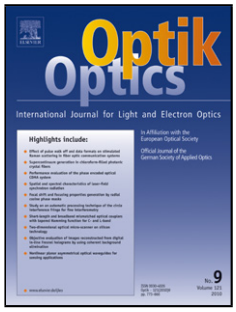

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Fabrication and Properties of ZnO Nanorods based MSM UV Detectors on Silicon Substrates

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Abstract: This work reports the ultraviolet (UV) detection characteristics of zinc-oxide (ZnO) nanorods (NR's) based metal-semiconductor-metal (MSM) devices. ZnO NR's were grown on silicon (Si) substrates (*p*-type) by low-temperature hydrothermal method in two steps. In the first step, approximately 50 nm thick pure ZnO seed-layer was grown on Si, then in the second step, main growth of ZnO NR's were done above seed-layer. The structural morphology of ZnO NR's were investigated by atomic force microscope (AFM) and by cross-sectional scanning electron microscopy (X-SEM) respectively. The results showed that high density NR's were grown uniformly above the ZnO seed layer and the tip of NR's were found in the shape of a hexagonal. After the growth of ZnO NR's, interdigited palladium (Pd) electrodes were deposited by using shadow-mask technique. The electrical characterization of the Pd/ZnO-NR's/Pd based detectors was studied under UV light. The values of contrast-ratio and responsivity were calculated from *I-V* characteristics of MSM UV detectors. These results may be helpful for the simplistic fabrication of hydrothermally grown ZnO NR's based UV detectors.

Key words: Zinc Oxide; Hydrothermal; Palladium; UV detector; Interdigited; *p*-type Si.

1. Introduction

The one-dimensional (1D) nanostructures have been comprehensively studied over the last few decades due to their use in the area of optoelectronics and spintronic devices [1-3]. Among the reported 1D system, the nanomaterials of ZnO is most popular due to their versatile use in various nanoscale devices [1, 2]. ZnO has a direct wide band gap of 3.3 eV, it has a very large exciton binding energy ~ 60 meV and it has high chemical and mechanical stability [4-7]. ZnO nanostructures can be grown in the form of several types of morphologies, like nanoflowers [8], nanorods (NR's) [9], nanoflakes [10], nanowires [2] and nanospheres [11] etc. These ZnO nanostructures are drawing great attention in the area of optoelectronic devices, such as surface acoustic-wave devices [12], chemical sensor [13], light emitting transparent conductors [14], gas sensor [12], solar cells [15], laser diodes [16], and transparent semiconductor electrodes etc [17]. Especially ZnO NR's based ultraviolet (UV) light detectors are attracting attention of many groups because they possess large surface-to-volume ratio and high quantum efficiency in comparison to the bulk ZnO [18-21]. In the recent past, many groups have reported ZnO NR based UV detectors with different structures. C. O. Chey et al reported Au/Fe-doped ZnO NR Schottky diode based UV photodetector [18]. W. S. Wang et al. reported ZnO nanostructure-based SAW oscillator UV detector [19]. L. Luo *et al.* reported heterojunction configuration for *n*-ZnO nanowires/*p*-silicon based UV detectors [20]. R. Azimirad *et al.* reported Fe doped ZnO/ZnO shell/core NR's based UV detector [21]. Many groups have preferred metal-semiconductor-metal (MSM) structures in comparison to other structures for ZnO NR's UV PDs. The MSM structure offer a simple, easy and controllable fabrication process [22-24]. In the recent past many groups have reported ZnO NR's UV detectors with MSM structure. Y. H. Ko *et al.* have reported ZnO NR's UV detectors with MSM structure [22]. They have used hydrothermal method for the growth of ZnO NR's and they have obtained very high on-off ratio ~ 37.4 for ZnO NR's based MSM UV detectors. S. J. Young *et al.* have reported Ga doped ZnO NR's based MSM UV detectors with constant ratio ~15.2 [23]. Vasudevan *et al.* have reported ZnO NR's based MSM UV detectors for different electrode dimensions and ZnO rod lengths [24]. All these groups have mainly used Au or Au/Cr or Au/Ti metal for interdigited electrodes of MSM devices. In this work, we have used