O-28

Production of retardation film with pixel strusture

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1. Introduction

At present the commercial success of LC displays is achieved due to the high characteristics of quality: viewing angles, contrast, price, etc. For example, LC display have been used for creation of 3D images by means of forming images on the display for the left and right eye and using of polarizing glasses for the left and right eye. It allows us to see the resulting 3D image. Such a system can be implemented by means of using of a pattern phase retardation film which is placed on the display screen. The retardation film is a structured phase plate with display pixels order resolution which allows to form lines of images for the left and right eye without loss of image quality [1].

2. Results and discussion

One of the approaches to obtaining of 3D images is a pattern formation by means of photoalignment, namely, the surface is coated with a photocrosslinkable polymer or an azo-dye and is irradiated with polarized light through the pattern, which forms a definite direction of the optical axis. Next, this base material is covered with a polymerizable liquid crystal which is oriented towards the direction of the pixel-formed optical axis and irradiated with UV light for the fixation of LC molecules in the film. As a result, there obtained retardation film with different optical axis directions in pixels. Such an approach is simple to describe, but technologically difficult to implement. This process is characterized with labor-consuming operations, the necessity of using of high-intensity polarized radiation sources, and there arise difficulties with the quality control of individual operations of technological process [2].

In order to obtain such pixel structures we have developed a method of forming of different directions of optical axes in pixels using holographic embossing, which is used in the manufacturing of relief-phase holograms. Thus, the film surface is covered with a specially developed polymer material, which is further embossed by means of a holographic matrix with some predetermined directions of diffraction gratings. It makes possible to form the necessary direction of the optical axes in pixels. Then, this structured base material is covered with a polymerized liquid-crystal material which is polymerized by means of UV irradiation (after being died and oriented). The process is carried out roll to roll with high productivity. At present, the minimal pixel sizes are 100 per 100 microns, with the possible disorientation of the optical axes in the neighboring pixels within an angular degree. The nearest aim is to reduce the size of pixels to 10 per 10 microns, while the transition zones between pixels are not more than one micrometer.

For the production of retardation films with pixel structure we use a polymerized liquid crystal of our own production with the required values of viscosity, refractive index and phase transition temperature. It allows to obtain structured optically transparent retardation films without any loss of light.

3. Conclusions

The technology mentioned above is not limited to the manufacturing of retardation films, but it can also be used to obtain the functional units of various optical devices.

4. References

[1] T. Kawai, " 3D displays and applications" Displays, Vol. **23**, I. 1-2. pp. 49-56, 2002.

[2] E. A. Shteyner, A. K. Srivastava, V. G. Chigrinov, H.S. Kwok, A. D. Afanasyev "Submicron-scale liquid crystal photo-alignment", Soft Matter, Vol. **9**, I. 23, pp. 5160-5165, 2013.