# Thermal Analysis of Packaged Deep Ultraviolet LEDs


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## Abstract


Deep Ultraviolet Light Emitting Diodes (DUV LEDs) are presently operating at a relatively low efficiency, thus large amount of LED driving power is dissipating in heat. Thermal heating degrades LED performance and decreases LED's lifetime. The degradation of DUV LED devices with temperature increase makes thermal management a key issue for DUV LEDs. We present a thermal analysis of DUV LED device by first investigating the thermal resistance of LED chip layers and interfaces, and then considering the overall heating of the LED package. COMSOL's AC/DC Module together with Heat Trasnfer Module was used to analyze the transient heating of the device. In addition, COMSOL Multiphysics Joule Heating interface has been used to analyze the thermal heating of the packaged DUV LED device. The modeled geometry included TO-39 package, submount and DUV LED die for realistic thermal simulations. Figure 1, shows a typical temperature distribution around DUV LED die mounted on submount and TO-39 package. The dissipated power in the device is 0.87Watts, and resulted junction temperature is 13 degrees above ambient. The temperature rise at the DUV LED die is primarily due to thermal resistance of submount, epoxy layer at the submount/TO-39 interface and thermal resistance of TO-39 package. For the calculations shown in Figure 1 the bottom surface of TO-39 package was maintained at the ambient temperature of 296K. To analyze detailed resistance of various interfaces, the transient heating analysis is performed and compared to experimental data for junction resistance fitting. The LED die is also investigated for temperature variations along semiconductor layers to locate regions of high temperature and high temperature gradients. The thermal analysis of DUV LEDs allowed us to identify thermal "bottlenecks" leading to overall device heating and temperature rise at the DUV LED die. The simulations also identified possible routes that will improve thermal management of the LED device and increase its performance and lifetime.

## Figures used in the abstract

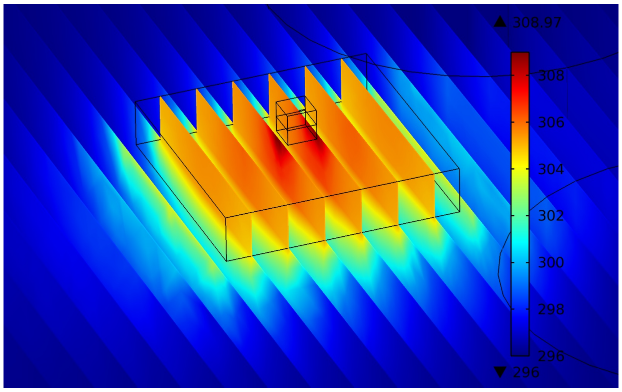


**Figure 1**: Temperature distribution for DUV LED die.