Health and Bioengineering Conference (EHB)
19-21 November 2015
Iasi, Romania

Micro-nano-technologies of zinc and copper oxides for sensor and medicine applications

Oleg Lupan ; Vasile Postica ; Mathias Hoppe ; Victor Sontea ; Serghei Railean ; Rainer Adelung

DOI: 10.1109/EHB.2015.7391542

Abstract:

The combination of sensors and biosensors with medicine and life science promises to yield extremely innovative and revolutionary advances in healthcare. In this work we report on micro- and nano-technologies for copper and zinc oxides crystalline structures. The detailed morphological study of Sn-doped ZnO nanostructured films and CuO nanowire (NW) networks for gas sensing and medicine applications are presented. ZnO based devices demonstrated good hydrogen response (Rair/Rgas ~ 3.4 to 50 ppm) with fast response and recovery times (2.7 s and 6.1 s, respectively) at operating temperature of 250 °C. In the case of CuO NW networks was observed an ethanol response (Rgas/Rair ~ 2.8 to 50 ppm) at the same operating temperature. Both sets of samples showed excellent repeatability and stability with complete recovery to initial baseline. Reported results serves as the basis for further investigations in field of biosensors and integration in biochips.

References:

1. F. Patolsky, G. Zheng and C.M. Lieber, "Nanowire sensors for medicine and the life sciences",*Nanomedicine*, vol. 1, pp. 51-56, 2006.
Show Context CrossRef Google Scholar

2. Y. Liu, E. Koep and M. Liu, "A highly sensitive and fast-responding SnO2 sensor fabricated by combustion chemical vapor deposition", *Chemistry of materials*, vol. 17, pp. 3997-4000, 2005.
Show Context CrossRef Google Scholar

3. O. Lupan, V. Cretu, V. Postica, M. Ahmadi, B.R. Cuenya, L. Chow et al., "Silver-doped zinc oxide single nanowire multifunctional nanosensor with a significant enhancement in response", *Sensors and Actuators B: Chemical*, vol. 223, pp. 893-903, 2016.
Show Context CrossRef Google Scholar

4. D. Kohl, "Function and applications of gas sensors", *Journal of Physics D: Applied Physics*, vol. 34, 2001.
Show Context CrossRef Google Scholar

5. O. Lupan, V. Cretu, V. Postica, N. Ababii, O. Polonskyi, V. Kaidas et al., "Enhanced Ethanol Vapour Sensing Performances of Copper Oxide

Nanocrystals with Mixed Phases", *Sensors and Actuators B: Chemical*, vol. 224, pp. 434-448, 2016.
Show Context CrossRef Google Scholar
6. M. Yilmaz, "Investigation of characteristics of ZnO: Ga nanocrystalline thin films with varying dopant content", *Materials Science in Semiconductor Processing*, vol. 40, pp. 99-106, 2015.
Show Context CrossRef Google Scholar
7. Y. Shen, Y. Liu, G. Zhu, H. Fang, Y. Huang, X. Jiang et al., "Patterned polymer nanowire arrays as an effective protein immobilizer for biosensing and HIV detection", *Nanoscale*, vol. 5, pp. 527-531, 2013.
Show Context CrossRef Google Scholar
8. E. Topoglidis, A.E. Cass, B. O'Regan and J.R. Durrant, " Immobilisation and bioelectrochemistry of proteins on nanoporous TiO 2 and ZnO films ", *Journal of Electro analytical Chemistry*, vol. 517, pp. 20-27, 2001.
Show Context CrossRef Google Scholar
9. O. Akhavan and E. Ghaderi, "Copper oxide nanoflakes as highly sensitive and fast response self-sterilizing biosensors", *Journal of Materials Chemistry*, vol. 21, pp. 12935-12940, 2011.
Show Context CrossRef Google Scholar
10. M. Kaur, K. Muthe, S. Despande, S. Choudhury, J. Singh, N. Verma, et al., "Growth and branching of CuO nanowires by thermal oxidation of copper", *Journal of Crystal Growth*, vol. 289, pp. 670-675, 2006.
Show Context CrossRef Google Scholar
11. J.F. Chang, H.H. Kuo, I.C. Leu and M.H. Hon, "The effects of thickness and operation temperature on ZnO: Al thin film CO gas sensor", *Sensors and Actuators B: Chemical*, vol. 84, pp. 258-264, 2002.
Show Context CrossRef Google Scholar
12. D. Gedamu, I. Paulowicz, S. Kaps, O. Lupan, S. Wille, G. Haidarschin et al., "Rapid Fabrication Technique for Interpenetrated ZnO Nanotetrapod Networks for Fast UV Sensors", *Advanced Materials*, vol. 26, pp. 1541-1550, 2014.
Show Context CrossRef Google Scholar
13. S.T. Shishiyanu, T.S. Shishiyanu and O.I. Lupan, " Sensing characteristics of tin-doped ZnO thin films as No 2 gas sensor ", *Sensors and Actuators B: Chemical*, vol. 107, pp. 379-386, 2005.
Show Context CrossRef Google Scholar

14. L. Seu Vi, L. Pang, L. Chia Ying, T. Tseung Yuen and H. Chorng Jye, "Effect of Sn dopant on the properties of ZnO nanowires", *Journal of Physics D: Applied Physics*, vol. 37, pp. 2274, 2004.
Show Context Google Scholar

15. S. Rackauskas, H. Jiang, J.B. Wagner, S.D. Shandakov, T.W. Hansen, E.J. Kauppinen et al., "In Situ Study of Noncatalytic Metal Oxide Nanowire Growth", *Nano Letters*, vol. 14, pp. 5810-5813, 2014.
Show Context CrossRef Google Scholar
16. A. Goncalves, L. Campos, A. Ferlauto and R. Lacerda, "On the growth and electrical characterization of CuO nanowires by thermal oxidation", *Journal of Applied Physics*, vol. 106, pp. 034303, 2009.
Show Context CrossRef Google Scholar
17. J.-W. Yoon, J.-K. Choi and J.-H. Lee, " Design of a highly sensitive and selective C 2 H s OH sensor using p-type C0304 nanofibers ", *Sensors and Actuators B: Chemical*, vol. 161, pp. 570-577, 2012.
Show Context CrossRef Google Scholar
18. S. Steinhauer, E. Brunet, T. Maier, G. Mutinati and A. Kock, " Suspended CuO nanowires for ppb level H 2 \$S\$ sensing in dry and humid atmosphere ", *ensors and Actuators B: Chemical*, vol. 186, pp. 550-556, 2013.
Show Context CrossRef Google Scholar
19. Y.K. Mishra, G. Modi, V. Cretu, V. Postica, O. Lupan, T. Reimer et al., "Direct growth of freestanding ZnO tetrapod networks for multifunctional applications in photocatalysis UV photo detection and gas sensing", *ACS Applied Materials & Interfaces*, vol. 7, pp. 14303-14316, 2015.
Show Context CrossRef Google Scholar