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Focused-ion-beam fabrication of ZnO nanorod-based UV photodetector using the in-situ lift-out technique

Oleg Lupan[*,1,2], Lee Chow[,1], Guangyu Chai[3], Leonid Chernyak[1], Olena Lopatiuk-Tirpak[1], and Helge Heinrich[1,4]**

[1] Department of Physics, University of Central Florida, P.O. Box 162385, Orlando, USA
[2] Department of Microelectronics and Semiconductor Devices, Technical University of Moldova, Stefan cel Mare Blvd. 168, 2004, Chisinau, Moldova
[3] Apollo Technologies, Inc., 205 Waymont Court, S111, FL 32746, Lake Mary, USA
[4] Advanced Materials Processing and Analysis Center, and Department of Mechanical, Materials, and Aerospace Engineering, University of Central Florida, P.O. Box 162385, Orlando, USA

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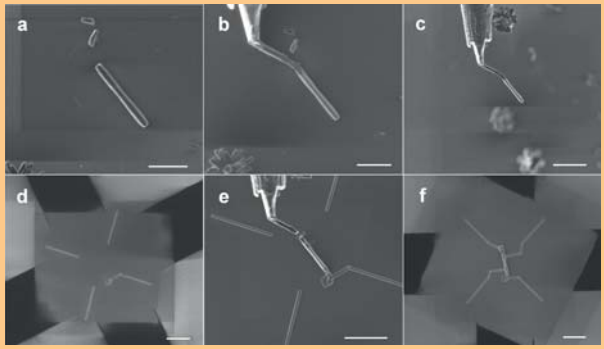
[*] Corresponding author: e-mail lupan@physics.ucf.edu; lupanoleg@yahoo.com, Phone: +1 407 823 52117, Fax: +1 407 823 5112
[**] e-mail chow@mail.ucf.edu, Phone: +1 407 823 2333, Fax: +1 407 823 5112

ZnO nanorods and nanowires are promising candidates as new types of high-sensitivity ultraviolet (UV) photodetectors due to their wide bandgap and large aspect ratio. In this study, single-crystalline ZnO nanorods were grown on glass substrates by a hydrothermal method. Specific structural, morphological, electrical, and optical measurements were carried out. A single ZnO nanorod-based photodetector was fabricated using the in-situ lift-out technique in a focused ion beam (FIB/SEM) instrument and characterized. With a source wavelength of 370 nm and an applied bias of 1 V, the responsivity of the ZnO nanorod is 30 mA/W. The single ZnO nanorod photodetector exhibits an ultraviolet (UV) photoresponse promising for potential applications as cost-effective UV detectors.



Secondary electron images in the focused ion-beam system showing the steps of the in-situ lift-out fabrication procedure in the FIB/SEM instrument.

1 Introduction Recently, much research has been focused on developing compact high-performance solid-state photodetectors in the ultraviolet (UV) spectral range [1–4]. High-tech applications of short-wavelength UV detectors range from commercial to military uses, and from biological and chemical sensing to flame detection and space communications, etc. [3, 5]. One major factor, which stimulates the development of new UV photodetectors is the growing "ozone hole" near the Antarctic linked to a growing number of cancer and skin illnesses [6].

UV detection using photomultiplier tubes [7] requires bulky, fragile and heavy equipment. Solid-state UV photodetectors are more efficient and lightweight [1, 8] and can be easily incorporated in different novel types of micro/nanosystems, such as in devices integrated in cell phones. These portable devices can help people to monitor their exposure to solar UV radiation.

With the development of optoelectronic nanodevices fabricated on wide-bandgap nanomaterials, high-performance UV photodetectors with high responsivity, line-