

Bright idea illuminates LED standards

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The lack of common measurement methods among light-emitting diode (LED) and lighting manufacturers has affected the commercialization of solid-state lighting products. In a recent paper, researchers at the National Institute of Standards and Technology proposed a new, economical method to allow LED and lighting manufacturers to obtain accurate, reproducible, and comparable measurements of LED brightness and color.

The quality of the light that high-power LEDs produce depends on their operating temperature. To speed production, LED manufacturers typically use a high-speed pulsed test to measure the color and brightness of their products. However, because pulsed measurements do not give the LED chip time to warm to its normal operating temperature, the measured light output quality is not the same as would be realized in actual lighting products.

The lighting industry uses a steady-state DC measurement approach similar to that used for traditional incandescents and fluorescents. This method involves turning the light on, letting it warm up, and measuring the characteristics of the light produced. Although time-consuming, DC measurement provides a more realistic test of how the lighting product will perform in a consumer's living room. The problem was that researchers did not understand how the DC measurement results correlated with the pulse measurement results that LED manufacturers use.

NIST scientists Yuqin Zong and Yoshi Ohno have created a standard

high-power LED measurement method that satisfies the needs of both LED and lighting manufacturers. The NIST method leverages the fact that the optical and electrical characteristics of an LED are interrelated and a function of the LED's junction temperature (the temperature of the semiconductor chip inside the LED, which is normally very difficult to measure).

The researchers' new method entails mounting the LED on a temperature-controlled heat sink set to the desired LED junction temperature between 10 and 100 °C. After applying a pulse of electricity through the LED and measuring the voltage flowing across the junction, scientists turn on the DC power to the LED and adjust the temperature of the heat sink to ensure the voltage remains constant. When measuring the light output of an LED, this approach allows researchers to achieve a junction temperature similar to that found in a commercial lighting fixture. The measurement results can be reproducible regardless of pulse or DC operation, or type of heat sink.

The new method also allows the measurement of heat flow in and out of the LED, enabling LED and lighting manufacturers to improve the design of the LED and the thermal management system of the associated lighting product. Effective thermal management is important in lighting products because LEDs perform more efficiently and last much longer at lower temperatures.

Citation: Y. Zong and Y. Ohno. New practical method for measurement of high-power LEDs. Proc. CIE Expert Symposium on Advances in Photometry and Colorimetry. CIE x033:2008, 102-106 (2008).

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