Experimental report

15/02/2021

Proposal: CRG-2739 **Council:** 10/2019

Title: Nanoparticle-supported lipid bilayers (NP-SLB), a new platform to study curvature-induced lipid segregation by neutron reflectometry

Research area: Biology

This proposal is a new proposal

Main proposer: Nicolo PARACINI

Experimental team: Maximilian WOLFF
Nicolo PARACINI

Local contacts: Alexei VOROBIEV

Samples: DMPC
Cardiolipin
Silicon wafer 100 coated with SiO2 nanoparticles

Instrument	Requested days	Allocated days	From	To
SUPERADAM	5	2	15/09/2020	17/09/2020

Abstract:

The importance of lipids and protein lateral organization within biological membranes has recently emerged as a prominent research area in bio-membranes. However, the challenges posed by the complexity of these systems require simple in vitro models to study the compartmentalization and clustering of macromolecules on the membrane plane with sub nanometer resolution. One of the ways protein and lipids form domains in membranes is by co-localizing in regions of high curvature, such as at the polar regions of rod shaped cells. Here, we introduce a novel model membrane to study the effect of curvature on lipid and protein segregation, which will provide complementary information to the fluorescence microscopy techniques used in this area of research

Report for experiment CRG-2739

on SuperADAM

AIM: The aim of the first part of this experiment was to measure the GISANS signal from samples made of a silicon wafer functionalised with a monolayer of hexagonally packed, spherical, silica nanoparticles (SiNP) at the solid/air and the solid/liquid interface. Three different samples were prepared functionalized with SiNP of 50, 100 and 200 nm in diameter (Ø).

After the characterization of the substrates, lipids (hPOPC) were deposited via vesicle fusion onto the SiNP monolayers and again characterized by GISANS at the solid liquid interface

RESULTS:

- GISANS at the solid/air interface: All samples produced a clear GISANS signal at the solid/air interface with spacing of the off-specular reflections corresponding to the size of the nanoparticles on the surface, in agreement with our preliminary characterization of the samples by GISAXS under the same conditions (**Figure 1**). The asymmetric GISANS signal from a bare silicon wafer without particles, highlighted irregularities in the detector efficiency.
- GISANS at the solid/D_2O interface: We were hoping to use GISANS to probe the solid/D_2O interface which is difficult to access by GISAXS and would allow us to detect the in plane SLD changes caused by the deposition of lipids onto the samples. Unfortunately, we were not able to see a difference in the data before and after the lipid deposition (**Figure 2A**). We think the solid liquid cell increased the background noise around the direct beam which hid the scattering from the sample as shown by the higher intensity of the wings on the sides of the specular direction shown in (**Figure 2B**). Adding cadmium shielding did not solve the problem and we are now designing a new absorbing cell to decrease the incoherent scattering of the plastic material of the current cell

