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

Absorption Properties of Langmuir-Blodgett Films of Retinoic Acid

Naohito Kimura [a], Yoshikadu Nakamura [a], Kazuaki Imai [a], Takayuki Sawada [a] & Isao Tsubono [a]

[a] Department of Applied Electronics, Hokkaido Institute of Technology, 4-1, 7-15, Maeda, Teine-ku, Sapporo, 006-585, Japan

Version of record first published: 24 Sep 2006

To cite this article: Naohito Kimura, Yoshikadu Nakamura, Kazuaki Imai, Takayuki Sawada & Isao Tsubono (2001): Absorption Properties of Langmuir-Blodgett Films of Retinoic Acid, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 371:1, 41-44

To link to this article: http://dx.doi.org/10.1080/10587250108024683

Mol. Cryst. and Liq. Cryst., 2001, Vol. 371, pp. 41-44

Absorption Properties of Langmuir-Blodgett Films of Retinoic Acid

NAOHITO KIMURA, YOSHIKADU NAKAMURA, KAZUAKI IMAI, TAKAYUKI SAWADA and ISAO TSUBONO

Department of Applied Electronics, Hokkaido Institute of Technology, 4-1, 7-15, Maeda, Teine-ku, Sapporo 006-585, Japan

Retinoid molecules are the important component for photoreaction. We observed absorption spectra of the solution of retinoic acid, soaked films, and LB films. The spectrum of the solution shows the peak at 368nm. The spectrum of the soaked film could be resolved into two peaks. The peak at 370nm would be due to the monomer molecules, and the peak at 418nm would be due to the aggregate. The absorption spectrum of the LB film of retinoic acid shows the main peak at 380nm (M), subpeak at 358nm (A2) and the shoulder peak at 420nm (A1). The main peak (M) is considered to be the monomer molecules. Eight kinds of aggregates of retinoic acid molecules were considered, and the shifts of absorption transition energies of the aggregates were calculated using the semiempirical electronic structure program. The results suggest that the peak A2 at 358nm should be due to the trimer of retinoic acid.

keywords retinoic acid; LB films; absorption spectrum; aggregate; dimer; trimer

INTRODUCTION

Mach attention has been paid to bacteriorhodopsin (bR) for the application to the molecular devices [1-3] and molecular computers [4], in the field of molecular electronics and molecular photonics. Retinal is a chromophore contained in bR, and the important component for photoreaction. So retinoid molecules (retinal and its derivatives) have also attracted attention [5-7]. And some studies of monolayers and LB films of "retinoic acid" were reported [8,9]. In this work, we deposited LB films of retinoic acid, and investigated optical properties of the films by absorption spectroscopy.

EXPERIMENTAL

We examined LB films of all-trans retinoic acid. Chloroform was used as the spreading solvent throughout this work. Subphase were ultra pure water. Monolayers were transferred onto quartz plates (35.0 mm x 14.0 mm x 1.05 mm) at π = 20 mN/m by the vertical deposition method using moving wall type NL-LB150-MWC system (Nippon Laser & Electronics Lab.) We also observed absorption spectra of solution of retinoic acid in chloroform and soaked films. Quartz plates were soaked in chloroform solution (0.120mg/ml) of retinoic acid for 10 hours, and the films were formed on the plates.

Absorption spectra of the LB films were measured using UV-260 system (Shimadzu Corporation).

RESULTS AND DISCUSSION

Figure 1 shows a surface pressure–area isotherm of retinoid acid. The limiting area is estimated to be 0.11 nm^2/molecule.

The spectrum of the solution of retinoic acid shows the peak at 368nm. Figure 2 shows absorption spectrum of the soaked film. The spectrum could be resolved into two peaks. The peaks at 370nm

(peak 1) and the peak at 418nm (peak 2) would be due to the monomer and the aggregate, respectively.

