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Study on Biological Molecular LB Films and Properties

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In this paper, Langmuir-Blodgett (LB) films of mixed bovine serum albumin (BSA)-phosphatidylcholine (PC) with different layers have been fabricated by LB technique. With the analysis of ultraviolet (UV) spectroscopy, circular dichroism (CD) spectroscopy and ellipsometer, the structural properties of BSA-PC mixed LB biological films are studied.

Keywords: bovine serum albumin; phosphatidylcholine; Langmuir-Blodgett films; circular dichroism spectroscopy; ellipsometry

INTRODUCTION

With the rapid development and combination of materials science and life science, it is more important and valuable to study the structure of LB films made by protein and lipid and their relation[1]. The target of using BSA, PC is to form a measure of preparing biological molecular LB films so that we can simulate biological environment and make further investigation on interactive mechanism and application of biological molecular films[2].

EXPERIMENTAL

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BSA (0.068mg/ml) and PC (10^{-4}M) mixed uniformly and formed monolayer at the air-water interface. Then it transferred to quartz substrates with a deposition ratio of 1 using a computer-controlled LB system (Model MC-1)[3].

RESULTS AND DISCUSSION

The surface pressure-area (π-A) isotherms of BSA-PC mixed monolayer compared with pure PC and BSA monolayer is showed in Fig. 1. The plateau at area/molecule greater than 100Å indicates the gas region. The region with steeply increasing π(13~25mN/m) is the coexisting liquid expanded (LE) and three-dimensional (3D) two-phase domains. The region (π>25mN/m) corresponds to the collapse of monolayer[4].

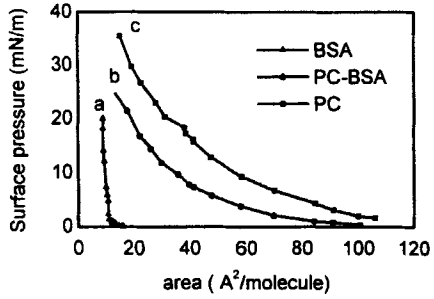
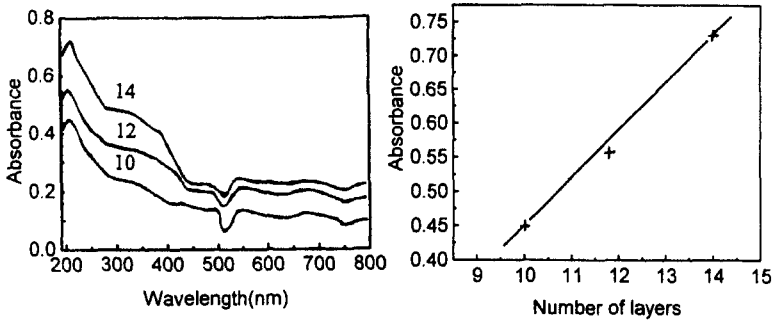


FIGURE 1 Surface pressure-area (π-A) isotherms of BSA-PC monolayer, compared with pure PC and BSA monolayer

Fig. 2 is ultraviolet (UV) spectra of BSA-PC LB films with different layers, which shows the absorption peak of BSA at 190nm, and the absorbance increases with the increase of number of layers. We can see the linear relationship between them. It shows the vertical uniformity of LB films.

Using an ellipsometer L116C, the thickness of mixed BSA-PC monolayer and multilayer at different surface pressures and pH values were measured

which are showed in table 1. With the increase of number of layers, the thickness increases linearly which coincides with the result of UV spectra.



(a) (b)

FIGURE 2 UV spectra of BSA-PC mixed LB films with different layers (10,12,14)

TABLE 1 The average thickness of BSA-PC mixed LB films with different layers at different π and pH

Number of layers	1	2	4	6
π=3.5 pH=4.92	26.5	52.0	104.8	156.5
π=18 pH=4.92	22.6	45.6	90.0	134.6
π=18 pH=6.2	34.5	68.5	136.7	206.4

Combining with circular dichroism (CD) spectroscopy, it is found that at lower surface pressure, some of BSA molecules distribute among PC lipid film, others lie on the surface of lipid film. The conformation of BSA is α-helix as showed by fig. 3 (b). When π≈18mN/m, pH=4.92=pI (isoelectric point), the polar groups of BSA penetrate among the polar heads of PC. The thickness of BSA-PC monolayer is similar to that of PC monolayer. It is available to transfer LB films at this time and the conformation of BSA is in a stable coexistent state of α-helix and β-fold as showed in fig. 3 (a). Changing pH to 6.2, fig. 3 (c) shows more random coil. When pH>pI, BSA molecules

carry negative charge, most of them are attached on the surface of PC film by electrostatic action. The thickness of monolayer increases obviously. There are complicated interactions between BSA and PC[3-5].

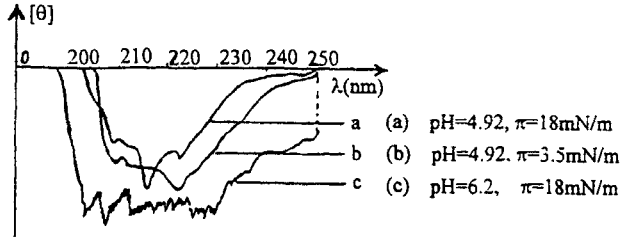


FIGURE 3 CD Spectra of BSA-PC LB film (80 layers) under different film-forming conditions (T=14℃)

CONCLUSION

Summarizing the results, the mixed protein-lipid monolayer and multilayer biological LB films at different conditions are obtained which have good vertical uniformity. When $\pi \approx 18$mN/m, pH=4.92, T=14℃, the thickness of mixed BSA-PC monolayer is obtained: 22.6Å which is similar to that of PC monolayer. The conformation of BSA in BSA-PC mixed LB films is different under different surface pressures and pH. The interaction between BSA and PC is very complicated and we can see it from the change of secondary structure of BSA and the change of the thickness of LB films.

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