

Synergistic impact of magnesium compound as a potential dye additive for organic-based sensitizer in DSSCs

Abstract

This study investigates the MgSO₄ salt compound as the dye additive for dye treatment in dye-sensitized solar cells (DSSCs). The properties of the chlorophyll-based dye molecule sensitizer extracted from *Mitragyna speciosa* (MS) under the treatment of MgSO₄ additive that contributed to the highest power conversion efficiency, PCE were examined. Field emission scanning electron micrograph, FESEM, X-ray diffraction, XRD, Fourier transform-IR, FTIR, UV-Vis spectroscopy, current to voltage characteristics, I-V and incidence photon to current efficiency, IPCE were used to investigate the structural, optical, chemical and also the electrical properties of the DSSC cells and their components. It was discovered that the extracted MS dye contained chlorophyll pigment, a powerful light-harvesting pigment required for the production of charge transfer and electricity. The MgSO₄-treated dye provides stable pH conditions, faster electron injection due to higher band energy, E_g position, higher dye molecules adsorption, and reduced back recombination of electrons in the fabricated DSSC. As a result, all of the treated MgSO₄ dye cell DSSCs outperformed the untreated dye cell, and at their optimal dye additive of 0.3 g (3-TM), the DSSC's current density, J_{SC}, and associated PCE were higher at 2.08 mA/cm² and 0.39%, respectively. Thus, using MS as a dye sensitizer in conjunction with an optimized MgSO₄ compound as an additive resulted in improved photovoltaic effects, increased solar light absorption, and improved photon energy utilization.

Keywords

DSSCs; Light-harvesting; MgSO₄ compound additive; Photovoltaic conversion efficiency