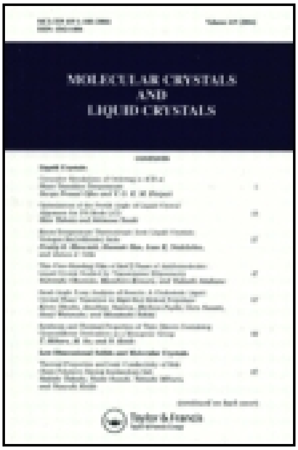

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Photopolymerization of Fullerene C_{60} in Langmuir Films at the Air/Phenol Aqueous Interface

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Photopolymerization of Fullerene C_{60} in Langmuir Films at the Air/Phenol Aqueous Interface

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The photopolymerization of C_{60} in Langmuir film at the air/phenol aqueous interface was studied by π-A isotherms and UV spectra. With the elongation of irradiation time at 254 nm UV-light, π-A isotherms of C_{60} monolayer became more expanded and the specific absorption peak of C_{60} LB monolayer at 342, 266, 218nm in UV spectra lowered gradually and no peaks were found in UV spectra finally.

Keyword C_{60}; photopolymerization; Langmuir film

INTRODUCTION

Photoreaction of film-forming molecules in LB films has attracted much interest due to its application both to stabilize the LB films and to mimetic some photochemical reactions occurred in the biological systems using LB films as model systems.

Fullerene C_{60} could polymerize under UV-light irradiation to form polymeric C_{60}[1]. The photoreactivity of C_{60} made it possible to be used as the negative photoresist in the fabrication of high-resolution patterns in microelectronic industry due to the fact that the dissolution of C_{60} molecules in organic solvents changed greatly after UV-light irradiation[2]. Further studies focusing on the electron beam (EB)-induced polymerization of C_{60} implied the same possibility of C_{60} as EB resist[3].

In this paper, we have studied the photopolymerization of C_{60} at the air/phenol aqueous interface by using π-A isotherms and UV spectra.

EXPERIMENTAL SECTION

C_{60}(>99%) was purchased from Fullerene Institute of Wuhan University. π-A isotherms were obtained on a NIMA 2000 LB system (Nima technology, Great Britain) at 25±1°C. Monolayers of C_{60} were obtained by spreading a benzene solution(1.0×10^{-5} mol·dm^{-3}) onto the surface of the phenol subphase. C_{60} monolayers were irradiated by 254 nm UV-light of a low-pressure mercury lamp (approximate power density 0.40 mW·cm^{-2}) at various times. The distance between the irradiation source and the surface of subphase was kept at 10 cm. Absorbance changes accompanying photopolymerization of C_{60} were followed with Shimadzu UV-240 spectrophotometer.

RESULTS AND DISCUSSION

As shown in Figure 1, with the elongation of the irradiation time, it is obvious that the photoreaction of C_{60} induced by the irradiation made the π-A isotherms of C_{60} Langmuir films change in a regular way. The isotherms moved along the direction of increasing molecular area and the films became more expanded. The molecular area enlarged with the increase of the irradiation time, until to 1.14 nm^2/molecule at 16 hours. surpassing the cross section area of C_{60} molecule of 0.98 nm^2. The average occupying area of C_{60} molecules was larger than its section area meant that the monolayer was more like a real monomolecular film than unirradiated film from the point view of statistical thermodynamics.

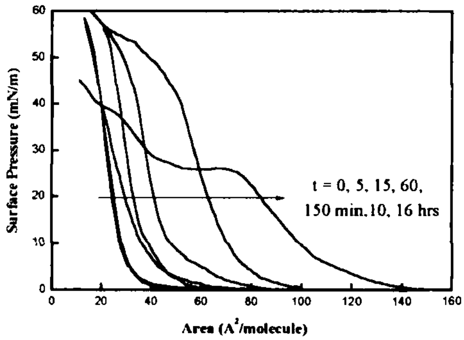

FIGURE 1 π-A isotherms of C_{60} Langmuir films irradiated by 254 nm UV-light irradiation at various times

UV spectra at various irradiation times of C_{60} LB monolayers prepared by using the horizontal lowering method at 10 mN/m also confirmed the occurrence of the photopolymerization of C_{60} at the air/aqueous interface(Figure 2). The three specific peaks of C_{60} at 218, 266 and 342 nm became weaker and weaker with the elongation of irradiation time. There were no absorption peaks in the UV spectra of C_{60} films after being irradiated 16 hours. This is due to the change of electronic energy level of C_{60} molecules(in fact, C_{60} portion in C_{60} polymer or oligomer) induced by the polymerization of adjacent C_{60} molecules under UV light irradiation.

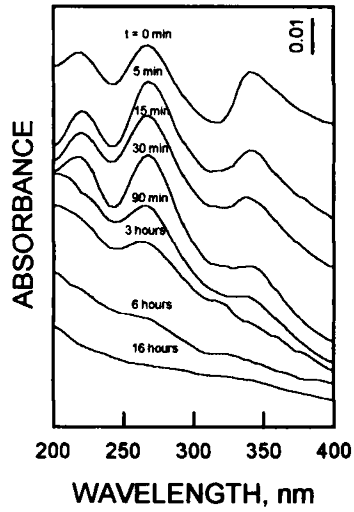

FIGURE 2 UV spectra of C_{60} LB monolayers with various irradiation times at the air/aqueous interface

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