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Functional Materials from Gas Sensors to Programmable Optical Components

Mounir Gaidi
University of Sharjah, UAE

The recent development of synthesis techniques has enabled the development of new materials and complex systems for which properties and functions are adjustable over several size scales, ranging from nanometers to centimeters. Functional materials, called smart, have taken now days an important place among the most studied research topics. Various applications have emerged as a result of this progress. As an example, we will discuss the following two cases:

Conductive gas sensor: SnO_2 as example

During the last years and following the increase in problems related to air pollution, the work of basic and applied research in the field of gas detection, particularly the detection of pollutants, have become more and more important. Progress in the field of developing and shaping solid materials and the new possibilities offered by micro and nano-technology have contributed to the research and development of new devices for the detection of polluting gases in the air and in particular, reducing gases such as carbon monoxide, methane, H_2S ... etc.Many devices operate then by using electrical conductivity variation of apolycrystalline semiconductor oxide as a result of gas-surface interactionon the grain boundaries.

Despite a very large number of studies on the effect of NP metal doping on the sensing properties of SnO_2, the role of these additions has so far remained largely unknown. This ignorance has been an impediment to the development of sensitive and reliable sensors. We try to propose and present the different mechanisms used to explain the role of these metal additions on the electrical properties of SnO2, and its response in the presence of a reducing gas. Inedited experiments using in-situ and simultaneous X-ray absorption spectroscopy and electrical conductivity and CO gases measurement present the main achievement of this work.

Programmable Optical Components

The need for next-generation photonic systems has led to the adoption of the technique known as multiplexing or “dense wavelength division multiplexing” to increase the capacity of existing optical networks. This approach requires the development of new concepts of components to ensure multiplexing, demultiplexing, switching, routing and control of each wavelength of the optical signal. This creates considerable pressure on photonic components currently used for optical signal processing. The trend will shift significantly to miniaturized optical devices with low power consumption and low cost, which not only provide superior performance than the current cumbersome devices, but also replace the functions of microelectronics. Photonic components such as networks waveguide / fiber embedded in anelectronically controllable geometry could form the basis of the new generation of “Programmable photonic components”.

Biography:

Mounir Gaidi, Doctor in physics (Ph.D Material Sciences from the national Institute of polytechnic of Grenoble-France)), now he is an Associate professor of physics at Sharjah University. He worked for many research institutes such as National center of Scientific Research (France), National Institute of scientific Research (Canada) and the Research and technology center of energy (Tunisia). Currently Dr. MounirGaidi’s researches focus on Nanomaterials for photovoltaic solar cells applications, Doped and un-doped metal oxide Gas sensors, Nanomaterials for photocatalysis and Multiferroic materials for opto-electronic application. He is also expert in Thin films elaboration by physical (PLD-sputtering), chemical process, electrochemical and pyrosol techniques. Dr Mounir co-authored more than 60 papers and books in the field of nano and smart materials applications.