The absorption spectrum of the LB is shown in figure 3. The spectrum shows the main peak at 380nm (M), subpeak at 358nm (A2) and the shoulder peak at 420nm (A1). The main peak (M) is considered

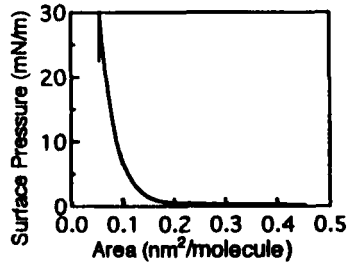

FIGURE 1. Surface pressure-area isotherm of monolayer of retinoic acid

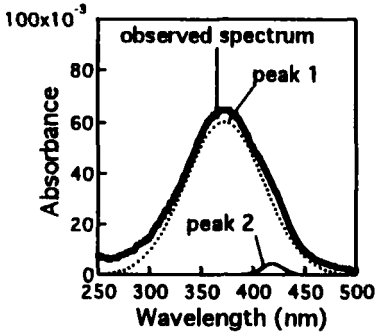

FIGURE 2. Absorption spectrum of the soaked film

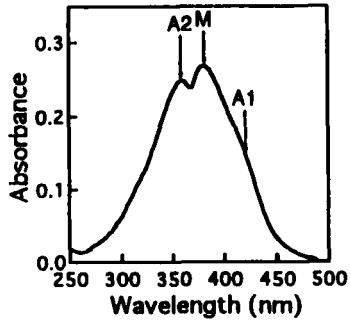

FIGURE 3. Absorption spectrum of the LB

to be the monomer molecules.

In order to consider the origin of the subpeak and the shoulder peak, we assumed eight kinds of aggregatesof retinoic acid molecules as shown in figure 4, and calculated the shifts of absorption energy from the monomer using the semiempirical electronic structure program MOPAC 97 and MOS-F version 4.1 (Fujitsu Ltd.) The results are shown in table 1.

In the table 1, the shift energy of trimer type I corresponds to the difference of energy between peak M and peak A2 in the observed spectrum. So the peak A2 at 358nm should be due to the trimer type I of retinoic acid shown in figure 6.

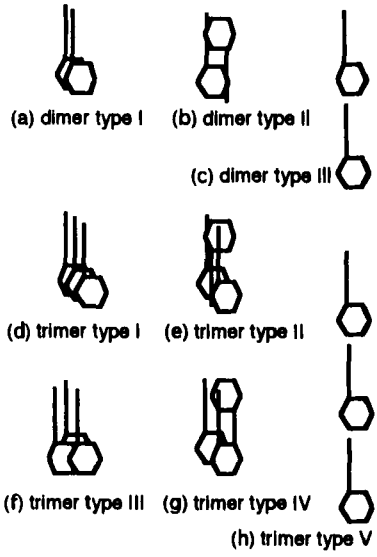

Table 1. Energy shifts of aggregates

Aggregate Type		energy shift from monomer (eV)
Dimer	I	0.113
	II	0.061
	III	-0.028
Trimer	I	0.205
	II	0.123
	III	-0.045
	IV	0.279
	V	0.193

FIGURE 4. Aggregation models

Acknowledgments

The authors greatly acknowledge Mr. Takemi Matuo and Mr. Takashi Nakamura for their help in experiments. This work was supported in part by the Science Research Promotion Found of the Promotion and Mutual Aid Corporation for Private Schools of Japan, the Hitachi ULSI Systems Foundation and the HIT Foundation.

References

1. K.Koyama *et al.*, Science, **265**, 762-765 (1994).
2. C.Okazaki, K.Takeda, Jpn.J.Appl.Phys., **34**, 1963-1967 (1995).
3. C.Okazaki, K.Takeda, Jpn.J.Appl.Phys., **34**, 3798-3802 (1995).
4. R.R.Birge, Scientific American, March, 90-95 (1995).
5. G.N.Nöll, Vision Research, **24**, 1615-1622 (1984).
6. M.Ikonen *et al.*,, Chem.Phys.Lett., **164**, 161-165 (1989).
7. H.Houjyo *et al.*, Chem.Phys. Lett., **294**, 162-166 (1998).
8. C. Okazaki, Jpn.J.Appl.Phys., **37**, 983-986 (1998).
9. N.Kimura *et al.*, Mol.Cryst.Liq.Cryst., **337**, 353-356 (1999).