SOL-GEL NANOSTRUCTURED THIN FILMS FOR AN ARTIFICIAL OLFACTORY SENSING SYSTEM

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Abstract

The sol-gel process is an emerging wet-chemical synthesis and deposition technique that seems to be well-suited for the preparation of thin sensitive layers for Metal Oxide Semiconductors (MOS) based gas sensors. It is characterized by many advantages respect to the traditional techniques, such as the low operating temperatures in the preparation of the starting solutions, the easy deposition of thin films (by spin-coating or dip-coating) and the possibility to modify the chemical composition of the films with multiple different dopants. This last feature is particularly interesting in the field of gas-sensors, where it is known that the addition of suitable catalysts to the sensing layer may improve the response of the sensor, as concerns both the response time and the selectivity of the sensor.

In this work pure and Ni-, Pt-, Pd-, Os-doped tin oxide and pure and Fe-doped indium oxide thin films have been prepared by the sol-gel process. The microstructural properties of the as-prepared films have been investigated by means of X-ray diffraction. All the samples showed a polycrystalline structure in the nano-scale range that resulted to be dependent on the presence of the particular doping element. Integrated gas microsensor devices based on both pure and doped sol-gel thin films of these two different metal oxides (SnO_2 and In_2O_3) were realized. They were linked in an array configuration and exposed to the volatile compounds present in the headspace of different foods (olive oils, milk, fruit, sausages) samples in order to test the application of the array in an electronic nose for the discrimination among olive oils of different quality, rancidity of milk, ripeness of peaches and dry salumi. The differently modified sensitive materials showed different sensing characteristics to the headspace of the tested foods, hence modulating the selectivity of the array. PCA analysis was performed on the array responses and the results showed the good performance for an artificial olfactory sensing system and consequently the good opportunity offered by the sol-gel method in combination with thin film technology for manufacturing multisensing devices..