The Effect of Color Reproduction Properties at TFT-LCD using High Color Reproduction CCFL

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Recently, color reproduction properties have attracted lots of attention with mass production of LCD especially corresponding to TV application and achievement of color reproduction properties such as CRT have been considered one of technical goals for high quality display. However, revision of the color reproduction properties only with CF(color filter) have fundamental limitations and resultant decrease in the transmittance of panel causes demand on high brightness of BL(Back Light). In this paper, we present such a method in which by optimization of original light spectrum from the BL source will improves the color reproduction properties corresponding to them of the CRT. When the intensity of RED and Green-Blue from ramp is revised densely, the characteristics different from CCFL(Cold Cathode Fluorescent Lamp) used before become added so that about 11 % of the color reproduction properties is improved compare to the existing LCD panel.

Keywords : TFT-LCD, Wide color gamut, Backlight, Color reproduction, CCFL(Cold cathode fluorescent lamp)

1. INTRODUCTION

In these days, demand on LCD(Liquid Crystal Display) for a TV panel have increased so that characteristics of the LCD have been tuned to TV applications[1].

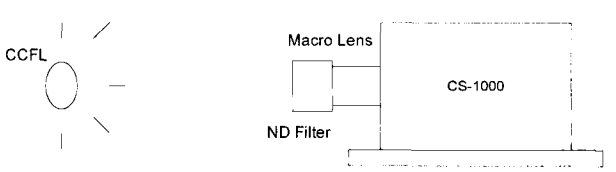
A wide variety of technologies for LCD-TV such as fast driving without an image sticking, high contrast ratio, wide viewing angle have been investigated[2-5] and the color reproduction properties also have been studied intensively as a part of them[6-8].

Generally, the demand on high color reproduction properties of the LCD was limited to experts. However, the high color reproduction properties are getting more important as the LCD-TV market grows. In fact, most of LCD-monitor have 60~70 % of the color reproduction properties of the CRT. The TV market oriented moving picture needs the color reproduction properties corresponding to the CRT in order to achieve high quality of display.

Previously, adjusting characteristics of the CF has been employed for improving the color reproduction properties. Unfortunately, this process causes decrease in brightness and has functional limitation on implementing colors. The emitted light from CCFL(Cold Cathode Fluorescent Lamp) used as a BLU(Back Light Unit) is comprised with Green-centered three wavelengths, differently from a visible ray which covers all the range of the wavelength. Because this emission-center wavelength is not identical with a color domain coordinated in a luminosity curve, the improvement of the color reproduction properties is one of the considerably difficult issues. In this study, a fluorescent body of the CCFL is revised and optimized with consideration of the luminosity curve and absorption spectrum of the CF on the basis of measured spectrum of the existing CCFL. It is also investigated that the color reproduction properties are improved without additional revision of the CF.

2. EXPERIMENTAL

The spectrum data of the existing and improved CCFL was measured by the Spectroradiometer shown below in the Fig. 1.



* Spectroradiometer : Minolta. Co., CS-1000

Fig. 1. Measurement of spectrum and brightness.

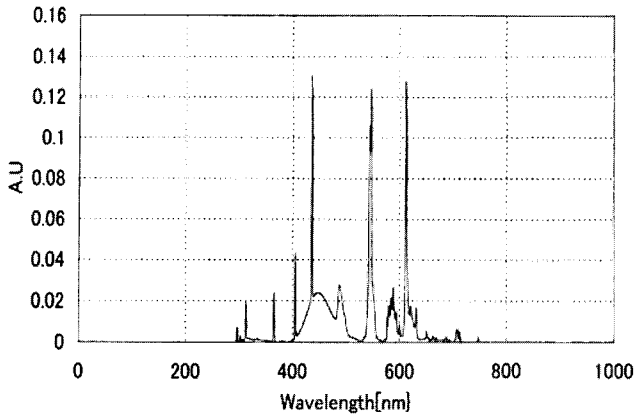


Fig. 2. The emitted spectrum of the existing CCFL.

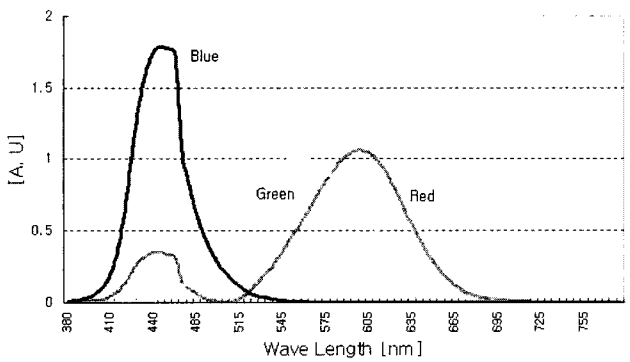


Fig. 3. Luminosity curve.

