Bilayers at the ILL

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Understanding the interfacial structure of pulmonary surfactant films by neutron reflectometry

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Pulmonary surfactant consists on an adsorbed phospholipid-based monolayer at the alveolar air-liquid interface connected to a membrane reservoir placed in the aqueous subphase. Its main function is to minimize the surface tension stabilizing the mammalian respiratory surface, enabling breathing dynamics and preventing alveolar collapse during expiration. Pulmonary surfactant is mainly composed of phospholipid, but the hydrophobic surfactant proteins SP-B and SP-C are small proteins that strongly interact with surfactant membranes playing a critical role during the formation and stabilization of surfactant films. SP-B is proposed to be involved in the regulation of surfactant adsorption to the interface forming lipid channels that could allow surfactant phospholipids to adsorb efficiently into the alveolar air-liquid interface. SP-C participates on remodelling of surfactant films along respiratory dynamics inducing curvature and promoting exclusion of unsaturated surfactant lipids when surface pressure increases. To accomplish a quantitative structural characterization of surfactant complexes, neutron reflectometry of adsorbed surfactant films in a dynamic air-liquid interface was performed. Surfactant films composed by model lipids (DPPC/POPC/POPG) with or without SP-B or SP-C were characterized at FIGARO. Experiments were performed using both hydrogenated and deuterated lipids and two contrasts: D2O and Air Contrast Match Water. Neutron reflectometry was recorded at 10mN/m and 35mN/m before and after 5 compression-expansion cycles. Data obtained are compatible with an increase in surface lipid concentration at 35mN/m. Although no significant differences in the reflectivity were detected when using surfactant proteins at their physiological concentrations, normalized 2-D detector scans showed a signal corresponding to a lipid reservoir in bulk as well as an increase in the off-specular signal in the presence of SP-B, meaning that SP- B promotes the formation of a reservoir connected to the material forming the interfacial film. Additionally, the reservoir and the adsorbed material undergo structural alterations as a consequence of compression-expansion cycles.

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