIR. DSSC efficiency testing utilizes a photon light source from a halogen lamp. The results showed that DSSC based on TiO₂ – ZnO: Al + chlorophyll produced an efficiency of 13.32%, while porphyrin (2:2:0.1) and (2:2:0.2) produced an efficiency of 8.91% and 13.95%, respectively. In conclusion, this study shows that adding dye to the TiO₂ - ZnO: Al composite significantly improves DSSC performance and shows optimal characteristics. The highest DSSC efficiency of 13.95% underscores the interdependence of absorber layer quality with photovoltaic performance, providing valuable insights for future solar cell design and optimization.

Keywords: TiO₂ and ZnO FTO, porphyrin, *Syzygium Paniculatum*, ZnO with Al doping.