SnO_2:Eu nanopowders for development of gas sensors

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Introduction

Gas sensors based on n-type metallic oxide semiconductors as SnO_2 are used for detection of combustible gases at low concentration levels, due to its high sensitivity. When some dopant is added on the tin oxide surface, chemical properties of the oxygen on surface can be widely modified, therefore, the sensitivity increases sharply with decreasing the crystallite size (D) [1].

Rare earth oxides introduced into the SnO_2 matrix promove basicity of the surface, increasing the oxygen ion mobility and presenting interesting catalytic properties. Yamazoe and co-workers [2] have found that the addition of rare earth oxides to tin oxide sensor, markedly improves the sensitivity and selectivity with excellent ability for discrimination EtOH from other gases, such as: gasoline and hydrocarbons.

Results and Discussion

Tin oxide nanoparticles containing 0 to 10 % mol of Eu^{+3} ion were prepared by chemical route derived from Pechini's method [3]. It was observed that the crystallite size, determinate by the Scherrer's equation, reduces with increasing additive concentration, whereas the specific area (S_{BET}) increases **(Figure 1)**.

Sensors were fabricated as resistors of SnO_2:Eu 5% thin films obtained by coat-deposition of polymer precursor on interdigitated Au electrodes on alumina substrate. These sensors were mounted into a test chamber in N_2 ambient, at 100 °C. The electrical resistance of the films were monitored by a Semiconductor Parameter Analyzer HP 4156A, while the test gas was flushed into the chamber and the resistance variation (ΔR) was observed, thus, the sensor sensitivity (S) for test gas was calculated as follows: $S = \Delta R/R_o$, where R_o is the film resistance into N_2 ambient **(Figure 2)**.

The sensors based on Eu^{+3} doped SnO_2 showed excellent sensitivity to detection of high polarity gases, such as NO_x, SO_2, O_2 and EtOH, at low concentrations (≈ 100 ppm). On the other hand, sensors showed very little sensitivity for C_3H_8 and gasoline, which are hydrocarbons with low polarity.

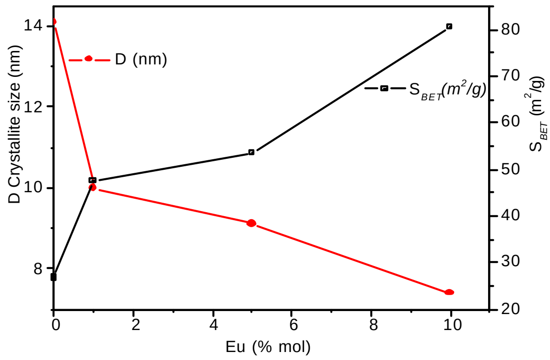

Figure 1. Relationship among additive concentration (Eu mol%), crystallite size (D) and surface area S_{BET}.

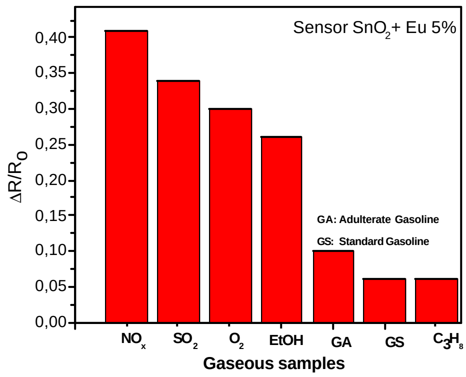

Figure 2. Sensitivity characteristics for (SnO_2 :Eu 5%) thin film to differents gaseous samples.

Conclusion

In conclusion, these results showed that SnO_2-Eu^{3+} is a promising material for detection of some gases that show different polarities, with potential applications for environment pollution control.

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