Effect of annealing temperature on the performance of ZnO seed layer for photoanode in photoelectrochemical cells

ABSTRACT

Zinc oxide (ZnO) thin films were coated onto Indium Tin Oxide (ITO) glass substrate using spin coating technique as a function of annealing temperature. The thin film preparation was undertaken by utilising zinc acetate dihydrate, ethanol and diethanolamine as the precursors. The films were coated at room temperature prior to being annealed at temperatures ranging from 300 °C to 450 °C. The resulting crystalline structure and surface morphology of the thin films were then examined using X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM). UV-visible spectrophotometer was also used to record the optical absorbance in wavelengths ranging from 200 to 800 nm. The findings revealed that the ZnO thin films showed a single phase of wurtzite with n-type semiconductor, with the lowest value of band gap energy of 3.28 eV for ZnO thin films annealed at 350 °C. FESEM results showed that the ZnO nanoparticles were very compact on the surface, whereby the average particle size was equivalent to 108.5, 115.3, 108.2 and 107.8 nm at the temperatures 300 °C, 350 °C, 400 °C, and 450 °C, respectively. Additionally, the highest photoconversion efficiency (0.11%) recorded for the sample was annealed at 350◦C. Thus, annealing temperature was found to significantly affect the optical and electrical properties of ZnO nanoparticle seed layer, as well as its band gap energy and surface morphology.

Keyword: Band gap energy; Photoelectrochemical; Sol-gel spin coating; ZnO seed layers