WO_3 Nanostructured Thin Films Prepared by In Situ Hydrothermal Method as a Low-cost, Multifunctional Material

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Abstract

Tungsten trioxide (WO_3), an n-type semiconductor is considered to be a technologically important material in many research areas including energy, and environment due to its excellent electrical properties, chemical stability, and relatively low cost. In this paper, we report the application of cost-effective hydrothermally prepared WO_3 thin films on a Fluorine doped Tin Oxide (FTO) glass substrateas thephotoanode in direct water splitting,as a sensor material in gas detection, and as a working electrode in electrochromic devices. Sodium Tungstate Dehydrate ($Na_2WO_4 \cdot 2H_2O$) and $NaNO_3$ dissolved in deionized water adjusted to 1.5 pH by HNO_3 was used as the hydrothermal solution. Hydrothermal treatment was carried out at 100 °C for 5 h. The structure and morphology of the prepared WO_3thin films were characterized by using different techniques including X-ray differaction (XRD), Fourier Transform Infrared (FTIR), UV-visible spectroscopy, and Scanning Electron Microscopy (SEM). Hydrothermally prepared pristine WO_3 film on FTO was used as a photoanode and exhibited a relatively high photocurrent (70 $\mu A\ cm^{-2}$) under UV-Vis irradiation for water oxidation. The same electrode of WO_3-coated FTO with less film thickness showed a change of its color between light green and blue when applied 3.5 V across the electrochromic device (ECD) of configuration FTO/WO_3/LiCl+polyethelene oxide (PEO) based gel electrolyte/FTO. Performance of the in situ constructed hydrothermal WO_3 thin film electrode was tested as a gas sensing material and exhibited a 15% of response towards the Liquid Petroleum Gas (LPG) at room temperature.

References

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