Seminario de Química Física

Jueves 9 de enero de 2024 – 11:30 h

Sala de Grados (Antigua Capilla, Edificio A)

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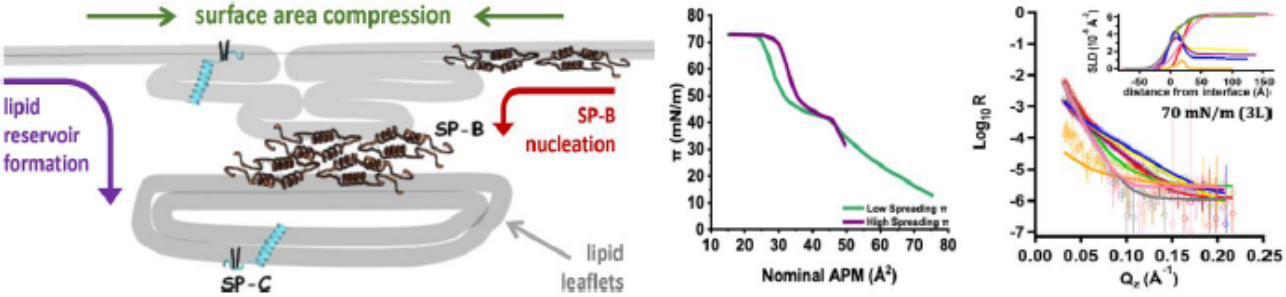
Structural characterization of model lung surfactant films on the approach to zero surface tension and tuned by soft nanoparticles

Infant respiratory distress syndrome (IRDS) is a condition suffered by premature babies due to insufficient secretion of lung surfactant protein SP-B during gestation in pregnancy.[1] The function of SP-B is to nucleate lipid reservoirs at the air/water interface, as the dynamic air/water interface in the lung contracts during exhalation, with the additional lipid confined close to the interface ready to spread rapidly across the interface during inhalation to maintain near-zero surface tension and prevent lung collapse.[2,3] This physical picture has been formed in no small part thanks to pioneering work conducted over the last decades at Complutense University of Madrid (adapted figure left).[4,5] Current exogenous medicines to treat IRDS, which are derived from animal lungs, fall short of having optimal properties because of severe side effects, as well as poor availability in developing countries because of their limited shelf life.[6] The shortcomings of current treatments persist in part because of the challenge to upscale production of purified or recombinant SP-B.[7]



This seminar presents a characterization of lung surfactant models comprising up to four lipid components where reflectometry techniques are applied to the air/water interface of a Langmuir trough to resolve the structure of the films over different time and length scales. The work follows on from our recent results in resolving 3D structural transitions in polymer/surfactant films.[8] Ellipsometry[9] and Brewster angle microscopy[10] measurements provide information about 3D structural transitions as well as macroscopic folding of the films, while neutron reflectometry (NR)[11] provides complementary information on the structure and composition of the lipid assemblies on the nanoscale. Data are presented at surface pressures of 50, 60 and 70 mN/m as well as at increments of 0.5 mN/m above 70 mN/m (surface pressure in figure center and NR in figure right). To the knowledge of the authors, it is the first time that such a combination of advanced techniques has been applied to lung surfactant models on the approach to zero surface tension. Lastly, recent data are presented of our attempts to tune the 3D structural transitions with the recombinant peptide SP-B_{1-25}, as well as newly synthesized nanogels,[12] which are flexible model soft particles that offer the possibility for functionalization in future work.

[1] Int. J. Biomed. Adv. Res. 2015, 6, 643; [2] BBA-Biomembr. 2014, 1838, 1568; [3] BBA-Biomembranes 2008, 1778, 1676; [4] Biol. Neonate 1995, 67, 61; [5] Chem. Phys. Lipids 2024, 266, 105459; [6] Clin. Exp. Immunol. 1991, 83, 41; [7] Comp. Biochem. Physiol. A Mol. Integr. Physiol. 2001, 129, 287; [8] Chem. Commun. 2022, 58, 10687; [9] Adv. Colloid Interface Sci. 2020, 277, 102118; [10] BBA-Biomembranes 2017, 1859, 1749; [11] Curr. Opin. Colloid Interface Sci. 2018, 37, 49; [12] Polymers 2024, 16, 2584.