# Design of a dye-doped liquid crystal cell with a constant transmittance-difference contour map

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*Abstract*
*Thus far, the trial-and-error method has been used to find the condition for a dye-doped liquid crystal cell with desired performances. In this paper, we report a systematic design process to find the condition for the desired performances without trial-and-error process.*

## 1. Introduction

Transmittance-control devices can be switched between the transparent and opaque states by controlling the light absorption. These devices are used as smart windows in architectural glazing, switchable sunglasses, and automotive applications [1,2]. Dye-doped liquid crystal (DDLC) devices can be used for fast transmittance control because they have a fast response time of several tens of milliseconds. DDLC devices require a high transmittance difference between its transparent and opaque states while satisfying the desired performance, such as the transmittance in the transparent state, driving voltage, and response time

In this study, we introduce a systematic approach to find the condition for the desired performance in a DDLC device. By excluding the conditions that cannot satisfy the desired performance within constant transmittance-difference contour map, we can easily obtain the condition for the desired performance in a DDLC cell without any trial-and-error process.

## 2. Design and fabrication process

We calculated the transmittance difference as we varied the cell gap and dye concentration [3]. To find the condition for the maximum transmittance-difference while satisfying the desired performance, we plotted the constant transmittance-difference contour map on the parameter space of the cell gap and dye concentration. By using the calculated constant transmittance-difference contour map, we can easily design a DDLC cell with the desired performance. As shown in Fig. 1, the design process is as follows: i) choose an appropriate liquid crystal (LC) mode for a specific application ii) exclude the condition that cannot satisfy the minimum transmittance in the transparent state. iii) determine the maximum cell gap considering the response time or driving voltage and the maximum dye concentration, considering the saturation concentration of the dye to be mixed with the used LC. iv) select the condition for the maximum transmittance difference [4].

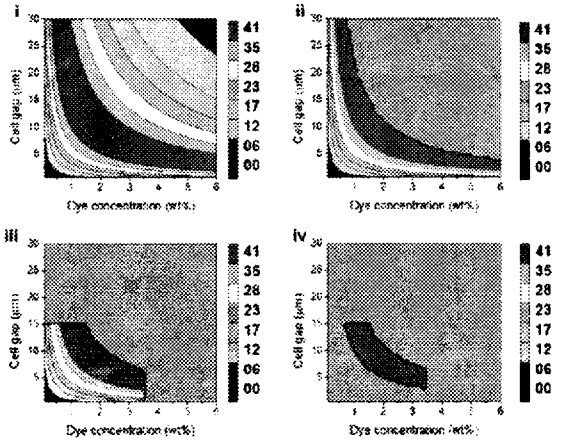


**Figure 1: The design process of a dye-doped cholesteric LC cell on a constant transmittance-difference contour map on the parameter space of the cell gap and dye concentration**

## 3. Conclusion

We confirmed experimentally that the design of a GHLC cell with the desired performance could be achieved through the proposed design process. We expect that the proposed design process will offer an effective method for the fabrication of a DDLC cell.

## 4. Acknowledgements

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. 2017R1A2A1A05001067).

## 5. References

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