A review on tin dioxide gas sensor: The role of the metal oxide doping, nanoparticles, and operating temperatures

Metal oxide gas sensors have many advantages over other solid-state gas monitoring devices, including low cost, ease of manufacture, and small design. However, the shape and structure of sensing materials have a considerable impact on the performance of such sensors, posing a significant challenge for gas sensing properties on materials or dense films to attain high-sensitivity characteristics. Various tin dioxide (SnO_2) nanostructures have been devised to increase gas sensing characteristics such as sensitivity, selectivity, and response time, among other characteristics. An overview of the most well-known techniques for synthesizing gas-sensing films, as well as the influence of doping with various metal oxides, nanoparticle size, and operating temperature on the gas-sensing properties of such films, is discussed in this work. The gas sensing mechanisms and the gas detection techniques are presented in detail. The metal oxide doped SnO_2 showed a strong response for SO_2 and NO_2 gases, whereas nanoparticle doping plays a crucial effect in increasing SnO_2 sensitivity towards H_2, H_2S, NO_2, CO, Ethanol, etc. Furthermore, the effect of operating temperature on SnO_2 response is discussed in this report. SnO_2 has a high sensitivity over a wide temperature range (100-350 C).