ESRF	**Experiment title:** High resolution reflectivity from single supported membranes at the solid-liquid interface using a new microfluidic setup	**Experiment number:** IH-SI-194
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Report:

We have carried out x-ray reflectivity experiments at solid-liquid interfaces using a new compact microfluidic sample chamber (figure 1). With this setup it was possible to record high resolution reflectivity curves of single supported membranes over a range of nine orders of magnitude in reflected intensity, which is a significant improvement in performance compared to previous experiments of this kind done at ESRF [1,2].

Our microfluidic setup consists of a small plastic chamber of low mass density which carries an embedded silicon substrate (figure 1). The small microchannel reduces the beam path through the liquid down to 5 mm. An x-ray energy of 19.5 keV was employed during the experiments in order to prevent radiation damage and to reduce absorption by the chamber material.

1.)

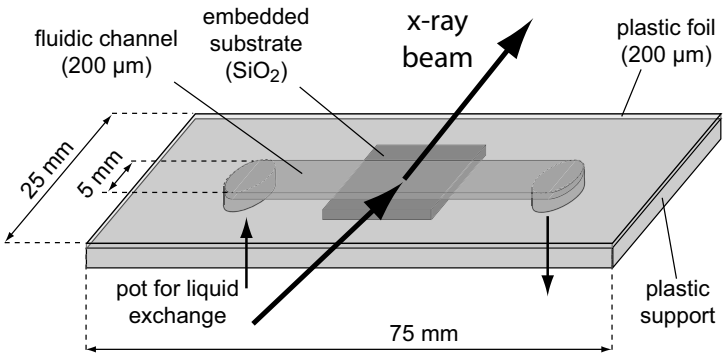
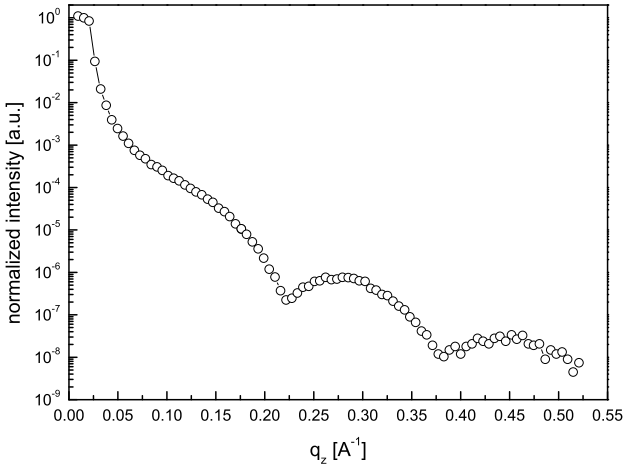
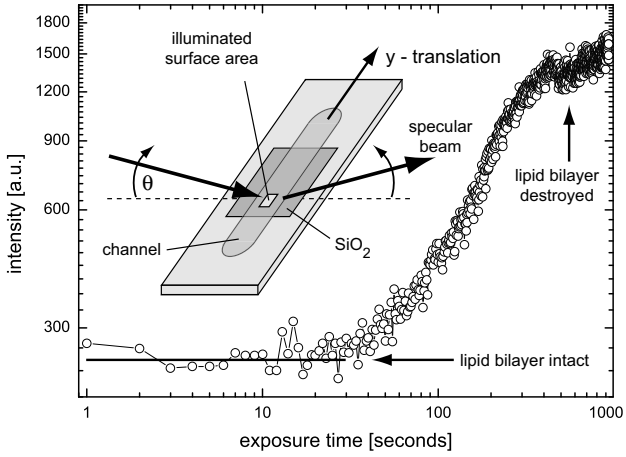


Fig. 1: Sketch of the microfluidic chamber with absolute dimensions.

We have investigated single supported membranes of 1,2-dioleoyl-*sn*-glycero-3-phosphatidylcholine (DOPC) on SiO_2. The bilayers were prepared by spreading lipid vesicles onto the hydrophilic surface of SiO_2 [3]. Figure 2.a) shows a typical reflectivity curve of such a supported membrane obtained with our setup. The curve could be recorded up to a momentum transfer of $q_z = 0.5$ Å^{-1} before reaching the background level. The loss of primary beam intensity is less than one order of magnitude due to the compact chamber geometry.



2.a)



2.b)

Fig. 2.a): High resolution reflectivity curve of a single supported DOPC-membrane. Fig. 2.b): Time evolution of the reflected intensity at $q_z = 0.22$ Å^{-1}.

The lifetime of the lipid bilayer was investigated when exposed to the full primary beam (ca. $5 \cdot 10^{10}$ photons/sec, spot size 0.02×0.2 mm^2). The time evolution of the specular reflected intensity was recorded at the position of the first minimum in figure 2 ($q_z = 0.22$ Å^{-1}). The intensity showed no notable change during the first 30 seconds of illumination (figure 2.b). Then the intensity started to rise until reaching saturation 10 minutes later. Thus the beam damage cannot be neglected if a single surface spot is illuminated for more than half a minute, which is almost always the case for a full reflectivity scan.

This problem can be overcome if homogeneous surfaces are investigated. The scan of figure 2.a) was recorded by shifting the beam spot laterally on the sample surface during the scan (y-translation). In that case, each contributing area was illuminated for a maximum of ten seconds during the scan.

This procedure together with the compact setup allows to minimize the actual radiation damage and to record reflectivity curves from homogeneous biological interfaces with high momentum resolution.

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[3] A. A. Brian, and H. M. McConnell, Proc. Nat. Acad. Sci. 81, 6159 (1984)