Cyclic measurements of DPPC monolayers at low surface tensions

Kaisa E. Lilja, Jaakko Välimaa

Biolin Scientific, Tietäjäntie 2, FI-02130 Espoo, Finland
kaisa.lilja@biolinscientific.com

Pulmonary surfactants cover the alveoli of the lungs and have a vital function in making the process of breathing easy. During inhalation, the surfactant reduces the surface tension of tissue by a factor of about 15. During exhalation, the surface area of the alveoli decreases making the surfactant even more concentrated on the surface. It is known that the highly ordered solid phase of dipalmitoylphosphatidylcholine (DPPC) sustains the near-zero surface tension on the alveoli during exhalation [1]. In order to model the actual surfactant behavior in the alveoli, measurements at near-zero surface tensions are needed.

Several groups have investigated the behavior of DPPC monolayers under low surface tensions using Langmuir troughs [2, 3], but with a conventional Langmuir trough it is challenging to measure near-zero surface tensions. We have shown that the compression speed in a Langmuir trough has a distinct effect on the layer formation of DPPC at low surface tensions and temperatures ranging from 20 ºC to 37 ºC. Now we further expand this observation by showing controlled cyclic measurements of DPPC at low surface tensions. The measurements were done on ultrapure water surface at temperatures of 20 ºC, 30 ºC and 37 ºC using a Langmuir trough equipped with a ribbon barrier to prevent monolayer leakage. The measurements show reliable compression measurements of natural phospholipid surfactants at surface tensions down to 15 mN/m. The measurements can be further expanded to examine phospholipid reactions with nanoparticles, phase transitions and the selective enrichment process of DPPC on the alveoli surface.

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