Vacuum
Volume 166, August 2019, Pages 393-398

VasilePostica [a]
IngoPaulowicz [b c]
OlegLupan [a b]
FabianSchütt [b]
NiklasWolff [b]
AlaCojocaru [c]
Yogendra KumarMishra [b]
LorenzKienle [b]
RainerAdelung [b]

[a] Department of Microelectronics and Biomedical Engineering, Center Nanotechnology and Nanosensors, Technical University of Moldova, 168 Stefan cel Mare Av., MD-2004, Chisinau, Republic of Moldova

[b] Institute for Materials Science, Faculty of Engineering, Kiel University, Kaiserstr. 2, D-24143, Kiel, Germany

[c] Phi-Stone AG, Kaiserstr. 2, D-24143, Kiel, Germany

https://doi.org/10.1016/j.vacuum.2018.11.046

Abstract

Rapid detection and fast response of nanoelectronic devices based on semiconducting oxides is nowadays a modern and stringent subject of research. Device performances depend mainly on the morphologies of the metal oxide nanostructures. In the scope of this work, the influence of the structural morphology of three-dimensional (3-D) ZnO nano- and microstructured networks on the room temperature UV detection properties is studied in detail. We show that the formation of multiple potential barriers between the nanostructures, as well as the diameter of the nanostructures, which is in the same order of magnitude as the Debye length, strongly influence the UV sensing properties. Consequently, 3-D ZnO networks consisting of interconnected ultra-long wire-like

tips (up to 10 µm) and with small wire diameters of 50–150 nm, demonstrated the highest UV sensing performances (UV response ratio of ~3100 at 5 V applied bias voltage). Furthermore, we demonstrate the possibility of substantially increasing the UV sensing performances of individual ZnO nanowire (NW) (diameter of ~50 nm) by surface functionalization with carbon nanotubes (CNTs), showing high response ratio (~60–50 mW/cm$_2$), as well as fast response (~1 s) and recovery (~1 s) times. The obtained results thus provide a platform with respect to the next generation of portable UV radiation detectors based on semiconducting oxide networks.