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Influence of Colloidal Silver Nanoparticles on the Performance of Novel Flower-Like Titanium Dioxide Oxygen Sensor

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Titanium dioxide (TiO_2-anatase phase) thin films, consisting of agglomerated, flower-like nanoparticles, have been synthesized using an ultrasonic spray pyrolysis (USP) method in combination with titanium (IV) oxide acetylacetonate [$TiO(acac)_2$] and methanol at 550°C. These thin films were subsequently thermally treated in air at 950°C for 6 h, and the flower-like particles were transformed into smooth surfaces mainly comprising the TiO_2-rutile phase. In order to prepare oxygen sensors, TiO_2 thin films were deposited on interdigitated gold electrodes in contact with alumina substrates. The silver colloidal solution was impregnated on the TiO_2 thin film. Since the solvent in which the silver nanoparticles are suspended evaporates at 200°C, the thin films were then annealed at this temperature in air for 1 h. The effect of colloidal silver nanoparticles on the response of the thin-film TiO_2 oxygen sensors was studied in a mixture with zero-grade air. The gas-sensing properties of TiO_2 sensors in an atmosphere of 10^4 ppm oxygen were measured between 25 and 500°C. The experimental results obtained with colloidal silver nanoparticles as surface additives show that the sensitivity reaches constant values for the TiO_2-anatase and TiO_2-rutile phases of 0.40 and 0.03, respectively, at an O_2 concentration of 100 ppm in zero-grade air at 300°C, which is as high as the values reported for oxygen sensors prepared by more expensive techniques.

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