Effects of Silver Nanoparticles on dipalmitoyl phosphatidyl choline (DPPC) Langmuir monolayers as cell membranes model

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Abstract

This work presents the results on the analysis of the interaction between silver nanoparticles stabilized with a polyether-block-amide, called PEBA, with Langmuir films built from DPPC lipids on aqueous subphase, which mimics cell membranes of bacteria and fungi.
On the aqueous subphase of the DPPC monolayer silver nanoparticle solution was spread and its effect was evaluated by tensiometry, infrared spectroscopy and Brewster angle microscopy.
The data showed the interaction between the silver nanoparticles with the lipids at the air-water interface, giving important information about its action on cell membranes.

Introduction

Nowadays, there are many studies about nanomaterials, due to their several applications on chemistry and pharmacy.
Particularly, silver nanoparticles have an important application as antimicrobial agent, used in hygiene and surgical products.
In this present work, we analyzed the interaction between silver nanoparticles stabilized with an polymer called PEBA dispersed in 1-butyl alcohol [1], with Langmuir monolayers built from dipalmitoyl phosphatidyl choline (DPPC) by surface pressure-area isotherms, polarization modulation infrared reflection-absorption spectroscopy (PM-IRRAS) and Brewster angle microscopy (BAM).

Results and Discussion

In the absence of DPPC, silver nanoparticles showed surface activity, but they do not form stable Langmuir monolayers. However, the incorporation of these nanoparticles in the DPPC monolayer expands the molecular film, as observed in figure 1, depending on the amount of added dispersion. The intrinsic interaction between the nanoparticles and DPPC was investigated by PM-IRRAS and BAM, pointing that they affect the interfacial properties of the lipid.

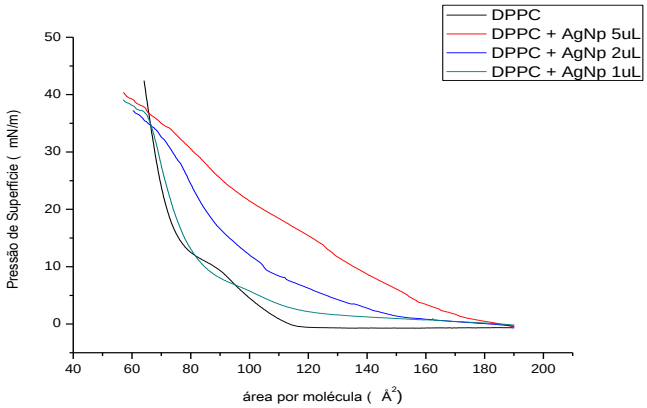

Figure 1. Surface pressure isotherm for pure DPPC and in presence of different amount of silver nanoparticles dispersion.

Conclusions

Silver nanoparticles expanded the monolayer of the molecular film of DPPC, which can be explained by the interaction between the nanocomponents at the interface with the lipid lateral interactions. In the absence of the lipid, there is no formation of real Langmuir film, being the surface activity of the nanoparticle governed by a dynamic process of adsorption and desorption during the compression and the rearrangement of the molecular system of the metallic nanoparticle and the stabilizing agent (PEBA), leading the formation of aggregates.

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[1] Roselaine S. Oliveira; Marcos A. Bizeto; Ana. M. A. Liberatore; Ivan H. J. Koh; Fernanda F. Camilo; J. Nanoparticle Reseach, 2014, **16**, 2723.