Tin dioxide and noble metal nanostructures for olfactory gas detection

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Air quality control in closed spaces (e.g. automotive cabin, transportation and offices or working places) is getting more and more relevant due to the actual pollution levels present in our environment. In the past, our research group has successfully developed an advanced generation of metal oxide gas sensor, based on the combination of a micromachined silicon substrates and nanosized core shell Sn/SnO_x composite derived from organometallic synthesis [1]. These sensors have been industrialized and implemented as air quality sensors in the automotive industry. A very new and improved generation of integrated gas sensors is presented here. It combines an improved silicon micromachined substrate and a fully oxidized nanosized tin dioxide material [2-4]. A key parameter for an improved response of the sensor is the highly porous nature of the sensitive layer that leads to a high number of electrical contacts between oxide grains. Indeed, the higher is the number of possible current pathways during sensor operation, the lower is the risk of sensitivity decreases due to deactivation of grain boundaries. As a matter of fact, for a given volume of sensitive layer, nanopowders offer the best ratio of grains and grain boundaries. The presented results demonstrate the high thermomechanical properties of the silicon substrate, the electrical and thermal stability of the platinum based heater element, and the very low membrane deformation during operation. High quality and micron thick layers can be obtained with a very low defect level (no cracks, no délamination). In addition, our team has developed a catalysis oriented approach for the improvement of the sensor response and selectivity: noble metal (Ru, Pt...) are added to the SnO_2 matrix in order to reduce the response time and to increase the sensitivity of the sensors. Gas responses under CO, C_3H_8, NH_3 and CH_3CHO on undoped and doped layer are presented and discussed in view of applications in the selective gas detection of odorous gases in automobile cabins.

[1] C. Nayral *et al.*, Applied Surface Science, 164 (2000) 219 .
[2] P. Ménini *et al.*, Eurosensors XXII proceedings, (2008) 342.
[3] P. Fau *et al.*, JNTE08 proceedings, (2008) 14.
[4] J.Ba *et al.*, Adv. Mater. (2005), 17, 2509.

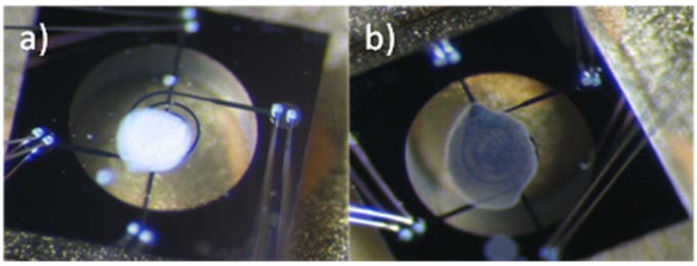

Figure 1: New gas sensor devices coated with a) undoped nanosized SnO_2 and b) Pt doped nanosized SnO_2 thick layers