나노구조 덴드리머의 변위전류 특성

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Displacement Current Properties for Nano Structure Dendrimer

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Abstract : In the Langmuir-Blodgett (LB) technique, a monolayer on the water surface is transferred onto a substrate, which is raised and dipped through the surface. From this, multilayers can be obtained in which constituent molecules are periodically arranged. The LB technique has attracted considerable interest in the fabrication of electrical and electronic devices. Many researchers have investigated the electrical properties of monolayer and multiplayer films. Dendrimers represent a new class of synthetic macromolecules characterized by a regularly branched treelike structure. Multiple branching yields a large number of chain ends that distinguish dendrimers from conventional star-like polymers and microgels. The azobenzene dendrimer is one of the dendritic macromolecules that include the azo-group exhibiting a photochromic character. Due to the presence of the charge transfer element of the azo-group and its rod-shaped structure, these compounds are expected to have potential interest in electronics and ptoelectronics, especially in nonlinear optics. In the present paper, we give pressure stimulation to organic thin films and detect the induced displacement current.

Key Words : Displacement Properties, Langmuir-Blodgett (LB) technique

1. Introduction

In the Langmuir-Blodgett (LB) technique, a monolayer on the water surface is transferred onto a substrate, whichis raised and dipped through the surface. From this, multilayers can be obtained in which constituent molecules are periodically arranged. The LB technique has attracted considerable interest in the fabrication of electrical and electronic devices. Many researchers have investigated the electrical properties of monolayer and multiplayer films [1-3].

Azobenzene dendrimer is one of the dendritic macromolecules that include the azo-group exhibiting a photochromic character. Due to the presence of the charge transfer element of the azo-group and its rod-shaped structure, these compounds are expected to have potential interestin electronics and ptoelectronics, especially in nonlinear optics [4-6].

Photoisomerization in monolayers of anazobenzene dendrimer was investigated for the first time by means of the absorption spectrum and Maxwell displacement current (MDC) technique. Dendrimers are well-defined macromolecules exhibiting a tree-like structure, first derived by the cascade molecule approach. According to the absorption spectrum, trans-to-cis conversion ratio was estimated to the azobenzene dendrimer generation. Charge with trans-cis isomerization was also measured by means of the MDC technique.

In the present paper, we give pressure stimulation to organic thin films and detect the induced displacement current.

2.Experiment

The chemical structure of AZ-G4 monomer is presented in Figure 1. Monolayers of AZ-G4 were spread from diluted chloroform solutions onto the surface of pure water.

The working area of Electrode 1 was 45.6[cm2].The distance d between Electrode 1 and the water surface was 1 mm. The displacement current I was measured by an electrometer (Keithley 6517).

AZ-G4 was spread on pure water (pH 6.0, 18.2 M cm) and maintained at 20[℃]. Once a monolayer was rested for 5 minutes, the monolayer was compressed at a compression speed of 40[mm/min]. MDCs were measured during monolayer compression. Irradiation with UV light (λ_1=365nm) and visible light (λ_2=450nm) regions occurred at AZ-G4 monolayers. The absorption spectra was measured using a UV-visible recording

spectrophotometer (Hitachi U-3501 spectrophotometer).

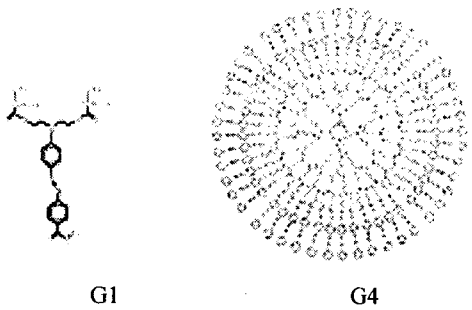

Fig. 1. Molecule structure of AZ-G4

3.ResultsandDiscussion

Figure 2 indicates the current generated from AZ-G4molecules during compression with a constant barrier velocity in the area per molecule ranging from 5900[2] to 1800[2]. Surface pressure-area isotherm is also shown in the figure. A current peak appears in the range of molecular area A between 4900[2] and 1800[2] by monolayer compression. The Absorption spectrum of AZ-G4 is indicated in Figure 3. From this we know that expressing peak in 440[nm], 340[nm], and maximum value of absorption ratio appears to be 340[nm] near in 200[nm]-800[nm].

