Controlling Liquid Crystal Pretilt Using a Novel Double Layer Alignment Film

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ABSTRACT:

We developed novel double layer alignment films (DLAFs) consist of a fluoropolymer coating coating on the top of rubbed PI 2555 film[1]. We chose two fluoropolymers both providing homeotropic alignment when act as a single layer. After coated on the top of PI 2555, we observed two distinctive film morphologies: continuous and discontinuous top layer structures, which is evidenced by AFM and XPS data. We found this difference on the film structures strongly affecting the pretilt angle of liquid crystal molecules. As the top layer thickness increases, the continuous top layer DLAF (DLAF 1) shows a first order pretilt transition from planar to homeotropic, which agrees with the local Fredericks transition theory proposed by de Gennes et al[2,3]. In contrast, the discontinuous top layer DLAF (DLAF 2) exhibits a more gradual pretilt transition, where the pretilt value depends on the area ratio of the fluoropolymer and the PI 2555. This is consistent with the pretilt control mechanism laid out by Kwok et al[4,5] based on the study on nanostructured alignment film produced by mixing planar and vertical polyimides.

The first order pretilt transition of DLAF 1 is very attractive for sensor application where a critical concentration of target molecules would trigger a dramatic optical response. We have successfully demonstrated a significant reduction on detection limit of lecithin in liquid crystal from 4% to 0.1% weight ratio by substituting 2555 with DLAF. On the other hand, the gradual pretilt transition of DLAF 2 offers great opportunity for display applications where a particular pretilt angle, especially from 20 to 70 degree, is of great interest but difficult to obtain from regular single layer polyimide film.

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