Single ZnO Hexagonal Nanodisk Photodetectors

Mohammad R. Alenezi,[1] Talal H. Alzanki,[1] Abdullah S. Alshammari,[2] Simon J. Henley,[3] S. R. P. Silva [3]

[1] College of Technological Studies, PAAET, P.O. Box 42325 Shuwaikh, (Kuwait)
[2] Department of Physics, College of Science, University of Hail, P.O. Box 2440, Hail, (KSA)
[3] Advanced Technology Institute, University of Surrey, Guildford, GU2 7XH (UK)

Mr.alenezi@paaet.edu.kw

Abstract

Nanostructured photodetectors have been reported extensively in the last ten years with a great focus on single nanowire photodetectors. The reason behind this focus on nanowire based devices could be related to the challenges facing the synthesis of nanostructures with different morphologies. Using nanostructures in photodetectors is advantageous and expected to enhance the photosensitivity greatly due to two key aspects. The first aspect is that nanostructures usually have a significantly large surface to volume ratio as well as high density of deep level surface trapping states. Both of these properties allow longer lifetime for the photogenerated carriers in the nanostructure. The other aspect is the decreased transit time of carriers because of the reduction in dimensionality of the active area in nanostructured devices. Truthfully, combining these two aspects together may lead to a significant photoconductive gain. [1]
For nanostructured photodetectors, the performance depends greatly on the morphological properties of nanostructures. [2-3] Therefore, it is essential to develop well-controlled synthesis techniques to fabricate highly functional materials for practical devices. Controlled hydrothermal method to produce single crystal ZnO hexagonal nanodisks using a mixed solution of zinc sulphate and hexamethylenetetramine without the need of catalysts, substrates, or templates at low temperature (75˚C) is introduced. Metal-semiconductor-metal photodetectors were fabricated based on individual single crystal ZnO hexagonal nanodisks (Figure 1). The fabricated photodetectors show high photosensitivity and fast response and recovery times. The enhancement in the device performance is attributed to the absence of grain boundaries in the single crystal ZnO nanodisk, high surface to volume ratio, and the polar exposed facets.

References

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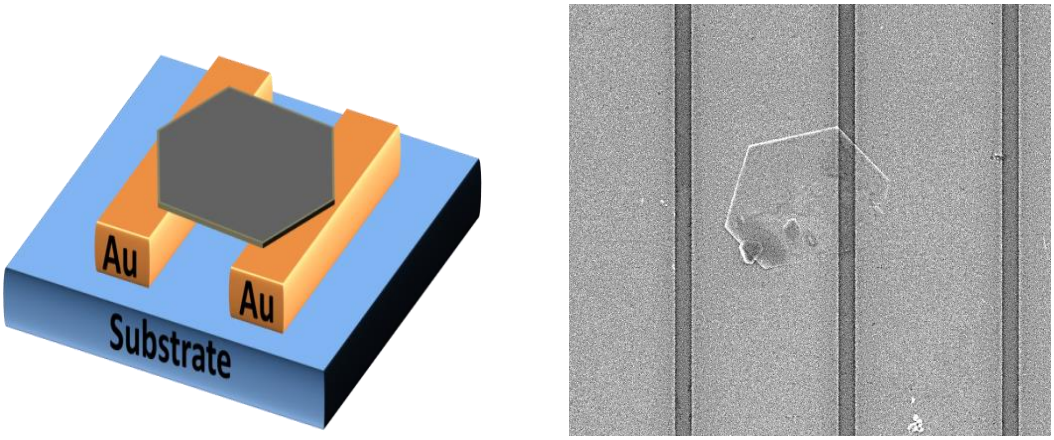

Figure 1: (a) Schematic and (b) SEM image of the hexagonal nandisk photodetector (2.5 µm space between the electrodes)