PHOTOBIOLOGICAL RADIANCE MEASUREMENT IN LEDS' RADIATION SAFETY ASSESSMENT

Tongsheng Mou[1] and Jiandong Yu[2]

[1]*Optical Engineering Department of Zhejiang University, Hangzhou, China*
[2]*Zhejiang University Sensing Instruments Co., Ltd, Hangzhou, China*

LED technology as well as its applications is growing very fast, powerful and high brightness products are continued to be brought to the marketplace, which deserve more attention to the hazard of LED radiation now. Primarily, the enlargement of the induced current and the multi-chips integration technologies, bring high power lighting LED products. Again, novel technologies, e.g. using of photonic crystals on the surface of LED chips, make LED device more efficiency. Furthermore, beam-forming optics which is widely used in some LED application products collimates the light emission of LED devices and enlarges the exposure on the human retina. Besides, applications of deep blue or UV LED chips, increase the possibility of radiation ocular hazard, especially for children, whose lens are more transparent over shorter wavelength in visible range.

Nowadays, there are two physical measurements for LEDs' radiance. One is calculated based on the radiant intensity in far-field and the emission area of the LED. The other one is a physical radiance based on average LED intensity at a specified position in CIE 127. However, what we have to determine in LEDs' radiation safety assessment is the weighted radiance based on the photobiological effects, which is related to hazard action spectral function, physiological status of human eye, viewing condition, and the radiance distribution and location of the apparent source. Therefore, there is great difference between the photobiological radiance and the physical radiance, which greatly challenge traditional measurements.

Existing commercial radiance meters and spectral radiance meters are the physical instruments, whose measurements are generally different from that for the photobiological radiance, including the field of view, aperture diameter, spectral weighting function, and temporal response.

More bothersome, multi-LED modules or arrays are widely used in SSL products, and the beam-forming optics may also be assembled together, which induce the beam configuration and the location of apparent source to be more complex, and bring great confusion in photobiological radiance measurement for LEDs' radiation safety assessment.

In this paper, we present a practical measuring method and the principle scheme of the measurement system. Meanwhile, the blue light weighted radiance of a high power LED and other two LEDs module products are determined in accordance with IEC62471-1(CIE S009). Moreover, the results based on the measurement in far-field and the average LED intensity are compared with above photobiological radiance.

Besides, we find the luminance/radiance conservation law in optical system will be not suitable for the photobiological radiance in LEDs' radiation safety assessment, and also propose how to evaluate the safety class of LEDs' application products from the assessment of independent LED devices.

Keywords: Photobiological measurement, Optical radiation hazard, Weighted radiance.