Nanocomposites and nanomaterials

The influence of conditions of nanosized SnO_2 formation on the sensor properties to hydrogen

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There are many methods to obtain nanosized tin dioxide as widely used material for producing the semiconductor sensors to hydrogen. In the case of the sol-gel method, it was found that usage of the organic precursors led to stabilization of the obtained particles. Materials properties are affected by many factors among which the heating rate is the most significant.

The aim of this work was studying of electrical resistance in air (R_0) of sensors based on the nanosized SnO_2 obtained from xerogel by using different heating rate (2,5; 5; 10; 20^{o}C/min) and isothermal hold (1 or 2 hours).

In the IR spectrum of obtained materials the bands at 594 cm^{-1} and 455 cm^{-1} are observed. Peak at 594 cm^{-1} is assigned to the antisymmetric Sn-O-Sn stretching mode of the surface-bridging oxide, peak at 455 cm^{-1} is assigned to a symmetric Sn-O-Sn stretching mode. For microcrystalline SnO_2-based material such bands are not observed. These spectral differences in the IR spectra of microcrystalline SnO_2 and SnO_2 obtained by sol-gel method can be easily attributed to nanosize effect, since it is known that for SnO_2 nanoparticles of different size and shape, the antisymmetric and symmetric Sn-O-Sn IR bands can appear at different wavenumber [1].

Basic criterion to assess the materials for gas sensitive layers of semiconductor gas sensors was reproducibility R_0. Incomplete decomposition of the material was observed for high heating rates. In order to achieve reproducibility isothermal hold at a 600^{o}C for 1 or 2 hours was introduced. It was established that increasing the time of isothermal hold for all heating rate led to increasing sensors resistance. At the same time for both modes isothermal holding by increasing the heating rate material resistance decreases. Therefore for obtaining optimal sensor material we should avoid small heating rates and large isothermal hold times, as it leads to increasing in the R_o value of the material because of particles size increasing.

1. *Zhu J., Lu Z., Aruna S. T., Aurbach D., Gedanken A.* Sonochemical Synthesis of SnO_2 Nanoparticles and Their Preliminary Study as Li Insertion Electrodes// Chem. Mater.- 2000.- **12**, No. 9.-P.2557-2566