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Nanostructured Photonic Sensors

NANOPHOS IST-2001-39112

COORDINATOR

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PARTICIPANTS

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- Universite de Droit, d'Economie et des Sciences d'Aix-Marseille, Marseille, France
- Universita Degli Study di Lecce, Lecce, Italy
- Institutul National de Cercetare Dezvoltare Pentru Fizica Laserilor, Plasmei si Radiatiei, Bucharest, Romania
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OUR ROLE IN THE PROJECT

- nanocomposite processing technology,
- deposition of thin and ultrathin oxide films,
- structural analysis of oxides,
- lithographic processing including post processing and post-deposition schemes for the formation of guided structures and gratings,
- suitable microelectronics processing for the fabrication of the sensor head

PROJECT DESCRIPTION

Targeting the five-to-ten-year industrial application horizon, NANOPHOS addresses the development of innovative nanostructured and nanocomposite media and respective devices of advanced gas sensing functionality. The objectives relate, first, to the production of functional nanostructured sensor media and interfaces activated upon exposure to chemical agents. Second, by investigating new linear and nonlinear light-matter interaction effects, the project aims to novel optical sensor interrogation concepts based on light diffraction and interferometry in free-space and waveguide geometries, as well as to the implementation of prototype devices and systems enabling sensing of gas chemical agents (such as O_x, NO_x, CO, SO_x, CH, VOC and other pollutants), with high sensitivity, selectivity and low-cost reliability.

NANOPHOS aims beyond the established electrochemical, conductivity or spectroscopic gas sensors concepts. It targets at alleviating deficiencies by implementing an innovative technology that can match and surpass performances of current products. It concerns media design to "react" in the chemical environment and exhibit a modified linear or nonlinear optical dielectric response based on reversible inter-particle interactions in synthetic photonic nanocomposites. Devices and systems of advances functionality will enable high sensitivity, selectivity and stability gas, room temperature sensing operations, together with remote interrogation, reliability and low cost. By selecting classes of important chemical agents, this effort is directed to the design and production of nanostructured media, development of interrogation methods based on mainly diffractive (and also other interferometric) optical schemes and integration and testing of advanced sensor-head devices and systems, via a well-balanced scientific and technical approach aiming to:

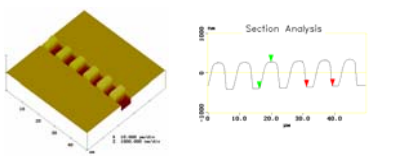
- Functional photonic nanocomposites via nanoparticle production and encapsulation, ultrathin, thin and multilayered media produced by chemical and physical methods;
- Molecular receptors media and interfaces for selective adsorption and sensitisation;
- Optical interrogation methods in free-space or waveguiding formats allowing detection of dielectric changes to better than 10^{-7} and respective sensing in the ppb region;
- Optoelectronic sensor device integration;
- System integration and environmental testing, aiming to pre-industrial devices.

NANOPHOS achievements are expected to have a world-wide impact on relevant standards and technology, opening up new links between nano-technologies and the Information Society and contributing to the strategic interests of the European Community.

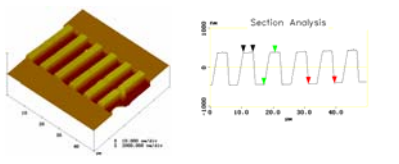
RESULTS

Direct photolithography & dry etching

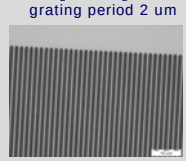
SnO_2 (665 nm), Ar^+ ion etching, SiO_2/Cr/ SiO_2 mask
grating period 4 µm



Pt/SnO_2/Pt (100/720/5 nm), Ar^+ ion etching, Ti mask
grating period 8 µm

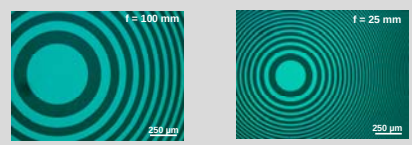


SnO_2 (235 nm), RIE in BCl_3plasma,
SiO_2/Cr/SiO_2 mask
grating period 2 um

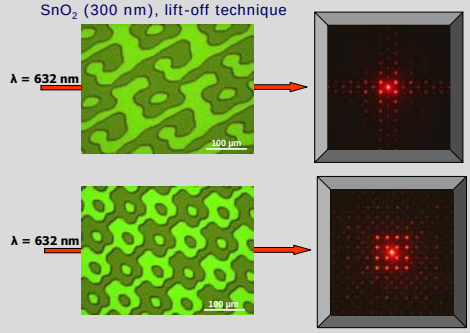


Diffractive optical elements

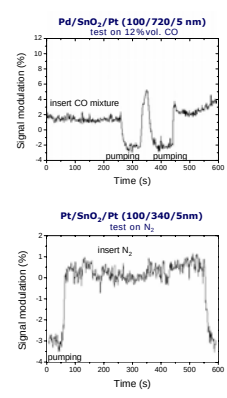
SnO_2 (235 nm), Ar^+ ion etching, Ti mask



SnO_2 (300 nm), lift-off technique



Response tests



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