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OPTIMIZATION OF EFFICIENCY IN DYE-SENSITIZED SOLAR CELLS BY THE INFUSION OF GRAPHENE TO PHOTOANODE

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This research studies the influence of added graphene on the structure and performance of Dye-Sensitized Solar Cell (DSSC) photoelectrodes. For this purpose, a series of TiO_2 multi-layer photoelectrodes were fabricated by infusing graphene into each layer at a time to all six layers. A colloidal paste prepared by mixing TiO_2 nanoparticles (13 nm) and 0.1 M HNO_3 was spin-coated on a clean FTO glass substrate to prepare the layered photoanodes. Graphene (Sigma-Aldrich) at 1 w% in relation to the TiO_2 was added to the colloidal suspension to prepare the graphene-added Nanocomposite layers of the multilayer photoelectrodes. The TiO_2 electrodes were sensitized with dye N719 and were combined with the Pt counter electrode and polyiodide-based electrolyte to assemble DSSCs. The results indicate that the efficiency of cells depends on the layer to which graphene has been incorporated out of the six layers in graphene-doped TiO_2 photoelectrode. The graphene-doped photoelectrodes efficiency rise with the increase in the layer number which graphene doped and reaches the maximum value at the fourth layer. When graphene was added to the fourth layer, DSSC showed the best performance with the largest photoelectric power conversion efficiency of 6.99%, resulting in a 19.52% enhancement compared to the undoped photoelectrode-based DSSC (5.85%). The high transparency and conductivity of graphene significantly enhance the photoelectric power conversion properties of DSSCs. This enhancement occurs by improving the light scattering and conductivity of the TiO_2 layers and the electron transfer process from the dye molecule to the surface of the TiO_2 layer. However, the study continues to investigate the correct mechanism.

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Keywords: DSSC, Graphene-TiO_2 layers, Light harvesting, Multi-layer photoelectrode.