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THE RESEARCH ON MEASUREMENT OF LED JUNCTION TEMPERATURE USING SHORT PULSE CURRENT

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With the improvement of brightness and power, LED application is turning to ordinary illumination from the indication, display, and special lighting fields. For the high-power LED applications, the controlling of junction temperature is one of the biggest problems. Excessive junction temperature will affect not only the luminous efficacy, but also makes great degeneration of reliability and lifetime of LEDs. LED junction temperature is closely related with the injection current in PN junction, internal quantum efficiency, output efficiency, thermal resistance coefficient of package material and their interface, and ambient temperature. Therefore, convenient, rapid and accurate measurement of the LED junction temperature has important significance in actual LED applications.

Thermal plotter, spectrometry and voltage measurement are the primary means to determine LED junction temperature and thermal resistance. The measurement of forward voltage under low current is more typical method of the voltage measurement.

A new measuring method of LED junction temperature based on short pulse current was presented by Mr. Yuqin Zong of NIST in the 26th Session of CIE.

This method avoids the shortcomings of traditional methods, such as that voltage-temperature coefficient of tested LED under low current need be calibrated at first, and also should be in relatively large range of linear relationship. The applied measuring current may affect the PN junction temperature, and switching time from rated working current to the low measuring current should be short enough, etc.

In order to obtain accurate results in the actual application, several important issues should be with more recognition, such as the pulse width of measuring current and junction capacitance may bring uncertainties

Based on the short pulse current measurement, a measurement system has been set up. It is composed of an adjustable pulse signal to produce a pulse with stable amplitude and adjustable period and duty cycle, pulse transform gating circuits to separate adjustable pulse signal into several states, a voltage-controlled current source, a high-speed sampling circuit with 1 μ s speed and a thermostatic chamber, etc.

The measurement has been implemented for junction temperature of a 1W white LED by using various pulse-width currents, and the results show that the width of pulse current should be less than 10 μ s. Otherwise due to the influence of junction capacitance, short pulse will influence voltage measurement. Therefore, the pulse width should match with the LED junction capacitance for the accurate measurement.

Finally, the paper draw the following conclusions: 1) In higher working current state, there is good linear relationship between the forward voltage and temperature in LED junction, 2) The junction temperature have a certain influence with the pulse width of measuring current, 3) Short pulse current measurement is a convenient method for the practical application; 4) LED junction capacitance will affect the measurement results.

Key words: LED Junction Temperature, high power LED