High Temperature Characterizations for GaN-based LED Devices

Student: Camara N. Johnson Mentor: Dr. Zhong Chen (ELEG)

Undergraduate School / Major: Hampton University / Electrical Engr

UNIVERSITY OF ARKANSAS
Graduate School & International Education
Microelectronics-Photonics

Microelectronics

Nanoscience

Background/Relevance

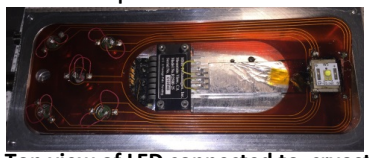
- LEDs are manufactured in a way that the cooler the environment, the higher the light output will be.
- Commercial LEDs that are currently on the market can only withstand temperature up to 425K (~150°C), and uses bulky heat sink to bring down the temperature to get high efficiency.
- GaN-based LEDs however can withstand higher temperatures (>650K) which makes them more ideal.

Innovation

- GaN LEDs will be used in power modules to control circuits for harsh environment applications such as: space applications, automotive industry, deep drilling machines, petroleum excavation, etc.

Approach

- High temperature vacuum test environment is created using MMR hall effect chamber
- Bias the LED with different forward biased current and collect light output using a Spectrometer
- Repeat the measurements for different temperatures varying from room temperature to 475 K
- Study the changes in peak wavelength and intensity at high temperatures

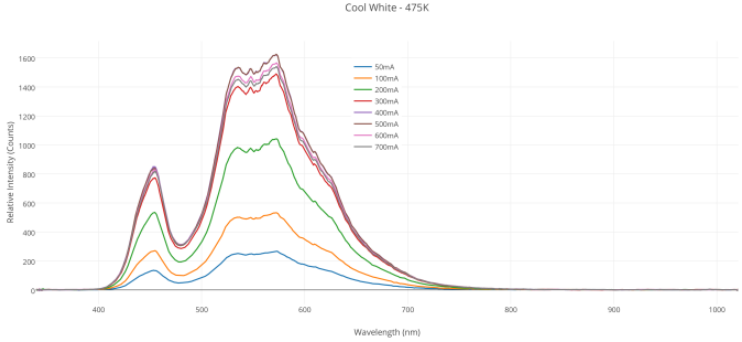


Top view of LED connected to cryostat

Experimental setup

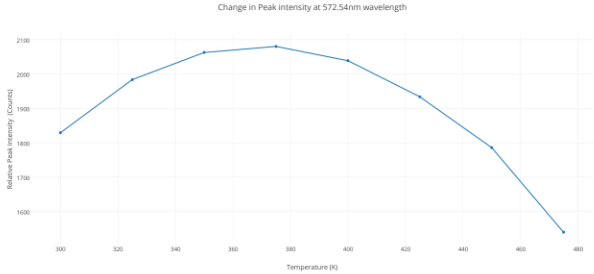
Key Results

- High temperature testing proved that GaN LEDs can withstand high temperature without efficiency droop.
- Collected data shows that the intensity of peak wavelength decreases with temperature as expected.



Conclusions

- GaN LEDs provide improved performance over traditional LEDs for applications requiring high temperatures; more experiments needed.



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