J Laser Opt Photonics 2018, Volume 5
DOI: 10.4172/2469-410X-C7-042

10th International Conference and Exhibition on
LASERS, OPTICS & PHOTONICS
November 26-28, 2018 | Los Angeles, USA

Ferroelectric localized field enhanced ZnO nanosheet ultraviolet photodetector with high sensitivity and low dark current

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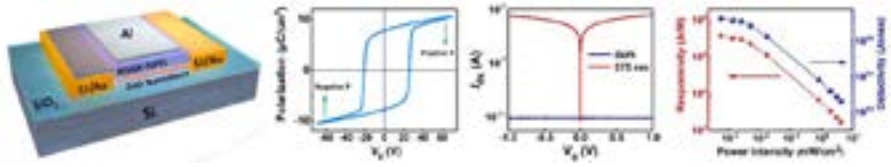
Ferroelectric local field enhanced FET photodetectors are capable of high sensitivity and low dark current without external applied gate voltage, resulting in high signal-to-noise ratio (SNR) and low power consumption performance. This is because the extremely strong ferroelectric local field can effectively deplete the intrinsic carriers of the channel material, leading to the very low dark current to improve SNR of the device. On the other hand, the novel nanostructured (ZnO nanosheet) materials have many excellent properties such as small effective volume, large specific surface area, easiness to modulate the carriers and high photoelectric conversion capability, which break through the theoretical limits of the photoelectric response of conventional thin-film photodetectors. In this report, we introduce an ZnO nanosheet ultraviolet (UV) photodetector driven by ferroelectric thin-film P(VDF-TrFE), which integrated the advantages of these two materials and achieved high-performance with low-power consumption. In this structure, the P(VDF-TrFE) film is used to introduce a local electric field to deplete the background charge carriers without external applied gate voltage and also act as a surface passivation layer to passivate the naturally unfilled traps of ZnO nanosheets. In addition, nano-ZnO as the absorption layer in the device has the advantages of natural direct bandgap, large specific surface area and et al, which provides a basic guarantee for high-performance photoresponse. Thus, ZnO nanosheet UV photodetectors driven by P(VDF-TrFE) reveal an improved optical response and detectivity up to 3.8×10^5 A/W and 4.4×10^{15} Jones, respectively. Moreover, the photocurrent gain is 1.24×10^6, which is far better than other ordinary ZnO UV photodetectors. In addition, the photodetector dark current can be restored to the initial state after continuous photocurrent measurement by using a positive gate voltage pulse demonstrating the potential of integrating the ZnO nanosheets with ferroelectrics for novel optoelectronic devices.



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