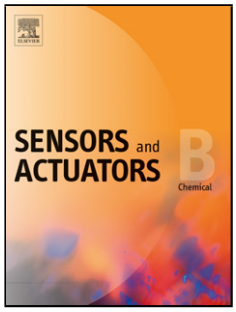

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Improved selectivity of SnO_2:C alloy nanoparticles towards H_2 and ethanol reducing gases; role of SnO_2:C electronic interaction

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Abstract

In the present study, changes in the sensing properties of SnO_2 on Carbon incorporation have been investigated in detail. The gas sensing response of size-selected SnO_2 and SnO_2:C alloy nanoparticles prepared by gas phase deposition method have been investigated for H_2 and ethanol over a varied temperature range (50°C- 200°C). The incorporation of carbon into SnO_2 lattice results in a large change in the sensing behaviour towards the two gases both having reducing nature. SnO_2:C nanoparticles show positive sensing response for H_2 and negative sensing response for ethanol, whereas SnO_2 nanoparticles show a normal sensing response of an n-type semiconductor towards both the reducing gases. Observed values of activation energy of sensing and energy levels of O-vacancies observed in the PL spectra of SnO_2 and SnO_2:C are consistent with these results. (i) Catalytic C-H interaction and (ii) modified work function of SnO_2 and C on hydrogenation resulting in alteration of electronic exchange between SnO_2 and C, and (iii) passivation effect of carbon during SnO_2-ethanol interaction along with a possibility of reduction in SnO_2 sites in SnO_2:C nanoparticles, are responsible for the observed behaviour. The present study shows that the incorporation of C in SnO_2 nanoparticles results in excellent selectivity towards H_2 and ethanol (both having reducing nature) in the low temperature range, normally not observed in oxide based resistive sensors.

Key words: size-selected SnO_2:C alloy nanoparticles, PL, selectivity, reducing gases, catalytic effect

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