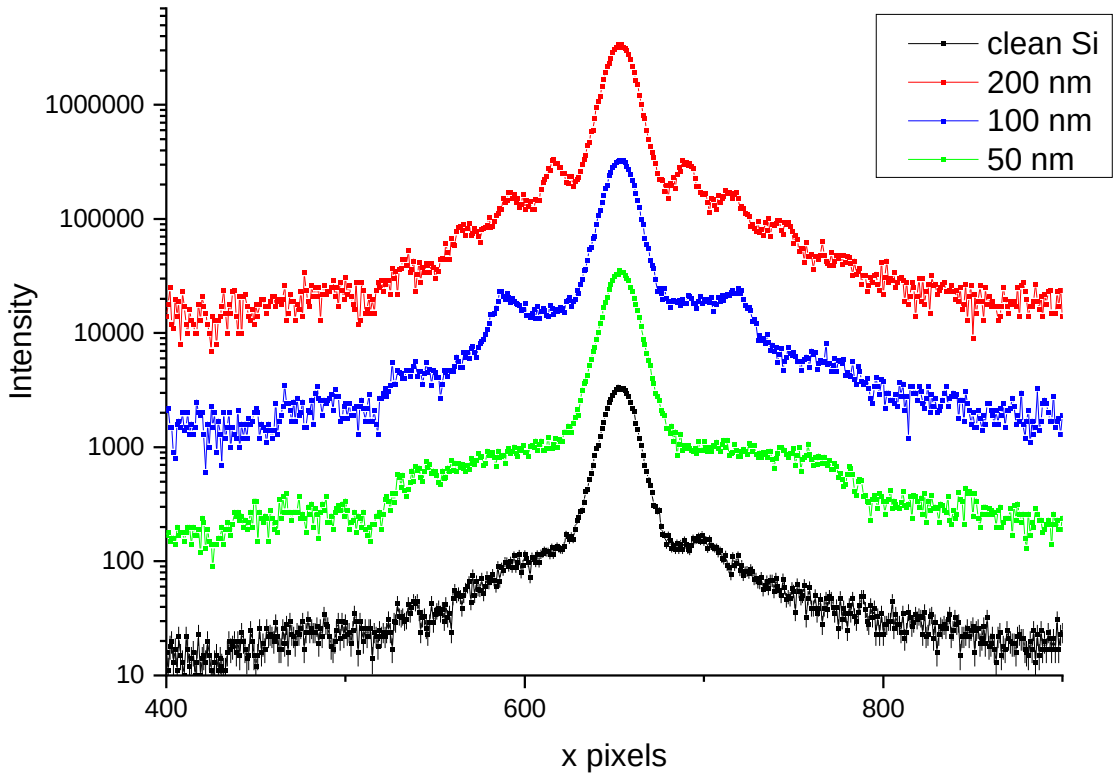

Figure 1 GISANS signal from 50, 100 and 200 nm Ø SiNP at the solid/air interface

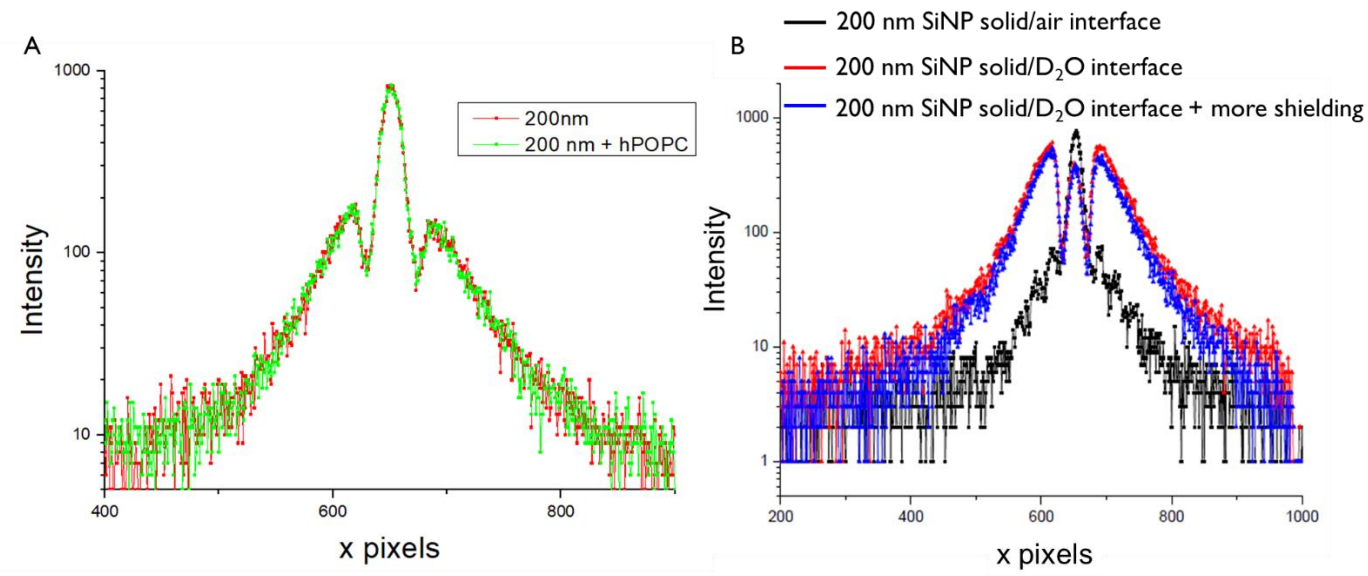

Figure 2 GISANS signal from 200 nm Ø SiNP at the solid/D_2O interface. (**A**) GISANS signal before and after the addition of hPOPC in the solid liquid cell (**B**) Comparison of the signals at the solid/air (black) and the solid/D_2O before (red) and after (blue) the addition of cadmium shielding to try reduce the background.