Comparison Measurements of LEDs: Spectral power distribution

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Five temperature stabilized LEDs were chosen, a blue, a green , a yellow, a red and a white one to measure their relative spectral power distribution by different methods and at three different locations. From the spectra colorimetric characteristics have been calculated and compared.

The chosen LEDs were all high efficiency types except the yellow. All where mounted in a housing which maintained the junction temperature at slightly above room temperature within ±0,5 °C and their forward current was set at 20 mA ± 0,1%. The light output remained very stable throughout the entire measurement cycle.

First measurements were performed at NIST in Gaithersburg using their spectroradiometer and standards; next they were sent to INPHORA Inc. in California where they were retested at their single grating scanning spectroradiometer system using NIST tracable standards using 2 nm and 10 nm bandwidths settings. As a next step the LEDs have been measured on a grating plus prism double monochromator spectroradiometer at Tenzi Kft and finally the five LEDS were sent to the University of Veszprem (Hungary) for testing on a CCD+spectrograph system. Standards for the tests in Hungary were calibrated at OMH (Hungarian National Laboratory).

At Tenzi detailed investigation were made to show how the colour temperature uncertainty of the incandescent lamp standards influenced the results. Measurements were also performed using different band-widths and step sizes (2 nm, 5 nm and 10 nm). A de-convolution programme was used to show how a measurement with larger band-width could be corrected in case the light intensity is not sufficient for smaller band-width measurements. (For the red LED the sensitivity of the Tenzi instrument was too low to work undoubtedly above noise level.

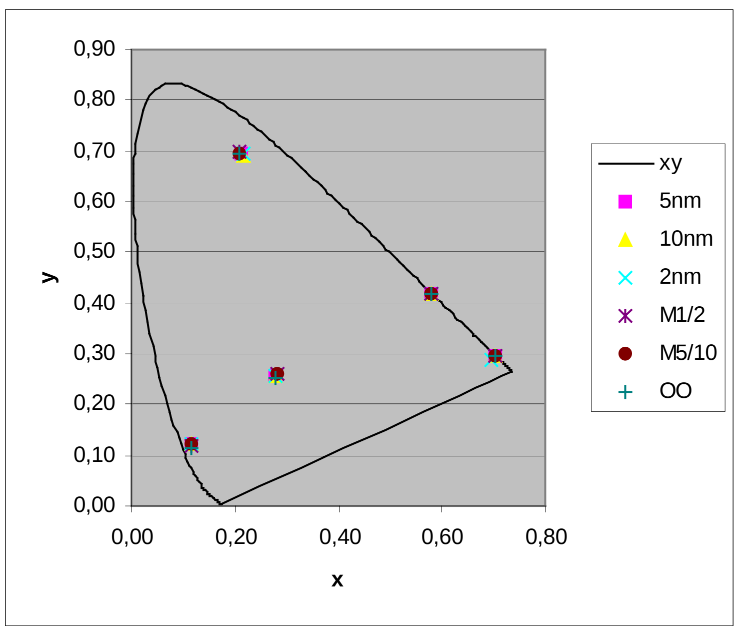

Figure 1.: Chromaticity of the five LEDs tested.

Fig. 1 shows the chromaticity of the five LEDs measured in the different laboratories. In this representation the results of the single laboratories are too near to each other to be well resolved. In Fig. 2. we show on the example of the measurements of the white LED results obtained in different laboratories, partly also using deconvolution to see how spectral measurements made with relatively broad slit width can be corrected to get results taking the bandwidth into consideration .

