Study of interfacial properties of two-component DPPC–silsesquioxane nanoparticles Langmuir monolayers

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Polyhedral oligomeric silsesquioxanes (POSS) has unique inorganic-organic core-shell structure. The thermal robustness of the inorganic silica cube, coupled to the flexible organic out of sphere functionality have highly contributed to the expansion of the chemistry of this new class of material [1]. Silica-based materials are widely used in the field of biomedicine because of their chemical inertness and biocompatibility [2]. In addition to ease of chemical functionalization, nanostructures and chemical stability, POSS units exhibit a variety of other attributes that make them attractive as drug delivery agents [3]. Due to the importance or usefulness of POSS compounds in viewpoint of medical applications it is necessary to know the way how these hybrid materials do interact with DPPC, predominant lipid component in lung surfactant. In the present study, the interfacial properties of Langmuir monolayers at the air/water interface of two component mixture of POSS derivatives with DPPC are presented. We selected two POSS derivatives belonging to the group of not fully condensed silsesquioxanes (with an open corner), each of which has, in addition to 7 isobutyl groups in the corners of the cage, also three organic functional groups (present in the open corner), differing in their properties (strongly polar polyether groups (PEG-POSS) and strongly hydrophobic fluoroalkyl groups (OFP-POSS)). The characteristics of monolayers were studied using a computer–controlled KSV NIMA Langmuir film balance system (KN 0033) together with Brewster Angle Microscopy (BAM) (KSV NIMA MicroBAM) and a KSV NIMA Surface Potential Sensor (SPOT).

On the basis of the analysis of $\pi$–$A$ isotherms as well as BAM images, it is concluded that a perfluorinated OFP-POSS molecules and DPPC formed an inhomogeneous film, while the mixed PEG-POSS/DPPC monolayer revealed uniform character upon compression process. Moreover, both POSS derivatives significantly changed the character of the surface potential isotherm ($\Delta V$–$A$) obtained for DPPC, but in different ways. In general the results obtained indicate the existence of two different interaction mechanisms between DPPC and POSS which depend on the chemical character of moieties present in POSS molecules.

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