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Room temperature hydrogen sensitivities of Pd nanorings/TiO₂ nanotubes composite structures**Xiongbang Wei, Xiaohui Yang, Tao Wu, Guodong Lv and Hanying Pang**

University of Electronic Science and Technology of China, China

A novel composite hydrogen sensor consisting of Pd nanorings distributed on TiO₂ nanotube arrays was fabricated and evaluated at room temperature. The layer of Pd nanorings was deposited on top surface of the nanotube arrays by using a direct current (DC) magnetron sputtering method. Effects of the TiO₂ nanotube's diameter size, Pd nanorings' thickness on the sensors' hydrogen response characteristics were investigated. Time dependence of resistance of the Pd nanorings/TNTs composite structure on various hydrogen concentrations was also carried out and demonstrated good room temperature hydrogen sensitive characteristics. Microstructure of the sensor was characterized by Scanning Electron Microscope (SEM) and it showed that the Pd nanoclusters were deposited on the top of TiO₂ nanotubes in isolation. Crystalline structure of composite analyzing was characterized by X-Ray Diffraction (XRD) and it showed that amorphous TiO₂ has been converted into anatase and rutile completely after annealing at 500 °C. The hydrogen sensing characteristic was tested in series of hydrogen concentration at room temperature and it revealed that the sensor has excellent response performance. Optimized experiments demonstrated that the hydrogen sensor composed of 25 nm thickness Pd nanorings distributed on the 77 nm diameter TiO₂ nanotube showed a fast response time (3.8 s) and high sensitivity (92.05%) at 0.8 vol% H₂. A hydrogen sensitive characteristic model is proposed and the Pd nanorings' important role in the hydrogen sensitive mechanisms is described. The hydrogen sensor's excellent hydrogen sensitive characteristic is ascribed to the Pd nanorings' quick and continual formation and breakage of multiple passages due to absorption and desorption of hydrogen atoms, so that the composite hydrogen sensors have promising hydrogen sensitivity at room temperature.

weixiongbang@outlook.com