Experimental Report

17/07/2014

Proposal:	**9-13-483**	**Council:**	10/2012

Title: Oxidation kinetics in mixed lipid monolayers

This proposal is a new proposal

Researh Area: Chemistry

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Samples: 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphocholine, $C_{42}H_{65}D_{17}NO_8P$
dipalmitoyl-2-sn-glycero-3-phosphocholine, $C_{40}H_{80}NO_8P$

Instrument	Req. Days	All. Days	From	To
FIGARO Langmuir trough	3	3	02/08/2013	05/08/2013

Abstract:

Ozone is a toxic pollutant gas present in ambient air. Ozone reacts and destroys unsaturated lipids in lung surfactant present at the air-water interface of the lung and an increase in ozone concentration is correlated with increased risk of death from respiratory failure. In this work we will use selective deuteration to determine the kinetics of the initial process when the unsaturated lipid, 1-palmitoyl-2-oleoyl-sn-glycero-phosphcholine reacts with ozone in the presence of the major saturated lung lipid dipalmitoyl-sn-glycero-phosphocholine. The reaction will be studied on an aqueous subphase at 37 °C using a range of POPC:DPPC ratios and initial surface pressures. We have performed successful preliminary experiments on pure POPC monolayers with selective deuteration of the oleoyl strand but surface pressure measurements indicate that different kinetics are followed in mixed lipid films.

Experimental Report for Experiment #9-13-483

Oxidation kinetics in mixed lipid monolayers

Background

The presence of lung surfactant at the air-water interface of the lung is essential to prevent death from respiratory failure. Lung surfactant contains a mixture of both saturated and unsaturated lipids. The air pollutant ozone is known to react with unsaturated lipids at the air-water interface. In this experiment we wished to investigate how the rate of reaction of the unsaturated lipids was altered by the presence of saturated lipids.

The unsaturated lipid we used was 1-palmitoyl-2-oleoyl-*sn*-glycero-phosphocholine, POPC. The terminal portion of the unsaturated oleoyl chain was deuterated, $Pd_{17}OPC$, as our previous experiments had shown that this portion of the molecule is rapidly loss from the interface when monolayers of pure $Pd_{17}OPC$ are exposed to ozone at the air-water interface. We studied mixtures of $Pd_{17}OPC$ with the saturated species dipalmitoyl-*sn*-glycero-phosphocholine, DPPC.

Experimental Details

Monolayers of $Pd_{17}OPC$:^1H-DPPC mixtures were formed on an aqueous subphase (8% D_2O in H_2O – null reflecting water) using a Langmuir trough. The trough was placed inside an environmental chamber and exposed to a low level of ozone. The surface pressure was measured using a Wilhelmy plate whilst the kinetics of loss of the deuterated portion of the lipid was followed using neutron reflection measurements.

Results

The presence of small amounts of DPPC in a monolayer containing mainly $P_{d17}OPC$ did not change the rate of reaction of the oleoyl strand with ozone, within experimental error. When the $P_{d17}OPC$ was present with larger ratios of DPPC the rate of reaction of the $P_{d17}OPC$ was measurably decreased, see figure 1.

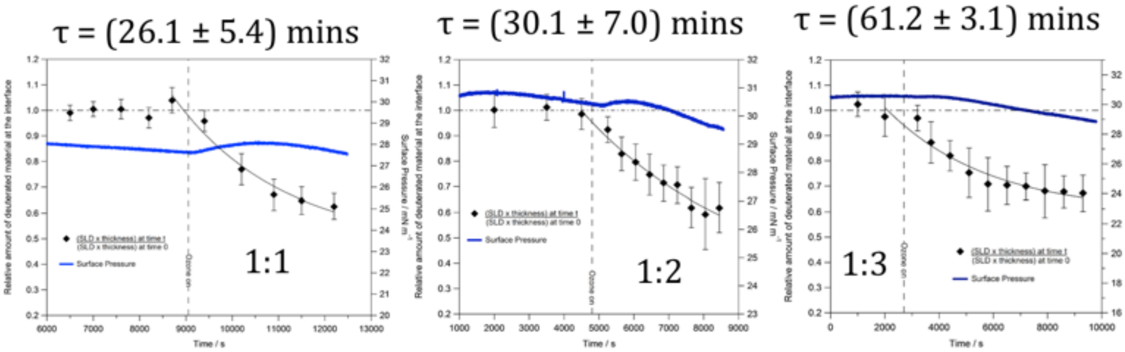

Figure 1 . Binary mixtures of $Pd_{17}OPC$ and ^1H-DPPC on NRW exposed to 0.25 ppm gas-phase ozone, from left to right: $Pd_{17}OPC$:^1H DPPC 1:1, 1:2, 1:3 w/w. The solid line shows the best fit of a single exponential function to the neutron data after the ozoniser was switched on.

We suggest that this decrease in reaction rate with increasing DPPC is caused by partially shielding of the oleoyl strand by the surrounding DPPC lipids.