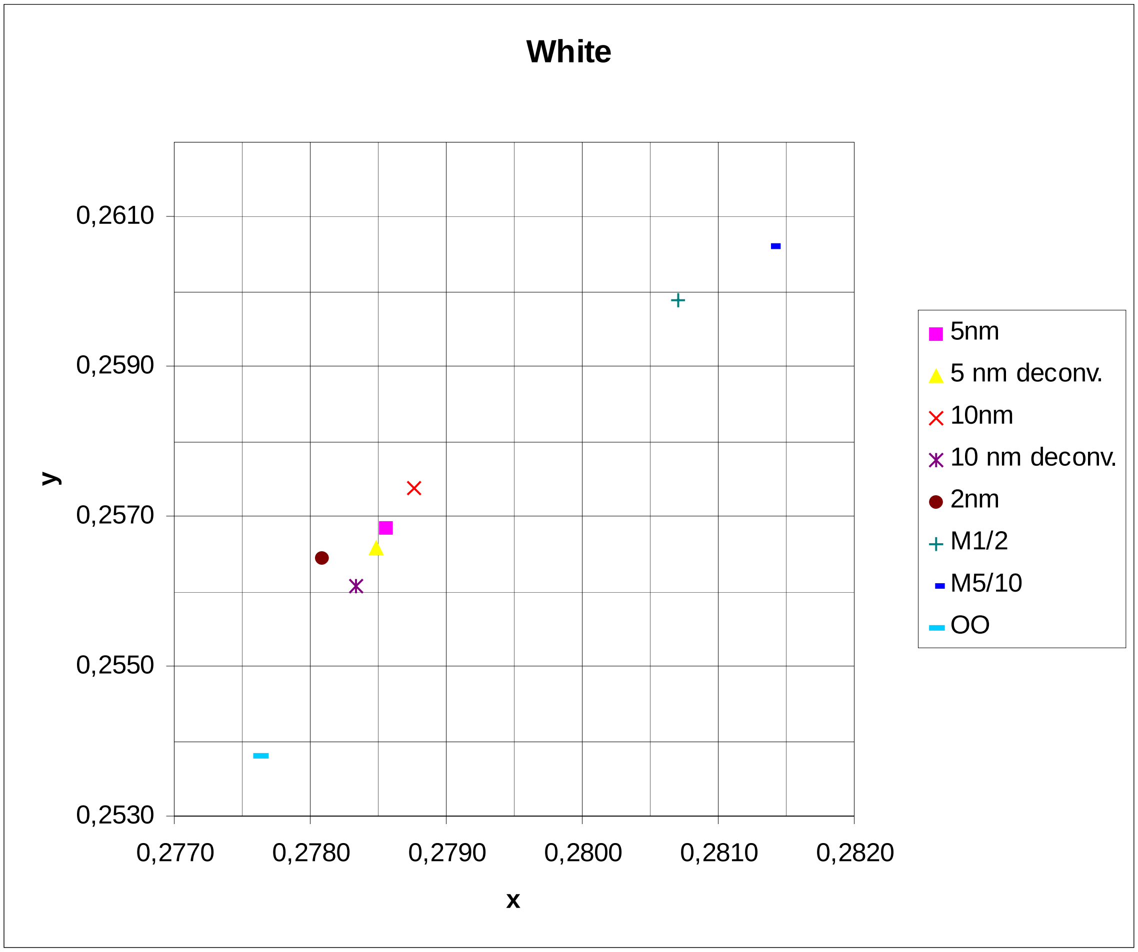

Figure 2.: Chromaticity of the white LED measured with different instruments: ◆: double monochromator 2 nm bandwidth; ■: double monochromator 5 nm bandwidth; ▲: double monochromator 5 nm bandwidth, deconvolution; x*: double monochromator 10 nm bandwidth;*✱ *double monochromator 10 nm bandwidth, deconvolution;* **+***: single monochromator 2 nm bandwidth; -: single monochromator 10 nm bandwidth; —: diode arrey spectroradiometer*

At the meeting the influence of the stray light of the monochromator, the aligning of the LEDs, band-width and sample size effects will be deal with.

The attainable measurement accuracy using spectroradiomeric instruments or well calibrated LEDs and tri-stimulus instruments will be touched as well.