Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl19

Preparation of SnO_2 Thin Films with Extremely Preferred Orientation along (101) Plane by LB Deposition Technique

Lixin Cao [a b], Lihua Huo [a b], Guichen Ping [a b], Dongmei Wang [a b], Guangfu Zeng [a b] & Shiquan Xi [a b]

[a] Changchun Institute of Applied Chemistry, Chinese Academy of Science, Changchun, 130022, China

[b] National Laboratory of Molecular & Biomolecular Electronics Southeast University, Nanjing, 210096, China

Version of record first published: 24 Sep 2006

To cite this article: Lixin Cao, Lihua Huo, Guichen Ping, Dongmei Wang, Guangfu Zeng & Shiquan Xi (1999): Preparation of SnO_2 Thin Films with Extremely Preferred Orientation along (101) Plane by LB Deposition Technique, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 337:1, 233-236

To link to this article: http://dx.doi.org/10.1080/10587259908023420

Mol. Cryst. and Liq. Cryst., 1999, Vol. 337, pp. 233-236
Reprints available directly from the publisher
Photocopying permitted by license only

Preparation of SnO_2 Thin Films with Extremely Preferred Orientation along (101) Plane by LB Deposition Technique

LIXIN CAO, LIHUA HUO, GUICHEN PING, DONGMEI WANG, GUANGFU ZENG and SHIQUAN XI

Changchun Institute of Applied Chemistry, Chinese Academy of Science, Changchun 130022, China; National Laboratory of Molecular & Biomolecular Electronics Southeast University, Nanjing 210096, China

SnO_2 thin films with extremely preferred orientation along (101) plane were made by LB technique and characterized by FTIR, UV-visible, X-ray diffraction, X-ray photoelectron spectroscopy and SEM.

Keywords: SnO_2; thin film; LB technique; preferred orientation

INTRODUCTION

LB technique was usually used to make amphiphilic organic films. But organic films were lack of mechanical strength and thermal stability. Recently some inorganic oxide thin films like TiO_2 and CdO[1-2] were made by LB technique successfully. Transparent conducting SnO_2 thin films have many applications, but the films made by this method haven't been reported. In this paper, we'll report the fabrication of oriented SnO_2 thin films by LB deposition technique.

EXPERIMENT SECTION

The SnO_2 nanoparticulate chloroform organosol was prepared using dodecylbenzene sulfonic acid sodiumsalt (DBS) as a surfactant. The SnO_2 organosol mixed with arachidic acid (AA) by mol ratio of 10 : 1 for SnO_2 : AA was used as spreading solution. Then by LB technique the composite LB films were transferred onto quartz and silicon (100) substrates at 25 mN/m at room temperature. The dipping speed was 10 mm/min. The transfer ratio was 0.8-1. Then the films were heated to different temperatures in air.

The as-deposited films and heated films were characterized by FTIR spectroscopy (BIO-RAD-7, resolution: $4cm^{-1}$), UV-visible spectroscopy (Shimadzu UV-3000), X-ray diffraction (Rigaku, D/max Rae), X-ray photoelectron spectroscopy (VG ESCALAB MK II) and SEM (JXA-840).

RESULTS AND DISCUSSIONS

The 61-layer as-deposited film was characterized by small angle X-ray diffraction spectrum (Fig.1). It shows three higher order reflections of the lamellar 001 periodicity, which Bragg peaks, were at 1.2°, 2.4° and 3.6° corresponding to a long spacing of 7.36nm. After the film was heated at 250℃ for 2h in air, the small angle X-ray diffraction spectrum only showed one widened Bragg peak . All the Bragg peak disappeared after the film was heated at 400℃ for 2h in air. These results showed that with the increasing of

the heating temperature the lamellar periodicity of the film was destroyed gradually. IR spectra of the film showed that the characteristic peak of organic component disappeared gradually with temperature increasing, but those of SnO_2 existed all the time. The organic component wasn't decomposed until 400℃.

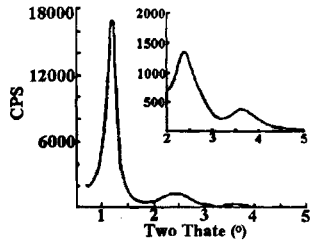

FIGURE 1 Small angle X-ray diffraction pattern of the 61-layer SnO_2 nanoparticle-arachidic acid composite LB film transferred onto silicon substrate. Insert: Expansion at the angle between 2° and 5°.

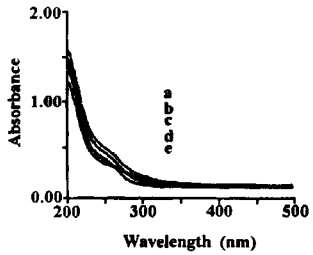

FIGURE 2 UV-visible spectra of the film transferred onto quartz substrate heated at different temperatures. (a) as-deposited film, (b) 150℃, (c) 250℃, (d) 400℃, (e) 600℃.

Fig.2 showed the UV-visible spectra of the film transferred onto quartz substrate heated at different temperatures. The absorption band at 250 nm can be assigned to the n-π* transition of the carbonyl group (C=O). The absorption of band edge between 300-200 nm can be ascribed to the absorption of SnO_2. It can be seen that after the film was heated at 400℃ for 2h, the band at 250 nm disappeared. This also indicated that the organic component was decomposed at 400℃.

The XPS spectra of the films also confirmed that the residual film was SnO_2 thin film. The XRD patterns of the films heated at different

temperatures were showed in Fig.3. All the patterns showed only one peak at 33.9° corresponding to the (101) plane of SnO_2 indicating that all of them had preferential orientation along the (101) plane. The peak intensity of the (101) plane was found to increase with the heating temperature increasing which indicate that the degree of crystal increased with the temperature increasing.

The SEM image of the film heated at 800℃for 2h was given in Fig.4. It can be seen that the film was uniform and showed some ordered arrangement.

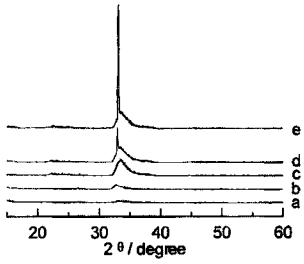

FIGURE 3 X-ray diffraction patterns of the composite LB films transferred onto silicon substrate heated at (a) 150℃, (b) 250℃, (c) 400℃, (d) 600℃, (e) 800℃.

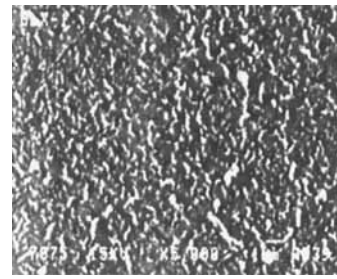

FIGURE 4 SEM image of the composite LB film transferred onto silicon substrate heated at 800℃ for 2 h.

Acknowledgments

We thank National Science Foundation of China for the financial support.

References

[1] D.V. Paranjape, M. Sastry and P. Ganguly, Appl. Phys. Lett., **63** (1), 18, (1993).
[2] N. Matsuura, D.J. Johnson and D.T. Amm, Thin Solid Films, **295,** 260 (1997).