Embedded Multi Gas Sensors for Monitoring Indoor Air Quality

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1. SUMMARY:

In this abstract, we present an embadded multi gas sensors for monitoring of the indoor air quality in office and classroom. The microsystem of gas detection is based on a metal oxides type n and type p such as SnO2, ZnO, CuO … or a mixture between these deffirente sensitives layers. These metal oxides are prepared in the form of a serigraphy paste and deposited on an optimized silicon micro-hotplate. The sensors can be operated at temperature of 550°C with a low energy consumption of only 55 mW.

2. MOTIVATION and RESULTS:

Indoor air quality is major health concern in our societies but European recommendations (directive 2008/50/EC) will be still difficult to fulfill without the help of simple and efficient air quality monitoring systems. MOX gas sensors have proven their interest for the air quality monitoring in open air or indoor areas [1]. The monitoring of indoor air quality, especially in offices or classrooms, is one of the objectives of the neoCampus project in the University of Toulouse Paul Sabatier, which also deals with networks of communicating sensors and the treatment of mass of data from these distributed sensors.
All the nanoparticles used in our application have been prepared in LCC (Chemistry and Coordination laboratory) through organometallic synthesis procedures. The ZnO nanorods have been prepared by the reaction of controlled amounts of water (4 equivalents) on Zinc dicyclohexyl (ZnCy2) placed at 40 °C under argon and in the presence of alkylamines ligands (2 molar equivalents octylamine, OA), according to previously published method [2]. The reaction is left running during 4 days and the resulting nanorods (mean diameter 6 ± 1 nm, mean length 36 ± 19 nm) are washed by several precipitation/dispersion stages with acetone. In Figure 1 we shows the SEM image of the ZnO.
The CuO nanoparticles. It has been obtained by the reaction of ambient air during 24 h on copper acetamidinate precursor (Cuamd) in the presence of 5 molar equivalents of OA [1]. The excess of OA in the medium is removed by several precipitation stages by centrifugation and washing with THF. In Figure 2 we shows the SEM image of the CuO.
We try also in our experiences a mixture between these two layers, so to obtain an homogeneous binary blend of these two metal oxides we have mechanically mixed the powders to define the proportion of each MOX.
The SnO2 octahedra has been obtained by the reaction of controlled amounts of water (8 molar equivalents) on tin amidure precursor (Sn(NMe2)2) in the presence of small amounts of hexadecylamine (HDA) (0.1 molar equivalent) [3]. Figure 3 shows SEM image of the as-obtained SnO2 octahedra.
After preparation of the different sensitives layers and deposit them on the microhotplates, they have been characterized in an automatized experimental gas testing set-up by applaying a gas injection protocol in a test chamber containing the sensors powered at various operating temperatures and under variable humidity levels. In addition, we applied an optimized bias current, controlled by a Source Measure Unit (SMU) to these sensitive layers. In our experience, the sensors were placed in 250 ml test chamber where we injected the reactive gases at different concentrations with a constant total flow rate of 200ml/min controlled by digital flowmeters. A specific software allows the setting of all tests and data acquisition. The analysis of these data can then be performed by mathematical tools (AFD, ACP, ...) using the Matlab. In Figure 4 we show an example of response gas.

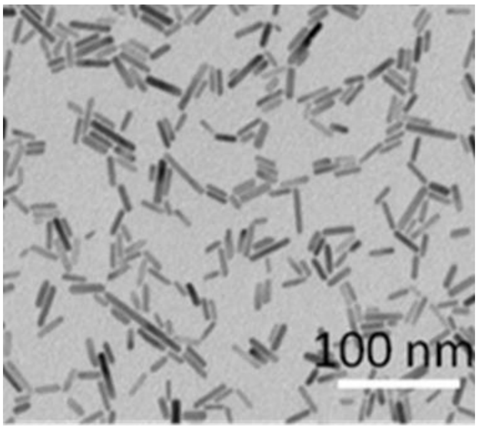

Figure 1. SEM image of ZnO NPs.

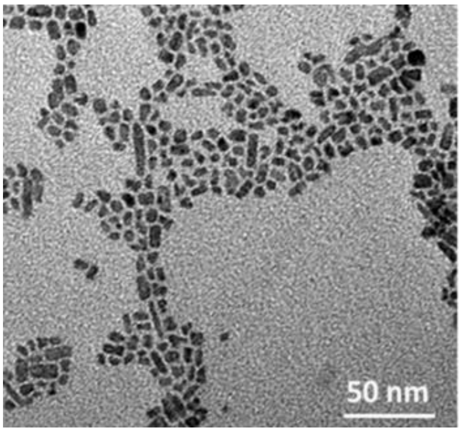

Figure 2. SEM image of ZnO NPs.

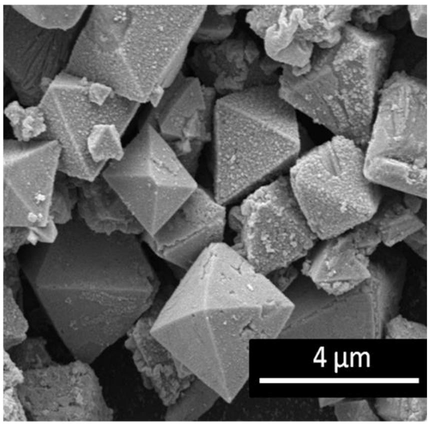

Figure 3. SEM image of SnO_2 octahedra.

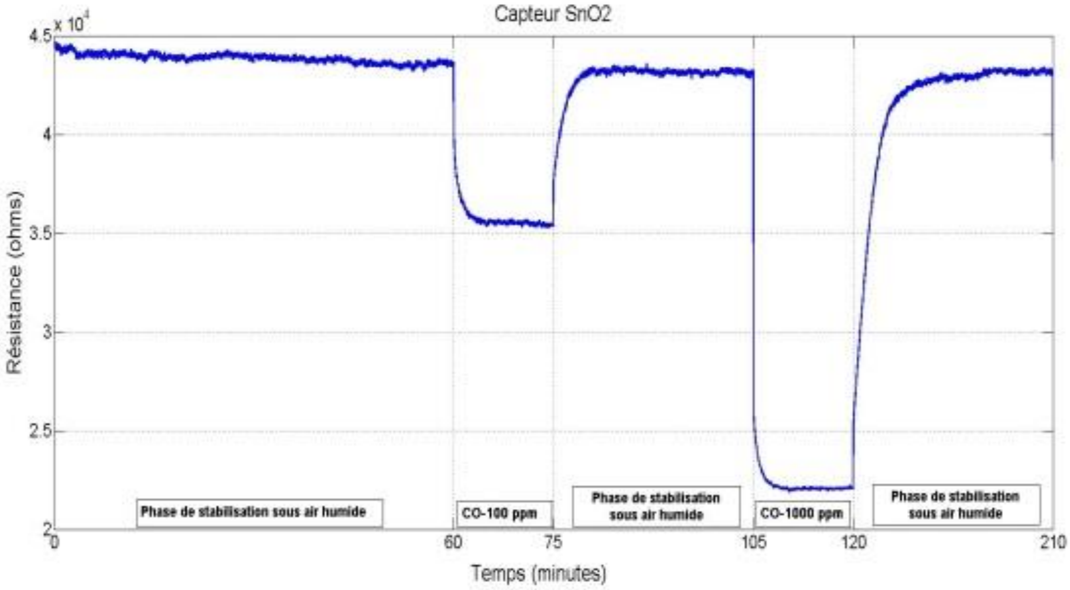

Figure 3. Responses of SnO2 gas sensor at 500°C

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