

# **Schottky barrier diode fabrication on n-GaN for ultraviolet detection**

by

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UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

**TO MY SON**

**LEBOGANG ONKGOPOTSE**

**DIALE**



UNIVERSITEIT VAN PRETORIA  
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# Brain Child

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There are many potential areas for the utilization of GaN-based nitride materials, including ultraviolet photodetectors. Ultraviolet photodetectors are used in the military for missile plume detection and space communications. Medically, ultraviolet photodiodes are used in monitoring skin cancer. Schottky barrier metal-semiconductor contacts are choice devices for the manufacture of ultraviolet photodiodes due to higher short wavelength sensitivity and fast response. They also require simple fabrication technology; suffer lower breakdown voltages, and record larger leakage currents at lower voltages as compared to p-n structures of the same semiconductor material. Thus the formation of a Schottky contact with high barrier height, low leakage current, and good thermal stability in order to withstand high temperature processing and operation are some of the most important factors in improving the performance of Schottky barrier photodiodes to be used for ultraviolet detection. The first stage of this study was to establish a chemical cleaning and etching technique. It was found that KOH was suitable in reducing C from the surface and that  $(\text{NH}_4)_2\text{S}$  further reduced the surface oxides. The next phase of the work was to select a metal that will allow UV light to pass through at a high transmission percentage: a combination of annealed Ni/Au was found to be ideal. The transmission percentage of this alloy was found to be above 80%. The next phase was the fabrication of Ni/Au Schottky barrier diodes on GaN to study the electrical characteristics of the diodes. Electrical

characterization of the diodes showed that the dominant current transport mechanism was thermionic emission, masked by the effects of series resistance, which resulted from the condition of the GaN surface. Finally, we fabricated GaN UV photodiodes and characterized them in the optoelectronic station designed and produced during this research. Device responsivity as high as 31.8 mA/W for GaN and 3.8 mA/W for AlGaIn were recorded. The calculated quantum efficiencies of the photodiodes were 11 % for GaN and 1.7 % for AlGaIn respectively

**Keywords: Al(GaN), Schottky, photodiodes, Ultraviolet, responsivity, quantum efficiency.**

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