Influence of degree of crystallinity at the surface of the alignment layer on alignment-ability of liquid crystals

Takahiro Sakai*(13560), Kouhei Goto(13602), Kimiaki Tsutsui(13586), Masahide Ishizuya(14569), Hirobumi Shida(14586) and Ichiro Hirosawa[1] (2088)

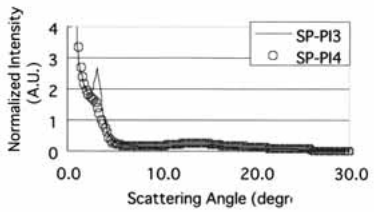
Electric materials research laboratories, Nissan Chemical Industries, LTD.
[1]Japan Synchrotron Radiation Research Institute

Rubbed polyimide film is widely used in liquid crystal (LC) displays to uniformly align LC molecules. The mechanism of the alignment of LC on rubbed polyimide surfaces is one of the most important issues from both fundamental and industrial viewpoints. But, there is no clear-cut explanation.

Up to now, we developed many alignment layers by using many kinds of polyimide to control the alignment of LC. Our study indicated that the alignment of LC was strongly influenced by the molecular structure of polyimide. Additionally, we found that there was a correlation between the alignment-ability of LCs and the degree of crystallinity at the surface of the polyimide. However, there was no experimental method to measure the degree of crystallinity at the surface. Thus, we investigated the degree of crystallinity using four kind of polyimides (SP-PI1, SP-PI2, SP-PI3, and SP-PI4) that have different alignment-ability of LCs by grazing-incidence X-ray scattering(GIXS).

A thin polyimide film was prepared by curing spinning coated polyiamic acid on a Si substrate. GIXS experiments were performed with using a multi-axis diffractmetor installed in the 2nd hatch of BL19B2. Incident angle of 10.0KeV X-ray to the sample surface was set more than the critical angle of total reflection at the polyimide surface.

The figure shows normalized intensities of an in-plane scan. The scattering plane of the scan was set to parallel to the sample surface. In the figure, Curve and Circles indicated the normalized intensities of SP-PI3 (that have best alignment-ability) and SP-PI4 (worst alignment-ability) polyimide, respectively. SP-PI3 has the well defined peak around 3.2 degree, but SP-PI4 do not. Considering with our previous report about SP-PI1 and SP-PI2, these differences indicate that there is a correlation between the degree of crystallinity at the polyimide surface and the alignment-ability of LC.



XAFS analysis of local structure around Sn in Sn-doped amorphous IZO films

Yukio Shimane[1)]*(9919), Shigekazu Tomai[1)](14068), Koki Yano[1)](15625), Norio Ishikawa[1)](15635), Futoshi Utsuno[2)] (8756), Syuuichi Kawata[2)](9147), and Atsushi Ueki[2)](15636)

1) Idemitsu Kosan Co., Ltd., Kamiizumi 1280, Sodegaura-shi, Chiba 299-0293, Japan
2) Institute of Industrial Science, University of Tokyo, Komaba 4-6-1, Meguro-ku, Tokyo 153-8505, Japan

Amorphous IZO (In_2O_3/ZnO_2=90/10wt%) films have high transparency in the visible range and high electrical conductivity. IZO is one of the candidate materials of transparent conductive oxides for use as transparent electrodes of flat panel displays such as liquid crystal displays. It was found that Sn doped IZO (IZTO) films had higher electrical conductivity. It is very important to reveal the relationship between conductivity and structural changes of the IZO films by addition of Sn, therefore XAFS measurements were carried out in order to investigate local structure of Sn in the IZTO films.

Film samples were prepared by sputtering method on SiO_2 glass substrates at 50℃, 150℃, and 250℃. Measurements of XAFS were performed at BL19B2 facility. XAFS spectra at the Sn K-edge of the IZTO films were measured by means of the fluorescence mode at ambient temperature using 19-elements SSD detector. X-ray was monochromated using Si(111) double crystals. Samples were set at an angle of 1.2 degrees to the incident x-ray.

Figure 1 shows the Sn K-edge Fourier transforms of EXAFS spectra of IZTO films. The conductivity of IZTO films increased with increasing temperature of substrates at sputtering from 50℃ to 150℃, but structural changes around Sn were not observed definitely. The IZTO film prepared on substrate at 250 ℃, which showed low conductivity, was considered to crystallized with substituting of Sn for In site. The relationship between conductivity and local structure around Sn of IZTO was different from that of ITO.

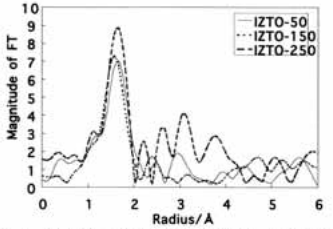


Figure 1 Sn K-edge FT-EXAFS spectra of IZTO films.