Graphite-Assisted Copper Electroplated Bilayer Counter Electrodes on Flexible Polyethylene Terephthalate Substrate for High-Efficiency Dye-Sensitized Solar Cells

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Abstract

As potential low-cost solar cells for the upcoming generation of photovoltaic technology, Dye-sensitized solar cells (DSSCs) have emerged as a promising alternative for photovoltaic research. The photovoltaic performance with long-term stability is largely influenced by the counter electrode used in the DSSC solar cell. Research on dye-sensitized solar cells has been the main emphasis for replacing costly platinum counter electrodes. A cost-effective, flexible substrate, such as PET coated with a conductive surface, offers a large surface area that facilitates the redox reaction by collecting electrons easily. Herein, we report *Dye-Sensitized Solar Cells (DSSCs)* based on Graphite assisted with copper electroplated bilayer counter electrodes on polyethylene terephthalate (PET) substrate. A device assembly with a hierarchical architecture, comprising FTO/TiO_2 (ETL)/graphite-assisted electroplated copper, was fabricated for experimental investigation. Natural dyes were extracted from Hibiscus flower in an ethanol medium, which acts as a natural sensitizer in the DSSC. A quasi-solid-state electrolyte prepared with iodide/tri-iodide within a cellulose base medium was employed as redox charge transport medium. The as-prepared sample was characterized using various analytical tools to explore Light absorption properties, surface morphology and structural properties via ultraviolet–visible, field emission scanning electron microscopy, and X-ray diffraction analyses, respectively. Furthermore, the solar cell sample was tested under AM 1.5 G solar illumination to envisage photovoltaic performance. The as-prepared solar device hierarchical architecture, comprising graphite assisted by an electroplated copper layer, shows a PCE of 3%, which is almost 150% higher than that of a graphite counter electrode without a copper layer.

Keywords

DSSC solar cell, flexible counter electrode, nanomaterial, thin film synthesis.