

Comparison between Aluminum 6061 and Ceramic (N9H – Nishimura advanced ceramic) Heat sink on LED light bulb

Overview:

LED cells have the potential to become the fastest developing lighting technology in different fields of electronics, mechatronics, aerospace, and bio-medical due to their longevity and energy-efficiency. LED cell's lifespan and efficiency are affected by the heat generated by the cells. To improve the efficiency of LED lighting, a heat sink module is added to the bulb design to dissipate the heat from the cells. In this project, I examined the difference between an Aluminum 6061 heat sink and an N9H – Nishimura advanced ceramic heat sink. The result showed that the LED bulb is 18% cooler when using N9H ceramic heat sink instead of Aluminum 6061 heat sink.

Properties:		
Ambient Air	Aluminum 6061	Nishimura N9H Ceramic
$h_{\text{conv}} = 50 \text{ W}/(\text{m}^2.\text{K})$	$k_{\text{alu}} = 180 \text{ W}/(\text{m.K})$	$k_{\text{cer}} = 39 \text{ W}/(\text{m.K})$
$T_{\infty} = 20 \text{ }^{\circ}\text{C}$	$\epsilon_{\text{alu}} = 0.08$	$\epsilon_{\text{cer}} = 0.97$

LED cell	$P_{\text{cell}} = 5 \text{ W}$ (each cell)
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Thermal Simulation:

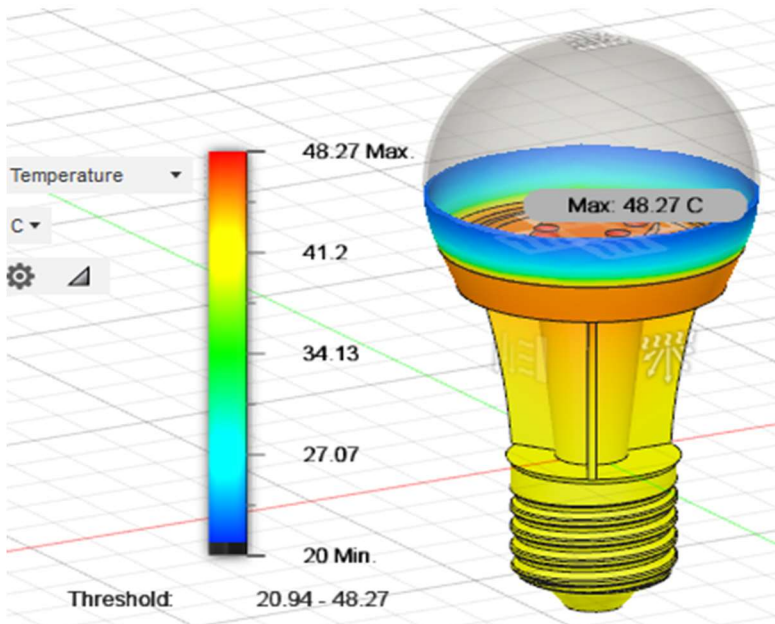


Figure 1: LED bulb with N9H Ceramic heat sink

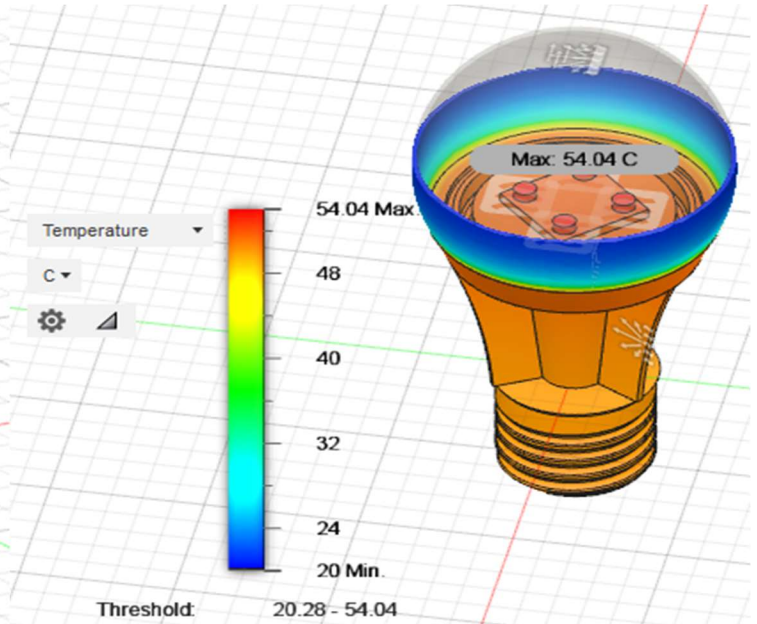


Figure 2: LED bulb with Aluminum 6061 heat sink

Discussion:

With Ceramic N9H heat sink, the LED bulb is at an average temperature of 41 °C. The LED bulb with Aluminum 6061 heat sink is at an average temperature of 50 °C. The LED bulb is 18% cooler when using N9H ceramic heat sink instead of Aluminum 6061 heat sink. These thermal simulations were based on the material characteristics provided by the manufacturer (Nishimura Advanced Ceramic). As LED lighting development advances and the LED cells become much more powerful, ceramic materials will be used widely in not only in lighting but also in many electronics cooling systems. Nishimura Advanced Ceramic also has many different types of ceramic heat sink for other cooling purposes at <https://nishimuraac.com/>

Reference: <https://nishimuraac.com/>