Nanostructured TiO_2 thin films prepared by Supersonic Beams and their application in a sensor array for the discrimination of VOC

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Many different kinds of gas sensing materials have been investigated within the past few years. This bewildering diversity in materials is also paralleled by the wide variety of deposition methods that are in use. The general driving force behind such investigations are obtaining improvements in sensitivity, selectivity and long term stability, i.e. in properties which are essential for producing reliable gas sensors. In this respect metal oxide gas sensors seem to be one of the most promising because these offer better stability and sensitivity than other sensing materials as for instance organic materials (conductive polymers, phthalocyanines, porphyrins and other). Nevertheless a lot of work still needs to be done to arrive at fully acceptable kinds of metal oxide gas sensors. Further advances are still needed to combat the effects of lacking selectivity and relatively large long-term drift. So, two lines of approach are being pursued in parallel: the first aims at tailoring the material properties in such a way as to enhance the selectivity to a particular gas and/or to improve the long-term stability. A particularly promising approach seems to be the control of the grain size together with the surface modification obtained by introducing other elements. The second line of approach aims at improving the problem of selectivity and /or stability by the use of sensor arrays composed from devices with overlapping sensitivities and by employing elaborate software to the sensor signals in order to extract the required pieces of information and self calibration.

From the single above exposed analysis it is clear that there is a strong need for improving the properties of existent gas sensors, looking also to new materials based in the surface properties control at the nano-grain level, new detection mechanism and new devices. The development of new generation of nanoscaled gas sensitive materials and new devices is then an emerging need for manufacturing more reliable gas sensor devices and systems.

The literature also suggests that the fundamental properties of sensors are strongly dependent on the techniques used for the realisation. Then new deposition techniques and optimised deposition processes need to be investigated.

We present here the first sensors ever build using films grown by supersonic beam of clusters oxides as sensing material. Microstructural and morphological characterisation of the films is also presented. Supersonic cluster beams, produced by a pulsed micro-plasma cluster source have successfully used to prepare nanocrystalline thin films of TiO_2. The sensors were prepared by means of different deposition parameters, obtaining in this way sensors having different performances, then suitable for the use in a gas sensor array for electronic nose. Experimental test of sensors showed a quite good response to ethanol, methanol and propanol. Principal Component Analysis was used as method for testing the array capability in discrimination and recognition of the volatile compounds.
The performance of the devices confirms that the growth from cluster beams gives a good control on the nano-crystallinity of the films.

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