The emission center wavelength was obtained by measuring emitted spectrum of the existing CCFL and resultant curve is exhibited in Fig. 2. As shown in Fig. 2., the Blue in the short wavelength area has a peak at the wavelength between 440 nm and 500 nm and the Green has a 555 nm highest-peak center. The Red in the long wavelength area has a 620 nm emission center wavelength.

When evaluating the resultant color reproduction properties considering luminosity curve displayed in Fig. 3., the most important reason why the color reproduction properties is low is that the Blue and the Red is overlapped around 450 nm. It is found that the wavelength area of the Blue from the existing CCFL bothers the color reproduction by the Red.

Considering upper luminosity curve, we shifted the position of the Blue peak to around 520 nm through adding a fluorescent body which has a midway peak of the Green and the Blue so that the light source improved color reproduction properties is designed.

As a result, the light source which can adjust emission spectrum was fabricated and the improvement of the color reproduction properties was confirmed. The revised part of the improved light source was expressed in a bold line.

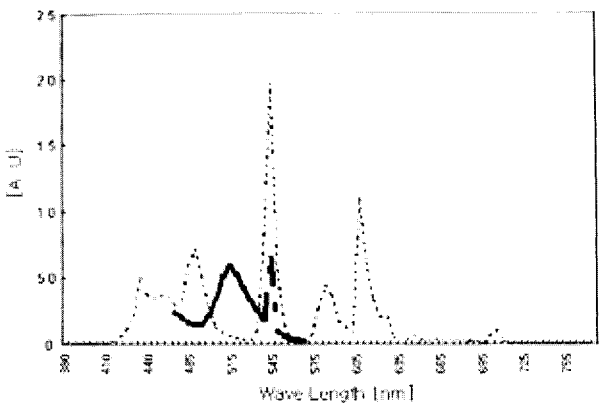
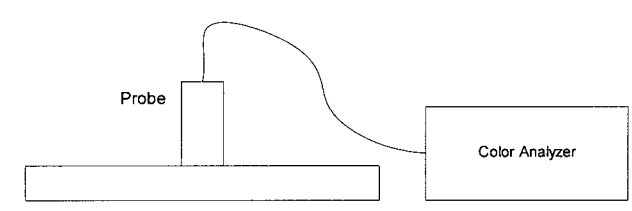


Fig. 4. Comparison of the emitted spectrum of the improved and the existing CCFL.

3. RESULTS AND CONCLUSION

Figure 5 shows the color reproduction properties measuring method using LCD module employing the improved CCFL with revised emission spectrum. After driving RGB patterns, the color reproduction properties were measured by the color analyzer. The measured results were described into the chromaticity diagram on the CIE color coordinates and converted into area compared to NTSC. Figure 6 exhibits each color reproduction properties of the existing and the improved CCFL. As depicted in Fig. 6., the chromaticity diagram become larger around Blue-Green area as a center. It is found that the increased area means the improvement of the color reproduction properties. And the practical values are arranged below.



* Color Analyzer : Minolta. Co., CA-110.

Fig. 5. Measurement of chromaticity diagram with Color Analyzer.

Table 1. Results of the color reproduction properties: the existing CCFL and the improved CCFL.

	NTSC	Existing CCFL	Improved CCFL
the color reproduction properties [%]	100	67	78

* Used normal 17-in Panel.

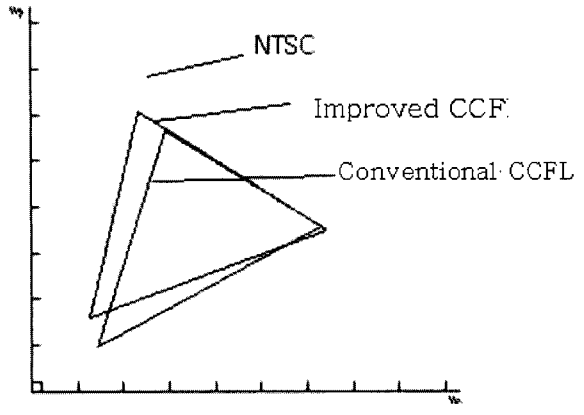


Fig. 6. The color reproduction properties on the CIE coordinates compared to NTSC.

As can be seen in Table. 1., it was revealed that the improved CCFL have more 11 % of the color reproduction properties than the existing CCFL when using the same LCD panel.

In the Fig. 6., the area of chromaticity diagram on the CIE color coordinates increased and therefore it is found that adjusting only back light source without revision of the CF could be a reasonable method to improve the color reproduction properties decently. Moreover, it is available without the variation of LCD fabrication process or materials and sequent high reliability of stable yield can be expected. It is also a promising way to achieve high color reproduction properties for the LCD applications such as high definition TV, Multimedia, etc.

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