Synthesis and Characterization of Functional Nanostructured Metal Oxide Thin Films

S. SHISHIYANU[1], Lee CHOW[2], O. LUPAN[1], T. SHISHIYANU[1]

[1]Technical University of Moldova, Department of Microelectronics and Semiconductor Devices
bd. Stefan cel Mare 168, MD2004 Chisinau, Republic of Moldova
[2]University of Central Florida, Department of Physics, Orlando, FL 32816-2385

A novel aqueous relatively low-temperature thin film growth technique has been developed to fabricate a new generation of smart and functional nanostructured metal oxide thin film materials. This chemical synthetic route uses stable and inexpensive hydrated-metal inorganic salts and environment-friendly solvents.

The nanomaterials are obtained to analyze the physical and structural requirements of their applications in gas sensors and solar cells. This claim is sustained by a model of the nucleation and growth processes through the chemical control of the chemical reaction. It allows monitoring the size of nano and microparticles, their surface morphology and arrangement on substrates. This aqueous chemical growth method allows generation of, at large scale and low-cost, advanced functional metal oxides nano- and micro-particulate multilayered thin films with complex nanoarchitectures. It includes nanocrystallites of zinc oxide nanorods and microrods. Other applications include nanocomposite thin films consisting of cuprous oxide micro/nanoporous films grown at low temperature from aqueous solution onto various substrates and rapid photothermal processed.

Zinc oxide and cuprous oxide nanostructures have the potential to significantly improve the performance and durability of materials in several areas of importance such as energy production and homeland security. For example, ZnO-based resistive type sensors have been used for the detection of toxic gaseous compounds important to environmental monitoring and to medical diagnostics. The responses of the sensing elements when exposed to 1.50 ppm of nitrogen oxide, 500 ppm of methanol, and 50 ppm of ammonia at temperatures between 20 °C and 300 °C have been assessed. A correlation between the nanoarchitectures of the nanostructured oxide sensing films and their relative gas selectivity to different classes of gases is proposed. We believe functional metal oxide nanostructures are materials which can have practical and useful technological applications in the near future.

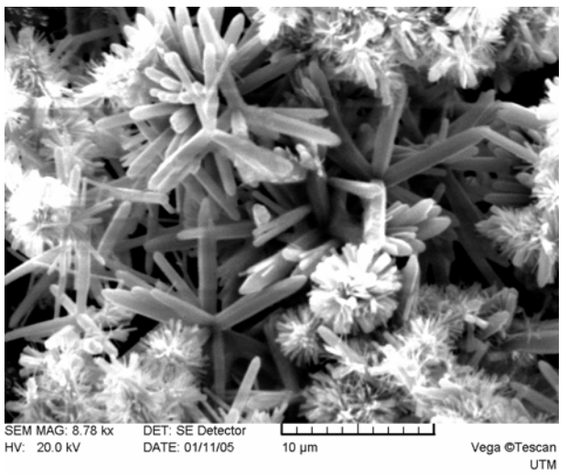

FIG. 1. SEM image of the as-synthesized nanostructured ZnO thin films obtained by aqueous relatively low-temperature growth technique

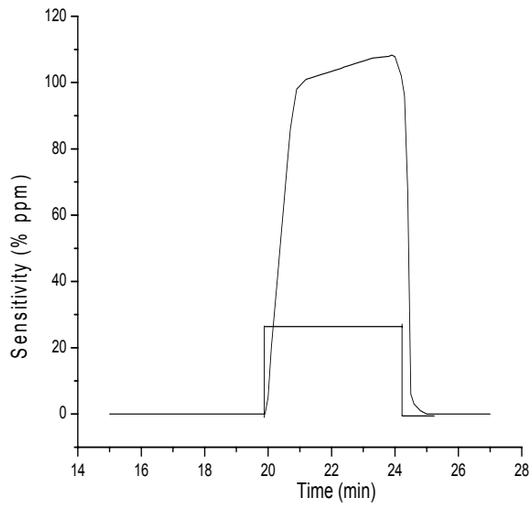

FIG. 2. Response of the ZnO nanostructure to ammonia at a working temperature of 100 °C and 40% RH.

REFERENCES

1. P. X. Gao, Z. L. Wang, J. of Appl. Phys., **97**, 044304 (2005)
2. O.K.Varghese, C.A.Grimes, J. of Nano-science and Nanotechnology, .**3**, 277 (2003).
3. S. Shishiyanu, R. Singh, T. Shishiyanu, O. Lupan, in *25th International Conference on Microelectronics-MIEL*, Belgrade, Serbia and Montenegro, p.8, 14-17 May 2006
4. O.Lupan, Technology of oxides ZnO, Cu_2O, SiO_2 obtaining with rapid photon annealing for semiconductor devices. Doctor Thesis, Chisinau, Moldova, 2005, 152p.