Abnormal Discharge Characteristics of Fluorescent Lamp

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Abstract

In this paper, we investigated influence of gas pressure and gas mixing ratio on the abnormal discharge characteristics of fluorescent lamp. Abnormal discharge characteristics have been examined by changing inner gas pressure and mixing ratio. As the inner gas pressure and mixing ratio increase, the occurrence of abnormal discharge was delayed. It was found out that the occurrence of abnormal discharge is sufficiently delayed at the optimized inner gas pressure and mixing ratio.

1. Introduction

According to the latest global TV shipment results, worldwide shipments of LCD TV overtook CRT TV. The demand for LCD module is increasing rapidly. With the increase of the portion of LCD TV, the portion of BLU (Back Light Unit) in overall LCD module also increases significantly. LCD is non light-emitting device, so it inevitably needs a BLU and its driving system. A BLU occupies the biggest part of material cost in Liquid Crystal Display. As the screen size becomes larger, the backlight cost gets higher. Also a backlight is one of the most important parts to determine the picture quality. There are several requirements for LCD TV from market such as fast moving picture quality, high luminance, high efficiency, lower power consumption, color gamut, long life time and etc. Therefore, the innovation on the backlight technology has become very important thing to solve these requirements. The discharge fluorescent lamp has been used widely as a light source in the BLU. Recently, even though new light sources have been constantly examined in the backlight for LCD TV, fluorescent lamps are still used widely in large size LCD TV. The discharge fluorescent lamp has been mainly used for light sources of BLU. LCD manufacturers and research groups are concerning about fluorescent lamp's technical issues like high luminance, high efficiency. Inner gas pressure and mixing ratio influence on the abnormal discharge characteristics. To find out abnormal discharge characteristics as a function of inner gas pressure and mixing ratio, we investigated electro-optical characteristics of discharge fluorescent lamp which has been examined by changing inner gas pressure and mixing ratio.

2. Experimental

The abnormal discharge was observed in discharge fluorescent lamp for high efficiency. The total length of examined discharge fluorescent lamp was over 900mm and its volume was 3015mm^3 with low inner gas pressure and mixing ratio in the glass tube.

3. Results and discussion

Inner gas pressure and mixing ratio play a very important role in discharge characteristics of lamp such as starting voltage, operating voltage, current, and luminance. Figure 1 shows the spectrums of normal and abnormal discharge. From 650nm to 780nm wave length emission spectra with high intensity was observed in spectrum data from abnormal discharge. It means that one and only discharge emission occurs in case of abnormal discharge.

Figure 2 shows the characteristics of firing and operating voltage in case of abnormal discharge. The firing voltage of abnormal discharge sample is approximately 200Vrms higher than the firing voltage of normal discharge sample. The firing voltage is abnormally high. The abnormal discharge is caused by exhaustion of inner gas in the fluorescent lamp.

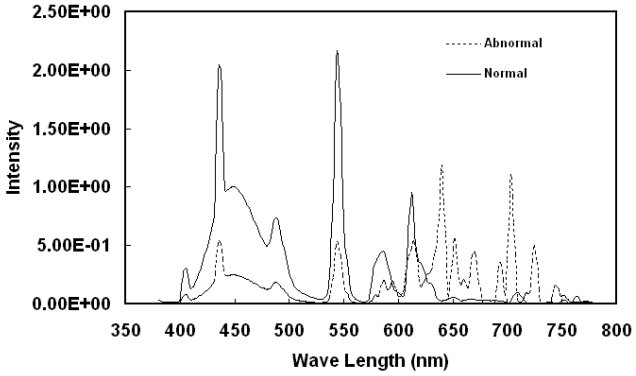

Fig.1. Spectrums of normal and abnormal discharge.

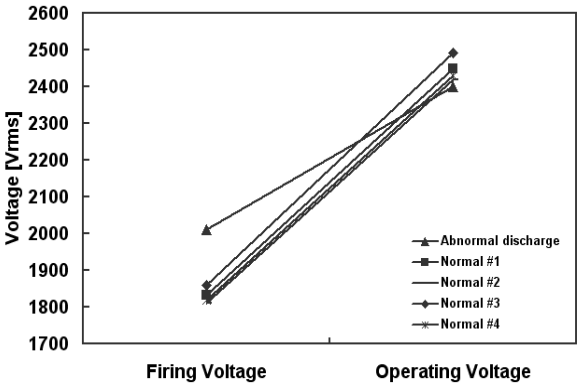

Fig.2. Firing and operating voltages for abnormal discharge.

