Abstract

Pure Zinc oxide (ZnO) stands out as a highly acclaimed semiconductor with exceptional sens-ing capabilities. In this study, we present the synthesis of both pure ZnO nanofibers and Tita-nium-loaded ZnO nanofibers, achieved through the sol-gel method combined with the electro-spinning technique. The key attributes of these nanofibers, including their extensive surface area and impressive aspect ratio, render them ideal candidates for a diverse range of sensing applications. The electro-spinning process, driven by a high voltage field, facilitated the for-mation of these nanofibers, which were subsequently collected onto an aluminum grounded sheet. To assess their crystalline properties, including crystallinity and crystallite size, X-ray diffraction (XRD) analysis was conducted. Notably, the XRD patterns exhibited distinct peaks corresponding to the (100), (002), and (101) crystallographic planes in both pure ZnO nano-fibers and their counterparts infused with Titanium at varying concentrations of 2%, 4%, 6%, and 8%. Additionally, when subjecting the nanofibers to calcination at temperatures of 400°C, 500°C, and 600°C, a reduction in surface diameter was observed, attributed to the processes of ethanol evaporation, PVP decomposition, and atomic rearrangement. The surface morphology of these nanofibers was thoroughly characterized using scanning electron microscopy (SEM), revealing a significant observation: an increase in Titanium content led to a noticeable smooth-ing of the nanofiber surfaces. Furthermore, energy dispersive X-ray analysis (EDX) was em-ployed for elemental analysis of the nanofibers, providing valuable insights into their elemental composition. Raman spectroscopy of the ZnO nanofibers unveiled a prominent peak at 437 cm^-1, a characteristic frequency indicative of the wurtzite crystal structure, further affirming the quality and crystalline nature of the synthesized nanofibers. In practical sensor applications, these nanofibers were strategically deposited onto a copper interdigitated pattern on an FR4 sheet. Subsequently, their performance was assessed in the detection of Hydrogen gas at a concentration of 60 ppm. The gas sensing experiments were conducted within a custom-de-signed gas sensing chamber, equipped with Keithly 2000 multimeter characteristic probes, and maintained at an operating temperature of 80°C.

KEYWORDS: ZnO;TiZnO; complex oxide; electrospinning; Hydrogen gas sensing