DEVELOPMENT OF HIGH-POWER LED CALIBRATION STANDARDS

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In recent years, the LEDs have evolved into light sources and challenge the position of the traditional incandescent lamps in many applications. Therefore, the importance of the correct measurement of LEDs is growing. Up to now, there are only few LED standards on the market, although they are recommended by the CIE127 and the national laboratories as a method of choice for the calibration. Typical luminous intensities of available standards lie in the range of 10 mcd to 100 mcd. With the development of high-power LEDs, the intensity increases rapidly and exceeds the intensity of the standards by up to three orders of magnitude. Therefore, there is a big demand for high-power LED standards. The principle of substitution can be applied for high-power LED standards, because their spectral distribution and intensity are similar to the measured objects.

Common concepts use the forward voltage to control the LED output. In our approach temperature is the control variable to stabilize the high-power LED standards. First results show that temperature as the actuating variable is ideal.

Therefore, the whole thermal management including the ambient surrounding of the LED is an important issue for the development of high-power LED standards. The temperature control is done with a PT-100 sensor placed as close as possible to the LED die. A closed-loop control of a Peltier-cooling element ensures a constant working temperature. A copper-zirconium rod below the Peltier-element acts as a heat sink. All components are placed in a package with a low heat conductivity to isolate the system from the ambience. The package contains a diffuser placed in front of the LED in order to ensure a hemispherical lambertian radiation pattern.

It is a known phenomenon, that LEDs show an initial increase in the light output for the first several hundreds of hours. The reason for the ageing is not fully understood, but it depends on the individual chip technology and the assembly of the LED. Therefore, it is important to perform a degradation analysis of the most established types of high-power LEDs. A number of different LEDs were burnt-in and their seasoning monitored. The drift of the photometric value and the x, y chromaticity coordinates depends on the individual performance of the LED. The behavior of different LED types over the first 2000 hours will be presented at the conference.

First results of the optical characterization of high-power LED standards will be presented:

- The LED reaches a stable photometric value after two minutes.
- The reproducibility is much better than 0.1 %.
- The absolute photometric values are up to 400 times higher than the currently used LED standards.
- Long-term tests over 20 hours show very good stability in optical output, which matches the measuring accuracy (see figure 1).

The figure below shows an example of a long-term measurement for an amber LED at 350 mA. The luminous intensity is stable within 0.05 % for a period of 16 hours. The measurement setup was driven at room temperature.

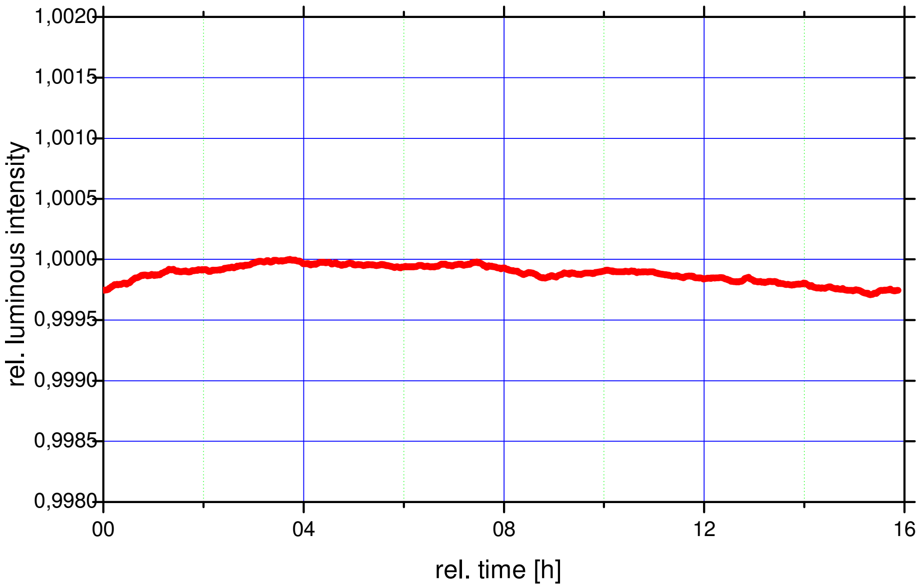

Figure 1: Long-term stability of an amber LED