Figure 3 shows the trend of electrode temperature by changing electrode length. As the electrode length increases, the temperature of electrode decreases when cold cathode fluorescent lamp is used. The rise of electron temperature accelerates exhaustion of Hg inside of the lamp. It is explained by the probability of Ion bombardment at the surface of electrode. Increase in the electrode temperature causes the abnormal discharge.

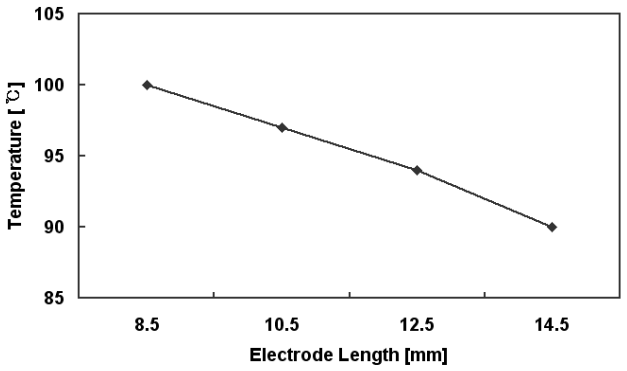

Fig.3. Electrode temperatures for various electrode length

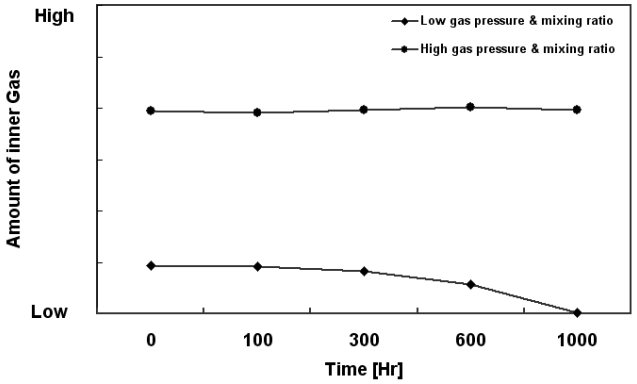

Fig.4. Characteristics of gas-consumption by changing inner gas pressure and mixing ratio.

It is possible to control the abnormal discharge by increasing inner gas pressure and mixing ratio. Figure 4 shows the characteristic of gas-consumption by changing gas pressure and mixing ratio. As the mixing ratio of inner gas increases, the gas-consumption in the glass tube decreases. In addition, gas-consumption decreases as inner gas pressure increases. These characteristics were also observed in other gas pressure and mixing ratio. It means that the higher gas pressure and mixing ratio prevent the occurrence of abnormal discharge.

4. Summary

In this study, we fabricated several discharge fluorescent lamps and investigated its abnormal discharge characteristics by changing inner gas pressure and mixing ratio. It was found out that the occurrence of abnormal discharge was sufficiently delayed at the optimized inner gas pressure and

mixing ratio. The abnormal discharge characteristics reported in this paper provides an effective solution for high efficiency and luminance in fluorescent lamps by controlling the gas pressure and mixing ratio.

5. References

1. T. S. Cho, et al., Japan. J. Appl. Phys. 41, L355 (2002).
2. S. J. Kim, et al., SID'02 Digest, p1511 (2002).
3. T. S. Cho, et al., Japan. J. Appl. Phys. 41, Part 1, No.12, p7518 (2002).
4. T. S. Cho, et al., IEEE Trans. on Plasma Science, 30, No.5, p2005 (2002).
5. B. S. Kim, et al., SID'03 Digest, p1372 (2003).
6. J. B. Kim, et al., SID'06 Digest, 26.3 (2006)
7. J. S. Yoon, et al., IMID'06 Digest, p1289 (2006)
8. J. F. Waymouth, Electric Discharge Lamp, the M.I.T. Press (1971).