BOTTOM-UP GAS NANOSENSORS BASED ON INDIVIDUAL TIN-OXIDE NANOWIRES

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Among metal-oxide materials, tin-oxide (SnO_2) is one of the most attractive ones because of the low –cost synthesis and its high sensitivity towards different gas species. These interesting properties have favoured the development of a large number of commercial gas sensors based on this material in the last decades [1].

On the other hand, one-dimensional metal-oxide nanostructures like nanowires or nanotubes have gained a lot of interest in the recent years because of their expected higher sensitivities and smaller recovery times compared to conventional microsensors. For this reason, big efforts are devoted to obtain reliable and well characterised devices containing only one of these nanomaterials. Nevertheless, their fabrication requires techniques with nanometric precision able to overcome a large number of size dependant problems [2, 3].

In this work, the gas sensor characterization of bottom-up nanosensor prototypes based on individual SnO_2 nanowires and fabricated with the help of FIB nanolithography techniques is presented (figure 1). The nanofabrication process has been developed in order to reduce as much as possible the modification of the physical and electrical properties of the nanowires [4].

The electrical response of these devices has been evaluated in different gas atmospheres (N_2, SA, CO, NO_2) enabling the analysis of their stability and reproducibility (figure 2). Moreover, it has been demonstrated that the response of these nanosensors correlates to the radius of the used nanowires yielding higher responses for the smallest ones. According to the obtained results, the best experimental conditions (nanowires' radius, operating temperature, etc) required for obtaining high sensitivity devices will be presented.

Finally, the advantages and disadvantages of introducing new bottom-up fabrication strategies based on the use of free standing micromembranes (figure 1) to improve the present devices will be analysed and discussed.

References:

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Figures:

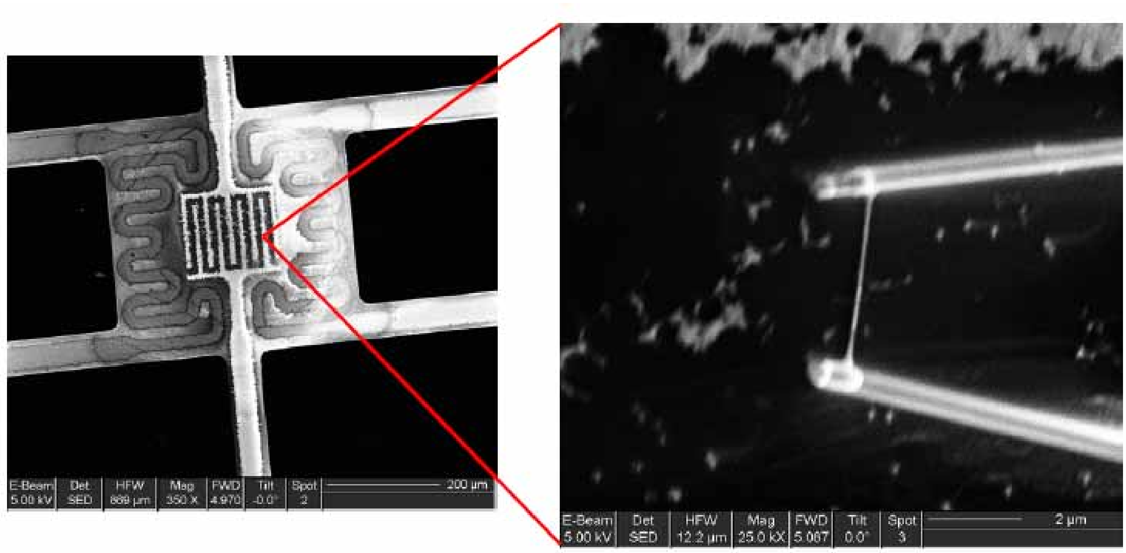

Figure 1. Tin-oxide nanowire electrically contacted to a platinum microelectrode (right image) using FIB nanolithography techniques. These microelectrodes are placed on a free membrane (left image), which also contains a heater system.

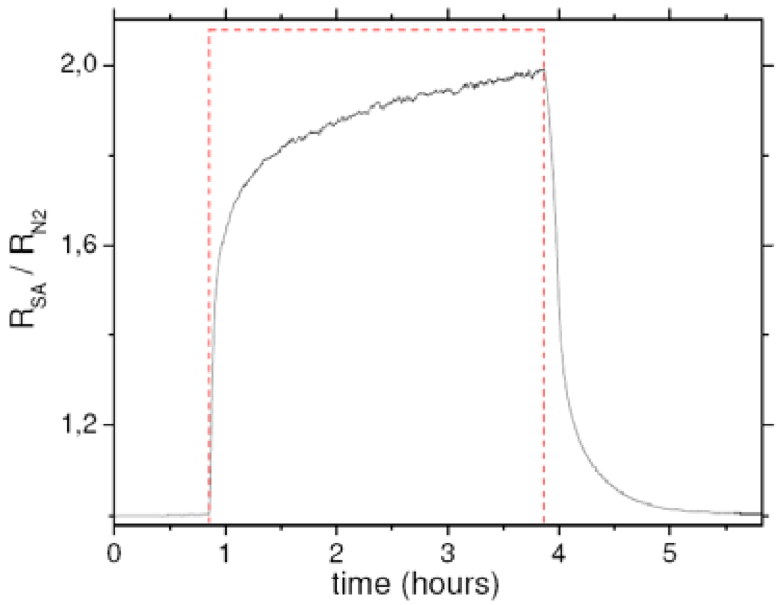

Figure 2. Response to nitrogen / synthetic air / nitrogen measurements of a single SnO_2 nanowire. A reversible rise in the device's resistance is observed in oxygen rich atmospheres due to the chemisorption of oxygen molecules at the nanowire's surface.