

A three-electrode integrated photo-supercapacitor utilizing graphene-based intermediate bifunctional electrode

ABSTRACT

A dye-sensitized solar cell (DSSC) employing a compact and mesoporous titania (TiO₂) film as the anode was integrated with a symmetrical supercapacitor utilizing polypyrrole/reduced graphene oxide (PPy/rGO) electrodes to form a photo-supercapacitor. The double-sided-electrodeposited PPy/rGO material served as an intermediate electrode which was bifunctional in nature; acting as a counter electrode for the DSSC to permit electrolyte regeneration, and also as an electrode for the supercapacitor. The isolated DSSC and supercapacitor were characterized before the integration, and the power conversion efficiency (PCE) of the DSSC was 2.4%, while the specific capacitance of the supercapacitor was 308.1 F/g. The performance of the integrated photo-supercapacitor was tested under a light illumination of 100 mW/cm². By using a single PPy/rGO electrode at the cell/supercapacitor interface, an extended lifetime was achieved with up to 50 charge/discharge cycles. The photo-supercapacitor possessed a specific capacitance of 124.7 F g⁻¹, and a retention percentage of 70.9% was obtained after 50 consecutive charge/discharge cycles.

Keyword: Integrated photo-supercapacitor; Dye-sensitized solar cell; Titania; Graphene