

Gas sensor for food industry and agriculture based on ZnO nanoparticles and nanorods

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Semiconductor gas sensors can be widely used in food industry and agriculture. Measurements of ethylene concentration in vegetable stores and greenhouses allow the control of fruit ripening, whereas detection of H₂S, mercaptans, amines may be used to control of meat, fish and vegetable freshness. In this work we present a new generation of semiconductor gas sensors based on the combination of micromachined silicon substrates [1] and highly sensitive layer of ZnO nanoparticles with controlled morphology (Fig. 1). ZnO nanoparticles of different size and nanorods with various length-diameter ratio were obtained following a controlled hydrolysis reaction of an organometallic precursor, namely the biscyclohexyl zinc, in the presence of long-chain amines as ligands [2]. Zinc oxide size and morphology was controlled by a choice of ligand, precursor concentration and water level. ZnO nanopowders were deposited on optimized micromachined silicon substrates with very low power consumption (Fig. 2) by a generic ink jet method. High quality and micron thick layers can be obtained with a low defect level (no cracks, no delamination). Gas sensitivity to reducing gases and air stability are presented in comparison with SnO₂ sensitive layers. Gas sensors based on ZnO nanorods show high sensor response to ethylene and ammonia, whereas their response to CO and C₃H₈ is considerably lower.

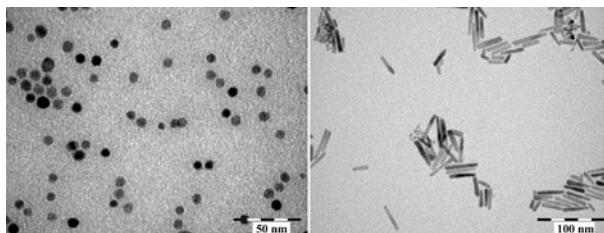


Figure 1: ZnO nanoparticles and nanorods

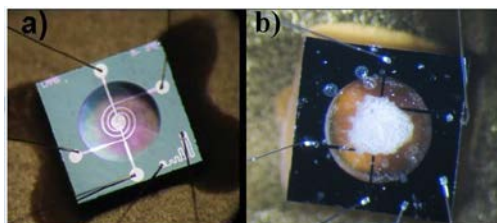


Figure 2: New gas sensor design a) before sensitive layer deposition b) with nanosized ZnO thick layer

References:

- [1] Ph. Ménini et al., Eurosenors XXII proceedings, 2008, 342.
- [2] M. Monge et al., Angew. Chem. Int. Ed., 2003, **42**, 5321-5324.