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Enhancement of the Photoelectric Response of Squarine Dye by Using C_{60}

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Enhancement of the Photoelectric Response of Squarine Dye by Using C_{60}

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The photocurrent of the ITO/SQ3 electrode increased to seven times when C_{60} was deposited on top of SQ3 layer. Electron transfer mechanism has been proved by Hans Kuhn's Method.

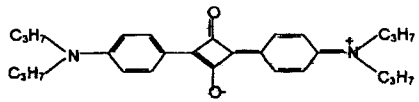
Keywords: C_{60}; squarine dye; LB films

INTRODUCTION

Squarine dye(SQ) is a kind of dye with special structure and properties which has been widely used in various fields [1,2]. Improvement of its photoresponse ability is of great significance in their application. C_{60}, as the third allotrope of carbon, has unique electron transfer properties, has been used to affect the photoelectric response of squarine dyes.

EXPERIMENTAL SECTION

In this work, squarine dye and C_{60} were used to make composite LB films on ITO. The structure of SQ3 used in this paper is as follows.



The LB film deposition was carried out in a membrane balance(HBM-SS, Japan). Photoelectric measurements were carried out with a pico ampere(pA) current amplifier and a digital storage oscilloscope(Goldstar Co. Ltd. Model OS-3020, made in Korea). When SQ3 LB film was deposited on ITO first and C_{60} LB film was deposited on the top of it, we obtained the ITO|SQ3|C_{60} film electrode. Vice versa the ITO|C_{60}|SQ3 film electrode was obtained. Photocells have been fabricated with a LB film coated ITO plate as working electrode and a platinum wire as counter electrode in a KCl solution(0.1 mol/L).

RESULTS AND DISCUSSION

When light with wavelength of 753nm irradiated onto a 15 layer SQ3 LB film modified ITO electrode a positive

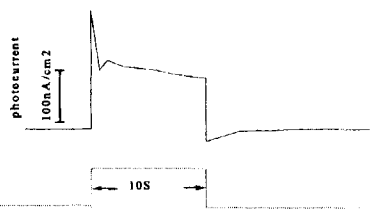


FIGURE 1 Photocurrent response of ITO|SQ3 electrode

photocurrent of ca. 100nA occurred as shown in Figure 1. When a composite LB film electrode, having 8 layers of C_{60} deposited on the top

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of ITO|SQ3 LB film containing 15 layers of SQ3, was irradiated by a 753nm (intensity 1.2 mW/cm^2) light, a positive photocurrent (as shown In Fig.2) which was much larger than that of ITO|SQ3 LB film itsself occured.

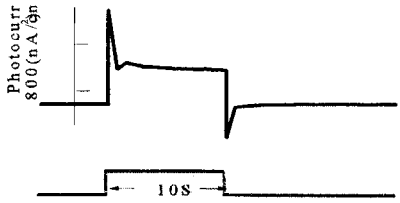

FIGURE2 Photocurrent response of ITO|SQ3|C_{60} electrode
See color plate VI at the back of this issue.

A set of experiment has been carried out according to the Hans Kuhn's [3] method to see the electron transfer mechanism. From Fig.3 it could be seen that the linear relation was evidence for tunneling mechanism of electron tranfer from the excited SQ3 to C_{60} in ITO/SQ3/C_{60} composite LB films.

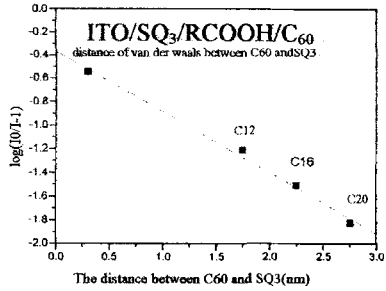

Fig.3 The log[(I0-I)/I] was plotted against d

On the other hand, if we change the arrangement of deposition, making a

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ITO|C_{60}|SQ3 composite film, where C_{60} became an electron acceptor due to in the photo exitation state. In this case, C_{60} will take up the electron from the electrode and gave a negative current.

Table 1 gave out photocurrent and the photon-to-photocurrent efficiency (IPCE%) of the ITO| SQ3, ITO|SQ3|$C_{60}$and ITO|C_{60}|SQ3 LB films with an irradiation of light at 753nm(intensity 1.2mW/cm^2). *IPCE* was calculated according to the formula given in the reference[4].

Table 1 The photocurrent of the LB films after irradiation about 10s

LB film	ITO|SQ3|C_{60}	ITO|SQ3	ITO|C_{60}|SQ3
photocurrent(nA)	640	92	64
IPCE (%)	0.088	0.013	0.0088

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