

Structural effects of polyimide substrate films on molecular orientation of liquid crystal

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1. Introduction

In liquid crystal (LC) displays, various kinds of polyimide films are widely used to align LC molecules. In this study, two kinds of polyimide films with different steric molecular shapes are investigated in order to see the structural effect of the substrate on the orientation of LC molecules. One is the aromatic polyimide of PMDA//PDA (inset of Fig. 1) with planar shape, the other is the alicyclic one of TCA//PDA with a bridge-like side chain (inset of Fig. 2). Molecular orientation of 5CB coated on these polyimide films were studied by near edge x-ray absorption fine structure (NEXAFS) measurements.

2. Experiment

The polymers were dissolved in an organic solvent and spin-coated onto indium-tin-oxide-coated glass plates. After heating to 80 °C to evaporate the solvent, the polymers were baked at 230 °C for 20 min. The polyimide films were rubbed using a rayon-cloth rubbing machine at 400 rpm rotation speed, 30 mm/sec plate speed, and a pile impression of 0.4 mm. Then the polyimide films were dipped into the solution of 5CB dissolved into 1-propanol and were heated to 60 °C to remove the solvent.

NEXAFS measurements were performed at the BL-8 of SR Center at Ritsumeikan University, equipped with a grazing incidence monochromator with a varied-line-spacing plane grating [1]. Nitrogen K-edge NEXAFS spectra of the samples were measured in partial electron yield by a micro-channel plate detector with retarding grids. The retarding voltage was set to -200 V. The incident angle with

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respect to the sample surface normal was varied and the electric vector of x-ray was changed in either parallel or perpendicular to the rubbing direction.

3. Results and discussion

Figures 1 and 2 show N K-edge NEXAFS spectra of the samples. Two peaks at 399.0 eV and 399.8 eV are attributed to the N $1s \rightarrow \pi^*$ ($C \equiv N$) transitions in 5CB. The structures above 401 eV are mainly derived from the polyimide films. The intensities of the two peaks for 5CB increase with incident angles for parallel geometry, while not for perpendicular geometry. This is because the 5CB molecules are aligned mainly parallel to the polyimide films whose main chains are pulled in the rubbing direction. In addition, the intensity change for 5CB on PMDA//PDA is larger than that on TCA//PDA. This indicates that the interaction of LC molecules with polyimide films is stronger in the aromatic polyimide of PMDA//PDA than in the alicyclic one of TCA//PDA.

4. Summary

We have investigated the orientation of LC molecules on two different kinds of polyimide films by NEXAFS. We have found that LC molecules interact much more with aromatic polyimide than alicyclic one.

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Reference

[1] H. Namaba *et al.*, J. Synchrotron Rad. **5**, 557 (1998).

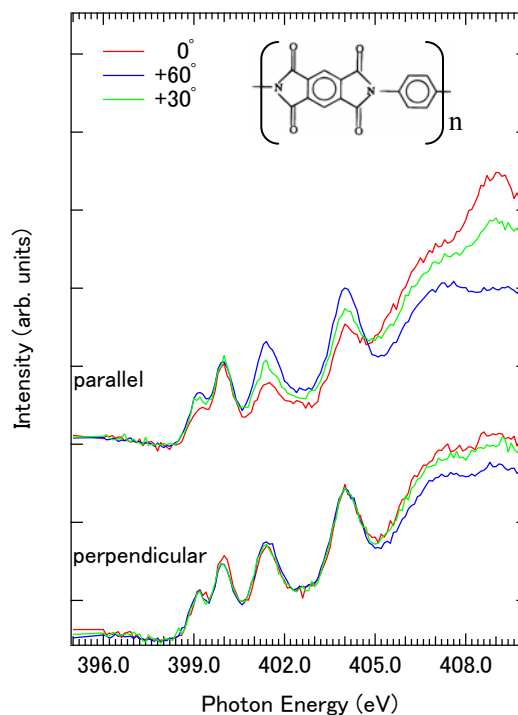


Fig. 1: N K-edge NEXAFS spectra of 5CB on PMDA//PDA.

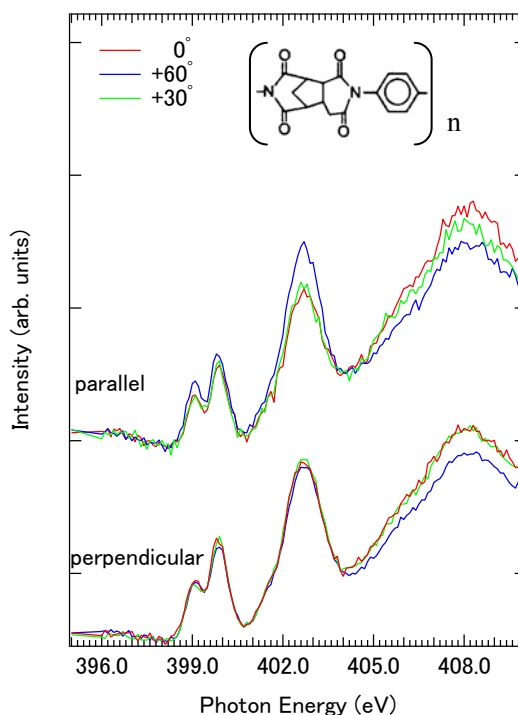


Fig. 2: N K-edge NEXAFS spectra of 5CB on TCA//PDA.