

# Characterization of Metal-Semiconductor Contacts using Circular Transmission Line Measurement



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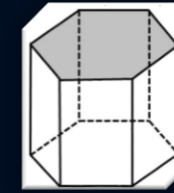
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## Background:

The current-voltage (IV) relationship of a LED's contacts effects the performance of the LED. Linear ohmic contacts are preferred over non-linear Schottky contacts, as ohmic contacts contribute to a lower series resistance. A lower series resistance equates to a smaller loss of power to thermal energy. Also, a lower series resistance contributes to a shorter RC time constant. A shorter RC time constant permits higher bandwidth modulation of LEDs.

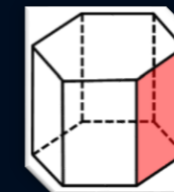
In this chart we offer characterizations done on the IV relationships of various contacts fabricated on the c-plane and m-plane orientations of the GaN crystal lattice.

## C-plane



c-plane orientation of the GaN unit cell.

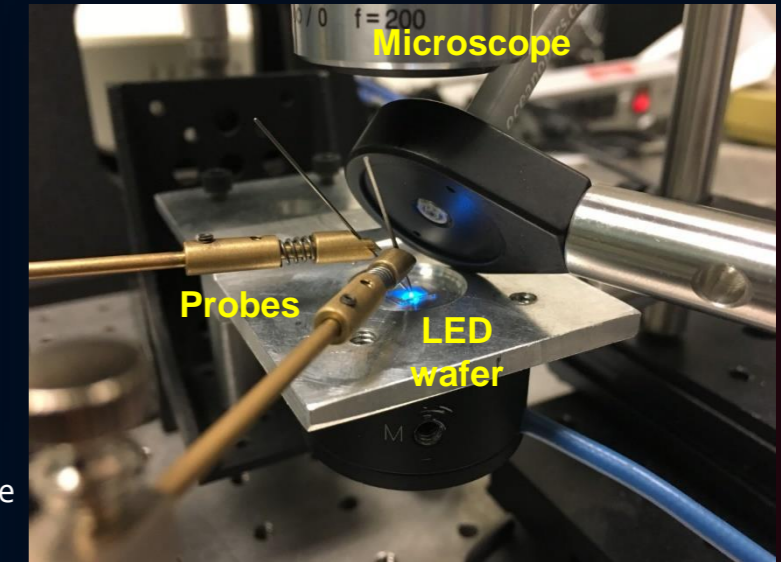
## M-plane



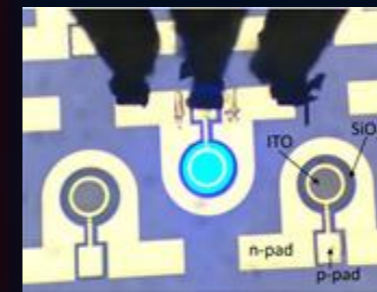
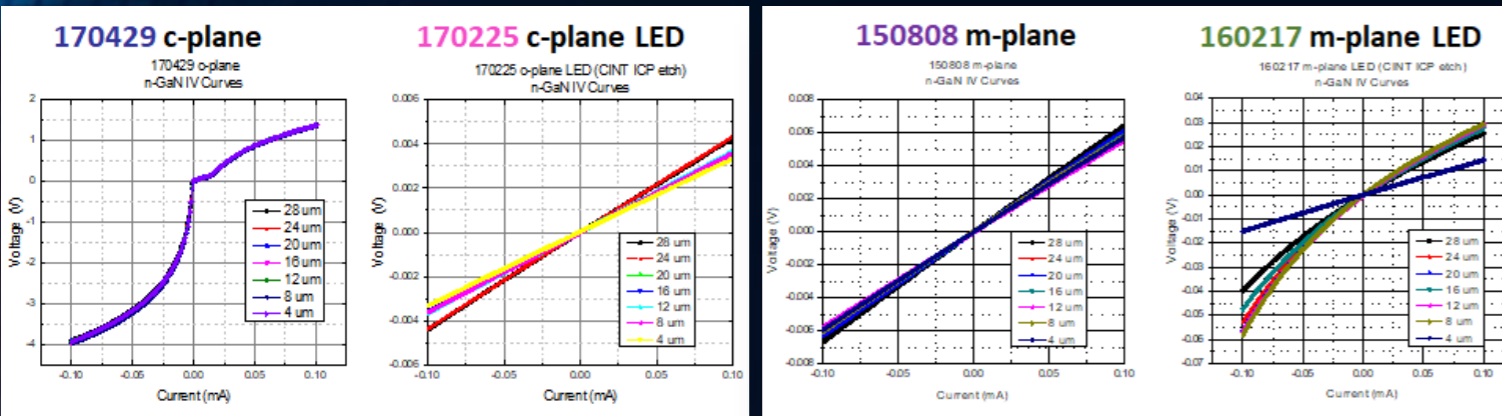
m-plane orientation of the GaN unit cell.



A Circular Transmission Line Measurement device



## Results:



An illuminated LED and it various components.

## Method:

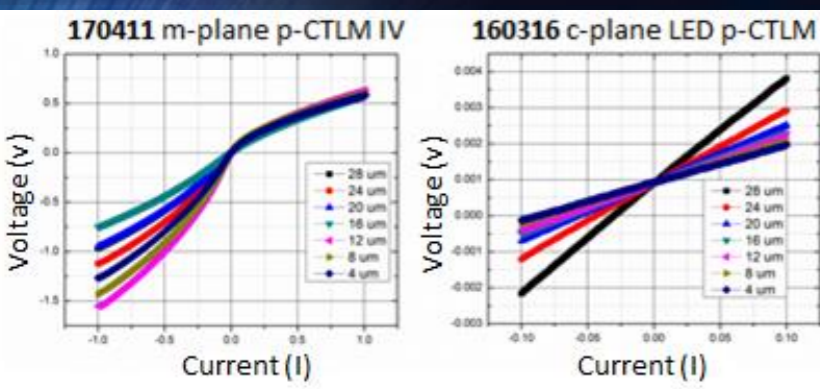
Fabricated and tested CTLM devices on doped GaN and on fabricated LEDs. The CTLM device were fabricated on both n-GaN and P-GaN. For n-GaN various doping profiles were measured while on p-GaN the root mean square surface roughness was measured with an Atomic Force Microscope.

## Conclusions:

The doping profile is an important contributing factor to the current-voltage relationship of a device. By having proper doping profiles and having a smooth interfacial contact layer.

## Future Work:

Investigate how the contact geometry, in addition to the semiconductor doping, effects the IV characteristics and RC time constant of the device.



N-CTLM Sample	Approximate Doping
170429 c-plane n-GaN (not etched)	$4 \times 10^{16}$
170225 c-plane LED (ICP etch @ CINT)	$2 \times 10^{18}$
150808 m-plane n-GaN (Not etched)	$2 \times 10^{18}$
160217 m-plane LED (ICP etch @ CINT)	$2 \times 10^{18}$