Effective Cell Gap Measurement and Optimization to Achieve High Transmittance for VA-LCD

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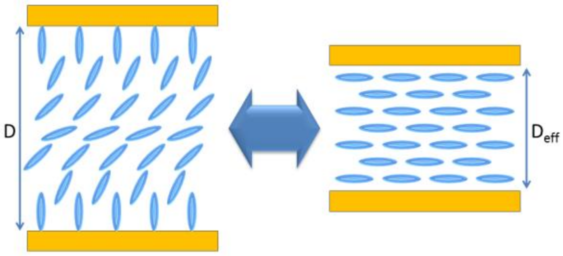
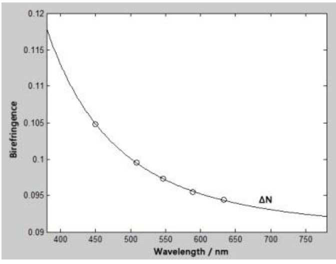
Effective cell gap D_{eff} is defined to be the equivalent cell gap with perfectly homogeneous aligned LCs which shows the same effective optical anisotropy with the original VA cell at the normal direction, shown in **Fig.1**. Obviously, D_{eff} is voltage-dependent. Transmittance of VA-LCD can be expressed as the **formula (1)**

$$T = (1/2) * sin^2(2\alpha) * sin^2(\pi * \Delta N * D_{eff}/\lambda) \tag{1}$$





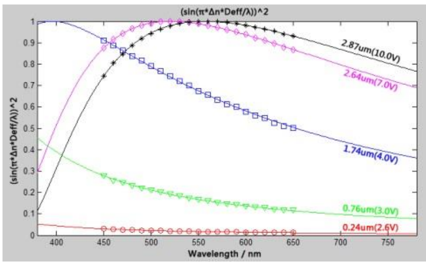
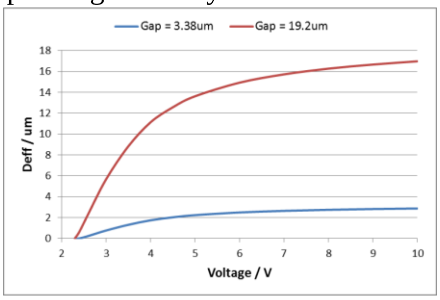
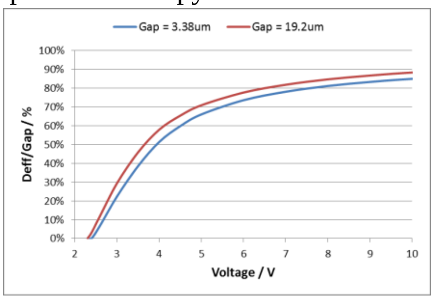


Fig.1 Concept of effective cell gap D_{eff} **Fig.2 dN vs wavelength** **Fig.3 D_{eff} fitting**

By measuring the phase ratardance φ of the cell at different wavelength and curve fitting, D_{eff} can be determined, see **Fig.3**. **Fig.5** show that more proportion of LC molecules in thicker cell can escape the anchoring trap of alignment layer and contribute to optical anisotropy.





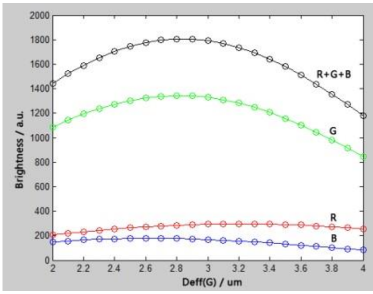


Fig.4 D_{eff} vs voltage **Fig.5 D_{eff}/gap vs voltage** **Fig.6 Lv vs D_{eff}**

In real panel design, for a given LC and color filter thickness rule, D_{eff} can be optimized to get maximal transmittance (**Fig.6**). And accroding to data in **Fig.4**, the best cell gap and driving voltage can be selected.

In this study, we proposed a new concept which named as effective cell gap. The measurement method of effective cell gap of VA cell at a certain voltage was built up. Measurement results of cells with different gaps and voltages show that the new concept is realizable and the outcome is reliable. For a given LC, the best effective cell gap D_{eff} with maximal transmittance can be calculated. And for a given VA cell with certain alignment layer, D_{eff} at different voltages can be measured. Based on these results, proper cell gap for the LC material can be estimated. For real product design with specific rules, the concept can also help to find out the best cell gap with maximal transmittance.

References

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