

Morphological and electrical characterization of hybrid thin-film composed of titania nanocrystals, Poly (3-hexylthiophene) and Piper Betle Linn

ABSTRACT

In this research, the effect of scan numbers of titania nanocrystals (TiO₂ NCs) on the morphological and electrical characteristics of hybrid thin-films is investigated. These hybrid thin-films consist of a combination of organic (Piper Betle Linn extraction and Poly (3-hexylthiophene) (P3HT)) and inorganic TiO₂ NCs (anatase structure) materials. These hybrid thin-films are fabricated in bilayer heterojunction of ITO/TiO₂ NCs/P3HT/Piper Betle Linn via electrochemistry method using Electrochemical Impedance Spectroscopy (EIS). The scan numbers of TiO₂ NCs are varied by 1, 3 and 5 number of scans. The morphological characterization is carried out via Field Emission Scanning Electron Microscopy (FESEM) meanwhile the electrical characteristic of the hybrid thin-film is measured by using four point probes. FESEM image indicates the particle size was found to be around 17-34 nm. The increment of scan number of TiO₂ NCs from one to five scan numbers of TiO₂ NCs in bilayers thin films showed that the atomic percentage of titanium decrease from 5.23% to 2.20%. This result indicates that as the thickness of thin films increases, the electrons required more energy to excite into conduction band of TiO₂. Meanwhile, the electrical conductivities of hybrid solar cell increase from 0.385 Scm⁻¹ to 0.389 Scm⁻¹ as the scan numbers of TiO₂ increase from one to three, however the electrical conductivity decrease to 0.346 Scm⁻¹ at five scan numbers. As a conclusion, this study shows that the morphological and electrical properties of hybrid thin-films can be significantly affected by the scan number of TiO₂ NCs.

Keyword: Electrical conductivity; Field Emission Scanning Electron Microscopy; Piper Betle Linn; Poly (3-hexylthiophene); Titania nanocrystals