

The Study of Order Parameter in PS-VA Mode

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The polymer stabilized vertical alignment mode (PS-VA) is the typical liquid crystal mode in TV products.[1,2] The PS-VA mode is the technology to align liquid crystals with reactive mesogens by the UV exposure process. After the process, liquid crystals have a pretilt angle about 85~89 degrees. The factor to control the pretilt angle is UV exposure dose and applying voltage. When liquid crystals have the pretilt angle, the response time is faster and the transmittance is improved but the Contrast ratio(White luminance/Black luminance) is reduced. The pretilt angle is the polar angle but the azimuthal angle is also important. In the PS-VA mode, when all liquid crystals are aligned to the direction of the micro slit electrode in the white state, the transmittance is the highest. So we investigated the degree of orientation of liquid crystals in the white state in various pretilt conditions. We defined SOI as SVA order parameter in the equation (1). Then we found that there was a relation between the pretilt angle and the degree of orientation as shown Fig.1. We could measure the direction of liquid crystals in the sub micrometer area with Axostep machine and draw the degree of order parameter as shown in Fig.2. When the SOI was not higher over 0.8, liquid crystals were not aligned uniformly. This SOI would be useful tool to develop the PS-VA panel.

$$SOI = \frac{1}{2} \langle 3\{\cos^2(\theta - 45)\} - 1 \rangle \quad (1)$$

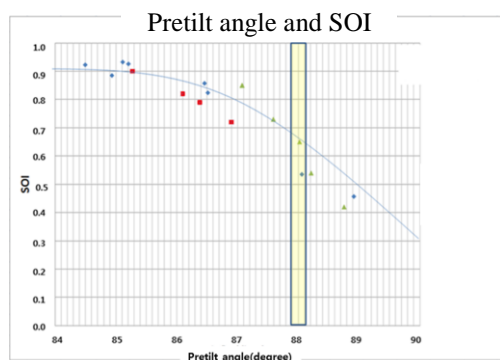


Fig. 1. The relationship of SOI and Pretilt angle

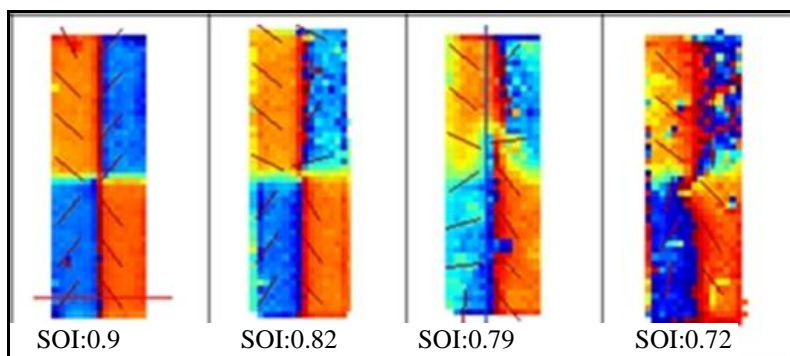


Fig. 2. The degree of orientation of PS-VA pixel

This SOI is very useful to control the UV exposure process. We optimized the pretilt angle and SOI to satisfy the transmittance and the contrast ratio.

References

1. Hanaoka K, Nakanishi Y, Inoue Y, Tanuma S, Koike Y and Okamoto K, Soc. Inform. Disp. Tech. Dig. 35 1200 (2004)
2. Kim S G, Kim S M, Kim Y S, Lee H K, Lee S H, Lee G-D, Lyu J-J and Kim K H, Appl. Phys. Lett. 90 261910(2007)