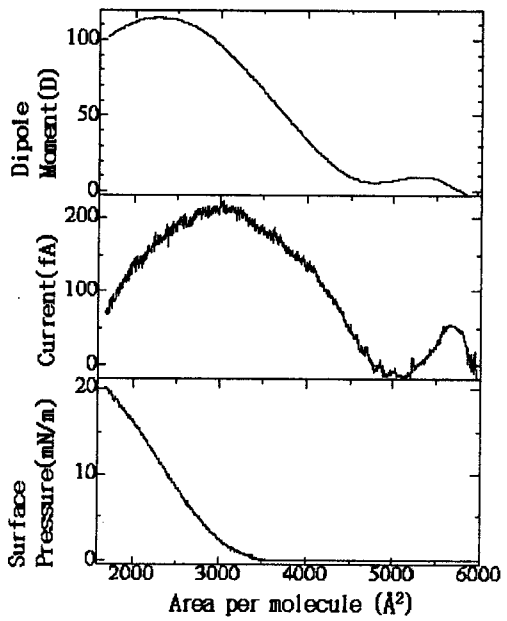

Fig.2. Displacement current of barrier compress

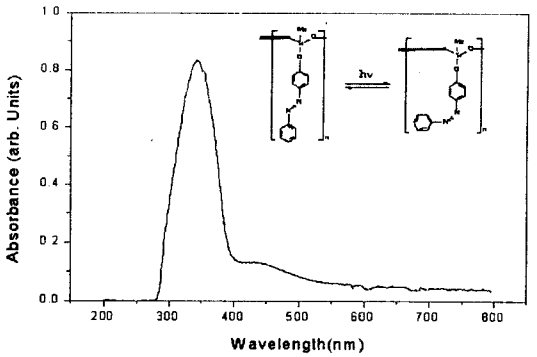

Fig.3. Absorption of AZ-G4

In addition, by irradiating the ultraviolet light ($\lambda 1$=360[nm]) and visible light ($\lambda 2$=450[nm]) region at the AZ-G4 organic monolayer known as cis-trans structure the displacement current in accordance with light stimulus were detected and compared.

Figures 4 and 5 show typical results of MDC measurements of the AZ-G4 monolayers with estimated induced charge. MDC current is generated with alternating 365[nm] and 450 [nm] photoirradiation and the direction of the current is alternated. Photoirradiation was permitted for 30 seconds, following examination for 30 seconds after displacement current amounted to 0. When photoirradiation was 365[nm]'s, displacement current occurred roughly at - 280 [fA] and it took 3 minutes to reach 0. When irradiation was 450nm's, displacement current occurred roughly at - 45 [fA], and displacement current amounted to 0 after approximately one minute. We discovered that displacement current appears more significantly in 365[nm] with absorption ratio indicating a maximum value in 340[nm] as demonstrated in Figure 5.

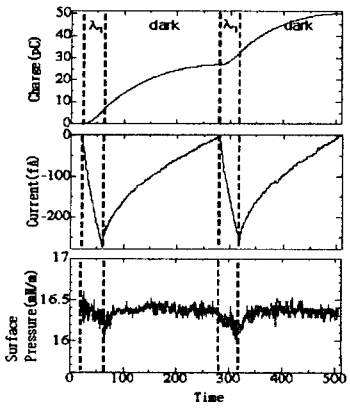

Fig.4. Photoirradiation of AZ-G4($\lambda 1$=365[nm])

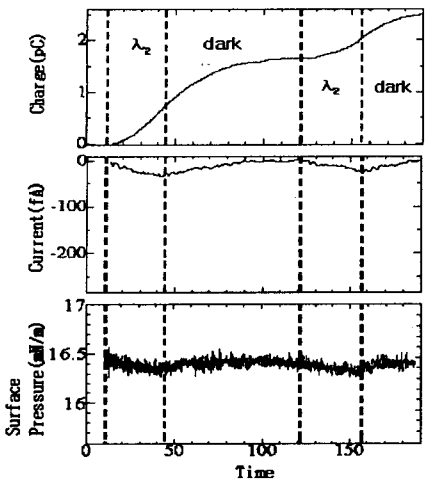

Fig.5. Photoirradiation of AZ-G4($\lambda 2$=450[nm])

Also, in the case of photoirradiation, surface pressure changed, and with the size of ensued displacement current at 365[nm], we could know that at 450[nm], surface pressure change shows more noticeably. The charge amount began to increase after photoirradiation, and the charge amount demonstrated that increase continuously occurred during dark conditions. Thisis considered by did not irradiation 250[nm] previous that can look cis-trans feedback. Also, is proportional in displacement current of 365[nm]'s photoirradiation and could know that the bigger charge amount happen.

4.Conclusion

We have investigated the photoisomerization phenomenon in an azobenzene dendrimer by means of the absorption spectrum and MDC technique. We showed the current generated from AZ-G4 molecules during compression with a constant barrier velocity in the area per molecule. When photoirradiation was 365[nm]'s, displacement current occurred roughly at - 280 [fA] and it took 3 minutes to reach 0. When irradiation was 450[nm]'s, displacement current occurred roughly at - 45 [fA], with displacement current amounting to 0 after about one minute. Also, in the case of photoirradiation, surface pressure changed, and with the size of the ensuing displacement current at 365[nm], we could know that at 450[nm], surface pressure change appears more drastically.

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