Exploring a Method for Measuring OLED Lumen Depreciation

Currently, there is no industry standard for measuring and reporting OLED lumen depreciation and life-time data, critical for OLED technology to gain widespread adoption. Because OLED is an area source, it is important to understand not only the overall light output depreciation but also the uniformity of the panel over time. Therefore, LRC researchers explored a method for measuring OLED panels using an imaging photometer.

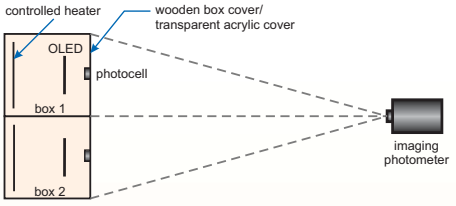
Experiment and Results

Two samples of two different commercial white OLED panels procured between September and October 2012 were tested. Each product was tested at rated and maximum allowed current, at a constant ambient temperature of 38°C. Each OLED panel was placed vertically in an enclosed temperature-controlled wooden box. Photocells, V(λ) corrected, were mounted in each test box to monitor the relative light output change throughout the long-term test of 13,730 hours. Periodically, the imaging photometer was used to measure the luminance of each OLED panel.

Condition	OLED Panel	Current
1	A	Max. allowed
2	A	Rated
3	B	Max. allowed
4	B	Rated

OLED panel measurement parameters

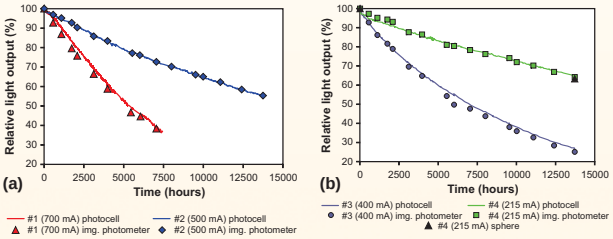
The lumen depreciation results measured by the photocells and the imaging photometer matched well. The integrating-sphere data further validated the beginning and end results from the photocell and the imaging photometer for condition #4. Both types of OLED panels showed faster light output degradations at higher current. The lumen depreciation to 70% (L_{70}) from the initial values for the two types of panels at rated currents of 500 and 215 mA, luminance values of 3405 and 2675 cd/m², were 8149 hours and 10885 hours.



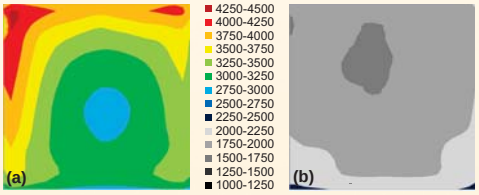
Schematic of the experiment setup for long-term testing of OLED panels

Conclusions

The results demonstrate that 6000 hours of data collection was sufficient to accurately estimate L_{70}. The lumen degradation analysis in this study was based on the average luminance on each OLED panel, which may not be sufficient to represent the performance of the whole panel. Because the OLED is a large area source, a useful lifetime definition needs to include not only L_{70} but also luminance uniformity and color uniformity.



Lumen depreciations of: (a) Panel A at higher current of 700 mA (condition #1) and rated current of 500 mA (condition #2); (b) Panel B at higher current of 400 mA (condition #3) and rated current of 215 mA (condition #4).



Luminance (cd/m²) of OLED panel A operated at rated current (500 mA) at: (a) 0 hours; (b) 13730 hours. This OLED panel degraded faster at the top than at the middle and bottom parts of the panel, which is likely because of the higher initial luminance at the top of the panel and the ambient temperature gradient surrounding the panel due to its vertical positioning.

For Details

Zhu Y, Narendran N, Tan J, and Mou X. 2014. An imaging-based photometric and colorimetric measurement method for characterizing OLED panels for lighting applications. *Proceedings of SPIE* 9190: 91900E. Available: http://www.lrc.rpi.edu/programs/solidstate/pdf/Zhu-SPIE2014.pdf.

Sponsor

New York State Energy Research and Development Authority (Agreement number 34929)

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