competitive as compared to the OLED technology. Moreover, this technique can be conveniently integrated with existing production process and is cost effective. These attractive features guarantee QD display as a promising backlight solution for next generation LCD.

Recently, Samsung [25] and Nanosys [22] reported their products to cover 104.3% and 109% NTSC in CIE 1931 color space. Our simulation results shows there is still room for improvement. The gap between our simulation results and real product's performance may attribute to the control of FWHM and central wavelength of each color component. The spectral distribution of QD emission is mainly affected by the inhomogeneous broadening due to size and shape distributions of QDs, and the central wavelength is mainly influenced by the average size of the QD particles (and also composition). Current synthesis techniques, such as rapid-injection method and continuous flow method, have evolved quickly and enable precise control of QD size and shape [21]. With this synthesis improvement, QD backlight can have an even brighter future.

4. Conclusion

We report a photometry study on QD-based backlights for liquid crystal display. The optimal emission spectrum is obtained by multi-objective optimization method. The fundamental tradeoff between display system's efficiency and color gamut is observed and responsible mechanisms explained. QD backlight outperforms conventional backlight sources in both system efficiency and color gamut. Especially it can reach color gamut of 115% NTSC standard in CIE1931 color space and 140% NTSC in CIE 1976 color space while keeping the same energy efficiency as conventional light sources. Our photometric study proves that QD is a competitive backlight solution and also provides some guidelines for improving QD backlight design.

Acknowledgments

The authors are indebted to Yu-Chieh Lin and Wen-Ching Tsai of AU Optronics (Taiwan) for providing the transmission spectra of color filters, Rongjun Xie of National Institute for Materials Science (Japan) for providing the spectrum of phosphors-based WLED, and Tony Wang of 3M for useful discussion. This work is supported by Industrial Technology Research Institute, Taiwan.

#195594 - $15.00 USD Received 12 Aug 2013; accepted 10 Oct 2013; published 25 Oct 2013