Porous Surface Processes of Cu/SnO_2 films in the detection of CH_3OH-liquid, Prepared by Dip-Coating Method

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Abstract

In recent years, the detection methods of toxic chemical species and measurement of their concentration increased significantly. In the field of detection of chemical species, we must distinguish chemical sensors that play a critical role in environmental monitoring. Much research has been focused on the development of highly accurate sensors, highly sensitive and reliable, in which SnO_2 is a proper candidate for potential application in chemical sensing [1-5]. In this context, Porous Cu-doped SnO_2 (CSO-0, 3, 5) thin films were synthesized by the sol-gel dip-coating method for enhancing methanol sensing performance. The effect of Cu doping concentration on the SnO_2 sensibility was investigated. XRD data confirm that the fabricated SnO_2 films are polycrystalline with tetragonal rutile crystal structure. UV-Vis spectrum shows that SnO_2 thin films exhibit high transmittance in the visible region ~ 95%. The band gap (3,80 – 3,92 eV) and the optical thickness (893 – 131 nm) of prepared films were calculated from transmittance data. Statistical processing of AFM-topography revealed that both the grain size (93 to 46 nm) and the RMS roughness (30,8 to 8,97 nm) were decreased with increasing cu doping concentration. SEM-topography show that the films are uniform with granular surface nanostructures, their diameter size is approximately in the range (50 – 90 nm), However, CSO films presented a three-dimensional random arrangement of nanoropores with an average pore diameter about of (49 – 67nm). Therefore, the surface morphology of films is strongly depending upon the Cu doping concentration. Inspired by this idea, the porous structure is believed to facilitate the transport of reactant molecules and to enhance chemical-sensing performance. The sensing results demonstrate that SnO_2 films have a high sensitivity and a fast response to methanol. In particular, CSO-3 films have a higher sensitivity (98 %), faster response (10^{-2} s) and a shorter recovery time (18 s) than other films.

Keywords :SnO_2, Cu-doped, sensitivity, porous, response time, band gap, roughness, SEM.

References

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