Novel hydrogen gas sensor based on PANI and PANI coated SnO₂ nanofibers

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The SnO₂ nanofibers were synthesized by using Polyvinylpyrrolidone (PVP) nanofibers as template through electrospinning technique and calcination procedure. After calcination at 300 °C for 4 h, the organic PVP core should be decomposed absolutely for pure SnO₂. Due to the high thermal stability, the SnO₂ shell should not break down at this temperature. So SnO₂ nanofibers will be obtained. SnO₂-Polyaniline (SnO₂/PANI) heterostructure sensors have been developed for sensing hydrogen gas at room temperature with high specificity. SnO₂/PANI heterostructure has been prepared and the heterostructures have been optimized by chemical deposition of PANI on nanofibers of SnO₂ (size ~200 nm). The as-grown films were studied for some of the useful physicochemical properties i.e. X-ray diffraction (XRD), FTIR, UV-VIS, scanning electron microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDX). Study of SEM micrograph revealed that pure SnO₂ nanofibers were ~200 nm and when PANI was coated then diameter increased to ~300 nm due to the micellar templates of PANI around them. The possible incorporation of SnO₂ in PANI matrix has been revealed from FTIR and UV-VIS spectra. The presence of tetragonal and crystalline structure of SnO₂ was not affected with the incorporation of PANI as confirmed from XRD pattern. XRD studies showed peak broadening and the peak positions shift from standard values, indicating presence of tin oxide in nanoparticles form in the polyaniline (PANI) matrix. The SnO₂/PANI composite sensor exhibited good sensitivity and much higher response magnitude towards H₂ gas than the sensor based on PANI alone. Figure 1 shows the Sensitivity-Concentration graph of PANI and SnO₂/PANI composite nanofibers [1].

Space charge modulation occurring at various interfaces such as SnO₂/PANI interface and boundaries between the SnO₂ nanograins explains the high toxic gas sensitivity observed

for the SnO₂/PANI heterostructured nanofibers thin film sensor. Figure 2 shows the mechanism of change in resistance of composite nanofibers for hydrogen gas [2].

Figure 1: Sensitivity-Concentration graph of PANI and SnO₂/PANI composite nanofibers.

Figure 2: Mechanism of change in resistance of composite nanofibers for hydrogen gas.

The hybrid showed higher response and good sensitivity towards hydrogen gas as compared to pure PANI and pure SnO₂ based sensors reported in earlier studies.

References

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