$RuO_2@SiO_2$ NANOMATERIALS AS CATALYTIC FILTERS FOR GAS SENSORS

Metallic or semiconducting nanoparticles are the subject of intense research owing to their unique physical properties arising from factors like large surface to volume ratio and quantum effects on charge carrier confinement.[1] This research is driven by potential applications in electronics, optics, catalysis, ceramics and magnetic data storage.

In this respect, nanomaterials attract more and more attention for the development of new gas sensing systems able to respond to growing industrial and societal demands. Metal oxides are widely employed as sensitive elements in gas sensors[2] and commercial devices produced by classical ceramic process have been available for a long time.[3] If such devices are able to detect low concentration of flammable or toxic gases at a ppm level, their lack of selectivity and long term stability remains their major drawback and improving the cross sensitivities between gases such as CO, hydrocarbons and NO_2 is still a major problem.

The use of filters combining catalyst-loaded materials represents a very attractive way to improve the selectivity of the sensor toward a target gas and to overcome the classical problem of saturation exhibited by passive filtering membranes.[4] The filtering efficiency of such a material, in term of selectivity, reproducibility and long term stability, nevertheless asks for requirements of crucial importance regarding its composition and its morphology.[5]

Our last research efforts in the design of $RuO_2@SiO_2$ nanomaterials as catalytic filters for gas sensors will be presented following two distinct orientations. On one hand the in situ growths or Ru nanoparticles within mesostructured silica[6] and on the other hand the one pot hydrolysis and polycondensation of functionalised Ru nanoparticles[7] with their subsequent thermal treatment. Both nanomaterials synthetic routes will be described and a comparison of their efficiency as catalytic filter for gas sensors will be given.

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[1] (a) T. Hyeon, *Chem. Commun.*, 2003, 927; (b) K. J. Klabunde, in *Nanoscale Materials in Chemistry*, ed. K. J. Klabunde, Wiley Intersciences, New York, **2001**; (c) M. R. Diehl, J.-Y. Yu, J. R. Heath, G. A. Doyle, S. Sun, C. B. Murray, *J. Phys. Chem. B*, **2001**, *105*, 7913; (d) D. L. Leslie-Pelescky, R. D. Rieke, *Chem. Mater.*, **1996**, *8*, 1770.

[2] (a) D.E. Williams, in *Solid State gas sensors*, ed. P.T. Moseley and B.C. Tofield, Adam Hilger, Bristol, **1987**, p. 71. (b) V. Lantto, in *Gas Sensors, Principle, Operation and Developments*, ed. G. Sberveglieri, Kluwer Academic, Dordrecht, Boston, London, **1992**, p. 117. (c) K. Ihokura and J. Watson, *The Stannic Oxide Gas Sensor: Principles and Applications*, CRC Press, Boca Raton, FL, **1994**.

[3] Figaro Engineering Inc. website.

[4] A. Cabot, J. Arbiol, A. Cornet, J. R. Morante, F. Chen, M. Liu, *Thin Solid Films*, **2003**, *436*, 64.

[5] (a) L. M. Bronstein, *Top. Curr. Chem.*, **2003**, *266*, 55. (b) J.-L. Shi, Z.-L. Hua, L.-X. Zhang, *J. Mater. Chem.*, **2004**, *14*, 795.

[6] S. Jansat, K. Pelzer, J. Garcia-Anton, R. Raucoules, K. Philippot, A. Maisonnat, B. Chaudret, Y. Guari, A. Mehdi, C. Reyé, R. J. P. Corriu, *Adv. Funct. Mater.*, **2007**, *17*, 3339.

[7] K. Philippot, A. Maisonnat, B. Chaudret, S. Jansat, J. Garcia-Anton, F. Turpin, V. Matsura, C. Reyé, Y. Guari, R. J. P. Corriu, PCT/FR2007/000905 (WO2007138197).