Characterization of Anisotropy Profile of Rubbed Polyimide Alignment Layer Using Reflection Ellipsometry

***Min Soo Park*[1], *Sang Uk Park*[2] *and Sang Youl Kim*[1,2*]**
[1]Department of Physics, Ajou University, Suwon 443-749, Korea.
[2]Ellipso Technology Co. Ltd, Suwon 442-190, Korea
**E-mail:sykim@ajou.ac.kr*

Uniformity control of alignment layer after rubbing process is crucial to get high picture quality of LCD, in terms of mura, contrast ratio, response speed, and viewing angle. The ability to characterize the alignment layer and to feedback the degree of alignment in real time, can be usefully utilized to improve the production efficiency, to reduce production cost as well as to enhance picture quality.

In this research, we identify formation of an alignment layer after rubbing and characterize the aligned layer in terms of anisotropy distribution in it. The variation of the ultra-small optical anisotropy of the rubbed PI on ITO glass is measured as a function of sample azimuth angle by using a customized reflection ellipsometer with PCSA configuration. The precision of this ellipsometer has been greatly enhanced by adopting the techniques which were previously introduced into a transmission ellipsometer, and an extremely high precision in Retardation measurement(3σ=0.005 nm) has been achieved by the authors.[1,2] With an autocollimator, sample is aligned into the exact position with its tilting error less than 0.03 degrees, and Anisotropy is measured with its error less than 0.05. Fig. 1 shows that the measured Anisotropy of a rubbed PI on ITO glass is less sensitive to small sample tilt but the measured Mis-Alignment increases linearly proportional to sample tilt. Variations of the ellipsometric constants (α,β) versus the azimuth angle of sample show that the variation depends strongly on rubbing depth(Fig. 2). Its amplitude increases in proportional to the magnitude of anisotropy. The asymmetric variation of the rubbed PI on ITO glass indicates that the optic axis of the anisotropic surface is not parallel to the sample surface. The angle between the optic axis and the sample surface or the tilt angle of the optic axis can be determined by analyzing this asymmetric variation of (α,β). Expressions are derived such that one can determine the anisotropy profile of the alignment layer by analyzing the asymmetric behavior of based on the model where the rubbed, anisotropic alignment layer is consisted of a surface layer and a main layer.[3,4] The ellipsometric constants (α,β) are analyzed to determine thickness, birefringence, pretilt angle and azimuth angle of the optic axis of each layer.

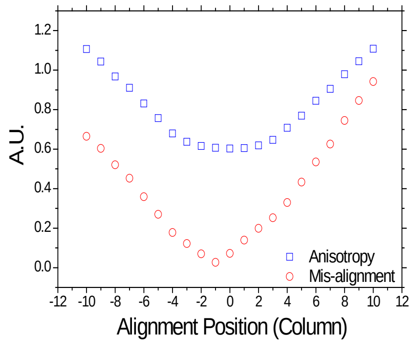

Fig. 1. Variation of Anisotropy and that of Misalignment vs tilt angle of sample.

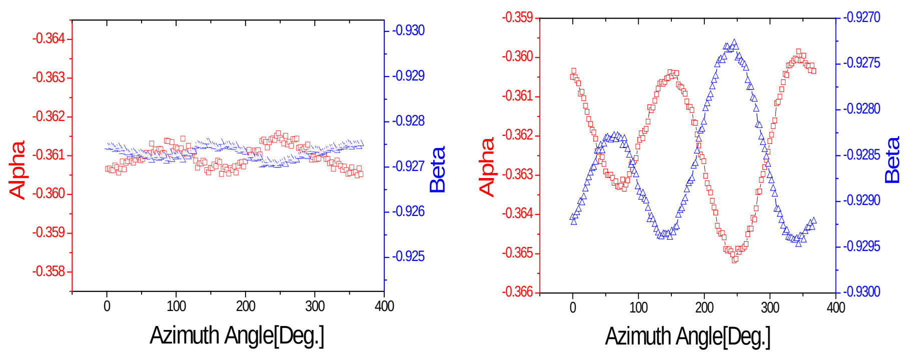

Fig. 2. Variation of ellipsometric constants (α,β) of unrubbed(left) and rubbed(right) PI on ITO glass versus the sample azimuth angle.

References

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