

Fabrication of Coatable Polarizer by Guest-Host System for Flexible Display Applications

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Abstract : The polarizer is one of the most essential optical elements in LCDs. Currently, the most widely used polarizers for LCD is the derivatives of the H-sheet polarizer. There is a need for coatable polarizers which are much thinner and more stable than H-sheet polarizers. One possible approach to obtain thin, stable, and coatable polarizers is based on the use of highly ordered guest-host system. In our research, we aimed to fabricate coatable polarizer based on highly ordered liquid crystalline monomer and dichroic dye 'guest-host' system, in which the anisotropic absorption of light could be achieved by aligning a dichroic dye (guest) in the cooperative motion of the ordered liquid crystal (host) molecules. Firstly, we designed and synthesized a new reactive liquid crystalline monomer containing polymerizable acrylate groups as the 'host' material. The structure was confirmed by $^1\text{H-NMR}$ and IR spectroscopy. The liquid crystalline behavior was studied by differential scanning calorimetry (DSC) and polarized optical microscopy (POM). It was confirmed that the monomers possess highly ordered smectic phase at relatively low temperature. Then, the photocurable 'guest-host' system was prepared by mixing the liquid crystalline monomer, dichroic dye and photoinitiator. Coatable polarizers were fabricated by spin-coating above mixture on a substrate with alignment layer. The in-situ photopolymerization was carried out at room temperature by irradiating UV light, resulting in the formation of crosslinked structure that stabilized the aligned dichroic dye molecules. Finally, the dichroic ratio (DR), order parameter (S) and polarization efficiency (PE) were determined by polarized UV/Vis spectroscopy. We prepared the coatable polarizers by using different type of dichroic dyes to meet the requirement of display application. The results reveal that the coatable polarizers at a thickness of $8\mu\text{m}$ exhibited $\text{DR}=12\sim 17$ and relatively high PE ($>96\%$) with the highest $\text{PE}=99.3\%$, which possess potential for the LCD or flexible display applications.

Keywords : coatable polarizer, display, guest-host, liquid crystal

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