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B-3-2 Photochemical Display – a New Type of Display Device –

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This paper proposes a new type of display device using photochemical phenomena and describes its basic properties. A light-value large screen display has the advantages of high brightness, large screen size and high efficiency compared with light-emitting displays.

The present display device utilizes an organic liquid cell, a short wavelength laser, light deflectors and a schlieren optics. The laser beam induces refractive index change in the organic liquid cell and the schlieren optics converts the refractive index change into the bright image on a screen. Figure 1 is the experimental arrangement of the schlieren optics used in the present experiment.

A certain kind of organic molecules, azobenzene, stilbene, azoxybenzene, 7-diethylamino-4-methylcoumarin , acetone and carbon tetrabromide were found to change the refractive indices by absorbing the 3250Å or 4416Å light. Among them, we selected the azobenzene ethylalcohol solution, since it can respond the 4416Å laser light.

Figure 2 shows a light intensity profile of the spot image formed by a 10.4mW TEMoo laser beam with 200μm diameter. The peak intensity profile changes with the exposure time. Figure 3 is the response characteristics of the peak intensity for 10.4mW laser power. The rise time is about 1.9 sec. Slight increase of the intensity was observed immediately after stopping the laser beam. Figure 4 shows the relationship between the contrast ratio and the exposure time. Bmax-on/Bmin and Bmax-off/Bmin correspond to the contrast ratio measured at t_1 and t_2 in the Fig.3, respectively. The maximum contrast ratio was 320:1. The 1/e decay time of the spot image brightness for 10.4mW laser power is shown in Fig.5. The shortest decay time was 26msec for 8msec exposure time and the longest decay time did not exceed 1.3sec for exposure time longer than 2sec. The resolution was about 1.25 lines per mm on the cell, even for longer exposure times, although better resolution is obtained for shorter exposure times. It should be kept in mind that these results include the characteristics of the schlieren optics as well as that of the material. The laser beam scanning speed at 4.5cm/sec on the cell was sufficient for a clear image. A photograph of a line image produced by scanning the laser beam with an optical scanner is shown in Fig.6. The image was very stable.

Several different mechanisms are possible to cause the refractive index change. We suppose photoisomerism for azobenzene, stilbene and azoxybenzene and formation of excited molecules for 7-diethylamino-4-methylcoumarin and acetone. For carben tetrabromide it is presumably due to dissociation yielding free radicals.

The present type of display device is possibly suited for large screen displays of dynamic line image.

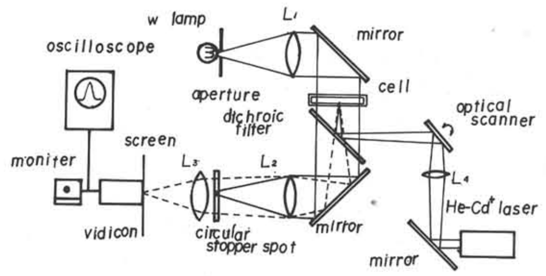

Fig.1 Experimental arrangement

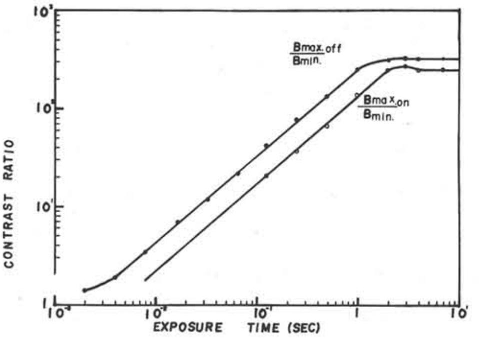

Fig.4 Contrast ratio versus exposure time

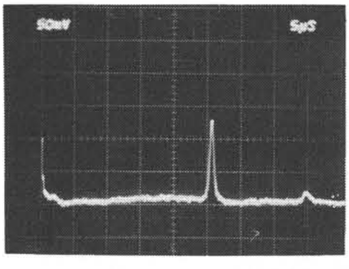

Fig.2 Light intensity profile of the spot image

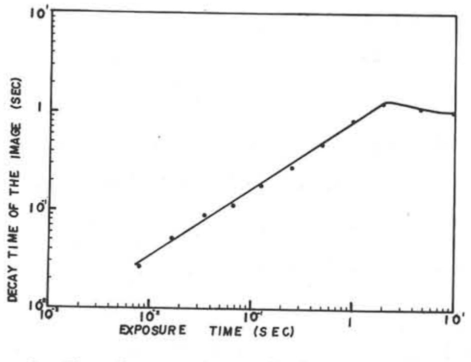

Fig.5 The decay time of the spot image

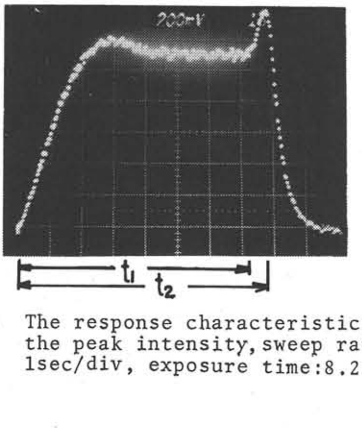

Fig.3 The response characteristics of the peak intensity, sweep rate: 1sec/div, exposure time:8.2sec

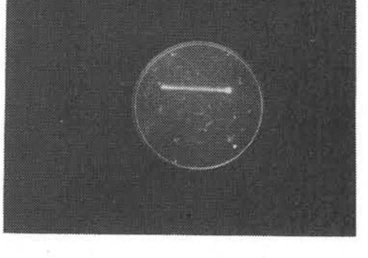

Fig.6 A photograph of a line image