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The photovoltaic efficiency of the fabrication of copolymer P3HT:PCBM on different thickness nano-anatase titania as solar cell

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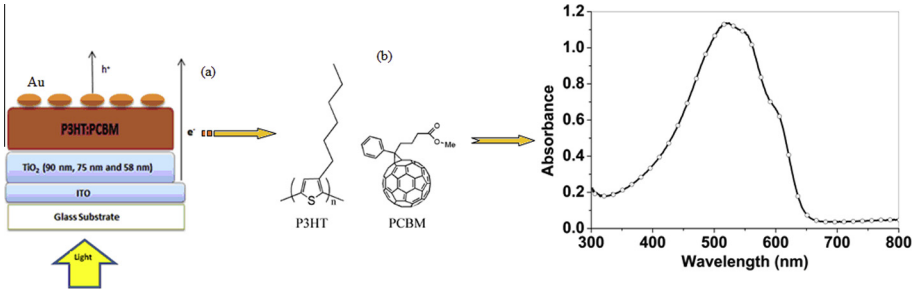
HIGHLIGHTS

- A transparent optically smooth and homogeneous titanium dioxide (TiO_2) films were prepared by the spin coating method.
- X-ray diffraction pattern of TiO_2 films indicate that TiO_2 is anatase phase.
- Films surface is more rough by increasing thickness to 90 nm with respect to the film of 58 nm in thickness.
- The optical band gap of the films has been found to be in the range 3.63–3.96 eV for allowed direct transition.
- Three films are suitable for applications in P3HT:PCBM bulk heterojunction (BHJ) solar cells.

GRAPHICAL ABSTRACT

Schematic demonstration of ITO/TiO_2 (different thickness/P3HT:PCBM/Au) bulk hetero junction PV device (a) and Chemical formula of P3HT and PCBM (b) and absorption spectra of P3HT:PCBM films.



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ABSTRACT

Organic solar cells based on (3-hexylthiophene):[6,6]-phenyl C61-butyric acid methylester (P3HT:PCBM) bulk heterojunction (BHJ) with an inverted structure have been fabricated using nano-anatase crystalline titanium dioxide (TiO_2) as their electron transport layer, which was prepared on the indium tin oxide coated glass (ITO–glass), silicon wafer and glass substrates by sol–gel method at different spin speed by using spin-coating (1000, 2000 and 3000 rpm) for nano-thin film 58, 75 and 90 nm respectively. The effect of thickness on the surface morphology and optical properties of TiO_2 layer were investigated by atomic force microscopy (AFM), X-ray diffraction and UV–visible spectrophotometer. The optical band gap of the films has been found to be in the range 3.63–3.96 eV for allowed direct transition and to be in the range 3.23–3.69 eV for forbidden direct transition to the different TiO_2 thickness. The samples were examined to feature current and voltages darkness and light extraction efficiency of the solar cell where they were getting the highest open-circuit voltage, V_{oc}, and power conversion efficiency were 0.66% and 0.39% fabricated with 90 nm respectively.

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Introduction

With a steady improvement in energy conversion efficiency during the past decades, organic photovoltaic (OPV) has evolved into a promising technology for renewable energy made possible by the first report of planar donor–acceptor heterojunction. Organic bulk heterojunction (BHJ-OPV) photovoltaics are solar cells that employ organic materials, either polymers (macromolecules) or small molecules, to absorb light and produce free electrons [1,2]. The most promising BHJ-OPV devices to date consist of conjugated polymers, such as poly (3-hexylthiophene)

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