Dark current characteristics of thermally treated contacts on GaN-based ultraviolet photodetectors

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The III-V nitrides (GaN and AlGaN) are excellent photodetector materials covering the 200 – 365 nm range, and are extremely tolerant to chemical aggressions. Also, its excellent thermal stability and radiation hardness have made it a highly capable candidate for application from high temperature to high-power devices in caustic environments. One of the most important considerations in fabricating a photodetector is achieving a low dark current condition, which is critical in producing ultraviolet (UV) photodetectors with a high signal-to-noise ratio. For this purpose, thermal treatment has been proven to be a useful method in reducing the leakage current in a Schottky contact, as well as reducing the dark current in a Schottky contact based metal-semiconductor-metal (MSM) photodetector. In this work, GaN based MSM photodetectors (photodiodes) with nickel (Ni) Schottky contacts were fabricated and characterized. The GaN samples used to fabricate the photodetectors were grown on different substrates (sapphire and silicon carbide). A comparative study of the photodiodes characteristics were carried out. The thermal stability of the contacts at various annealing temperatures (300 – 700°C) was investigated. Cryogenic cooling after heat treatment was also performed to determine the effects of this treatment on the electrical characteristics of the devices. Electrical and morphological characterizations were performed by current-voltage (I-V) and scanning electron microscopy (SEM) measurements respectively, to investigate the contact properties of the MSM photodiodes.

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