

## Organometallic approach for the preparation of metal oxide nanostructured gas sensitive layers (ZnO, SnO<sub>2</sub>)

J. Jońca<sup>1</sup>, A. Ryzhikov<sup>1</sup>, M. L. Kahn<sup>1</sup>, K. Fajerweg<sup>1, 2</sup>, B. Chaudret<sup>3</sup>, A. Chapelle<sup>4</sup>, P. Menini<sup>2,4</sup>, P. Fau<sup>1</sup>

1: Laboratoire de Chimie de Coordination (LCC), CNRS, Toulouse, France

2: Université Paul Sabatier, UT III, Toulouse, France

3: Laboratoire de Physique et de Chimie des Nano-objets (LPCNO), INSA, UPS, CNRS, Toulouse, France

4: Laboratoire d'Analyse et d'Architecture des Systèmes (LAAS), CNRS, Toulouse, France

### Abstract :

Semiconducting metal oxide sensors are one of the most widely used gas sensors. However, the main drawback of this type of devices is their lack of selectivity and sensitivity. Few pathways are usually investigated in order to achieve a better sensor performance, namely: choice of the chemical composition of the sensitive layer [1], careful morphology control of the used structures [2], integration of the catalytic filters [3], and surface modifications with noble metals [4].

In this paper we present a simple, room-temperature organometallic approach for the preparation of metal oxide gas sensitive layers (ZnO, SnO<sub>2</sub>). Controlled hydrolysis of zinc precursor leads to the formation of crystalline zinc oxide nanostructures [5]. Under different reaction conditions it is possible to master the ZnO particles morphology leading to the formation of either cloudy-like nanoparticles, isotropic nanoparticles (diameter of *ca.* 5 nm), or nanorods (diameter of *ca.* 5 nm and length of *ca.* 20 nm). Similarly, the hydrolysis of tin precursor leads to the formation of pristine nanoparticles made of Sn<sub>3</sub>O<sub>2</sub>(OH)<sub>2</sub>. Upon *in situ* heating, the layer is transformed into SnO<sub>2</sub>. All prepared materials are deposited on miniaturized gas sensors substrates [6] by an ink-jet method. The results show that at 500°C all sensor exhibits good response to exposed gases, namely 100 ppm CO, 100 ppm C<sub>3</sub>H<sub>8</sub>, 5 ppm NH<sub>3</sub>. Sensitivity of ZnO nanorods towards C<sub>3</sub>H<sub>8</sub> (70%) is the highest from all tested structures. Also SnO<sub>2</sub> sensor gives very good response to this gas (59%). The ZnO cloudy-like sensor gives the weakest response to C<sub>3</sub>H<sub>8</sub> (10%). ZnO nanorods and SnO<sub>2</sub> sensor give also high responses in the case of CO detection (63% and 67%, respectively). The CO sensing performance of ZnO isotropic and cloudy-like nanoparticles sensors is quite similar (*ca.* 40%, 500°C). All ZnO sensors give a quite similar and weak responses to 5 ppm NH<sub>3</sub> (*ca.* 5-7%), whereas the SnO<sub>2</sub> sensor is very sensitive to this gas (55%). These results highlight not only the role of the chemical composition of the sensitive layer, but also the influence of nanostructures morphology on gas sensor sensitivity and selectivity.

### Keywords:

Gas sensor, ZnO, SnO<sub>2</sub>, organometallic synthesis

### References:

- [1] De Lacy Costello, B. P. J. et al., *Sens. Actuat. B* 2003, 92, 159
- [2] Rout, C. S. et al., *Chem. Phys. Lett.* 418, 2006, 586
- [3] Shimizu, Y., N., et al., *Sens. Actuat. B* 77, 2001, 35
- [4] Oliaee, S. N., et al., *Sens. Actuat. B* 147, 2010, 400
- [5] M. L. Kahn, et al., *Adv. Funct. Matter.* 15, 2005, 458
- [6] Ph. Menini, et al., Eurosenors XXII proceedings, 2008, 342