H_2 sensor based on tapered optical fiber coated with MnO_2 nanostructures

ABSTRACT

A novel hydrogen (H_2) sensor was developed using optical fiber coated with manganese dioxide (MnO_2) nanostructures. Optical multimode fiber (MMF) of 125 μm in diameter as the transducing platform was tapered to 20 μm to enhance the evanescent field of the light propagates in the fiber core. The tapered fiber was coated with MnO_2 nanograins synthesised via chemical bath deposition (CBD) process. Catalytic Palladium (Pd) was sputtered onto the MnO_2 layer to improve the H_2detection. The sensing layer was characterized through Field Emission Scanning Electron Microscopy (FESEM), Energy Dispersive X-ray (EDX), X-ray Diffraction (XRD) and Raman Spectroscopy to verify the properties of MnO_2. Two sets of sensors consist of as-prepared MnO_2 and 200 °C annealed MnO_2 were tested towards H_2 gas. The tapered optical fiber coated with Pd/MnO_2 nanograins was found to be sensitive towards $H_2$with different concentrations in synthetic air at 240 °C operating temperature. The annealed sensor showed higher response and sensitivity as compared to the as-prepared sensors when measured in the visible to near infra-red optical wavelength range. The absorbance response of the annealed Pd/MnO_2 on fiber has increased to 65% as compared to 20% for the as-prepared Pd/MnO_2 upon exposure to 1% H_2in synthetic air.

Keyword: Hydrogen sensor; Tapered optical fiber; Optical sensor; Absorbance response; Manganese dioxide nanostructures; Chemical bath deposition