

Optical H₂ sensing properties of vertically aligned Pd/WO₃ nanorods thin films deposited via glancing angle rf magnetron sputtering

Abstract

In this work, the optical H₂-sensing properties of Pd/tungsten trioxide (WO₃) nanorods prepared by rf magnetron sputtering with glancing-angle deposition (GLAD) technique are investigated. From grazing-incidence X-ray diffraction and field emission scanning electron microscopic characterizations, annealed WO₃ structure deposited on a quartz substrate at glancing angle of 85° exhibited polycrystalline monoclinic crystal structure with uniform partially isolated columnar nanorod morphology. The nanorods have the average length, diameter and rod separation of around 400 nm, 50 nm and 20 nm, respectively. The developed sensors show remarkable gasochromic absorbance response when exposed to H₂. Cumulative absorbance in 650–1000 nm wavelength range is increased by approximately 51% toward H₂ with 0.1% concentration in synthetic air, which is more than an order of magnitude higher than that of WO₃ dense film prepared by conventional sputtering method. Moreover, WO₃ nanorod based sensor is much more promising for practical use due to its much faster response. Therefore, the developed Pd/WO₃ nanorod based optical sensors are highly potential for low H₂ concentration sensing with highly sensitivity, fast and stable responses and low operating temperature.

Keyword: Tungsten trioxide; Glancing-angle deposition; Nanorods; H₂ sensor; Optical gas sensor