EUROPEAN SYNCHROTRON RADIATION FACILITY

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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** Interaction Dynamics of Ionic Liquids with Biomimicking Liposomes by Time-resolved SAXS	**Experiment number**: CH4719
Beamline:	**Date of experiment**: from: 29.6.2016 to: 1.7.2016	**Date of report**: 20.2.2017
Shifts:	**Local contact(s)**: Sylvain Prevost	*Received at ESRF:*

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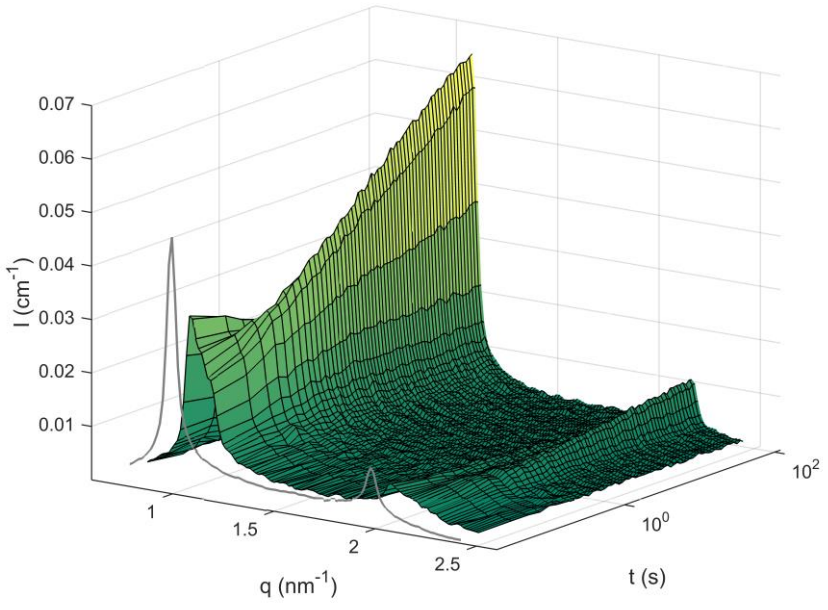
Report:

We performed a time-resolved SAXS experiment on the effects of ionic liquids (ILs) on biomimicking liposomes. The experiment was carried out using the stopped-flow device on beamline ID02, and the experiments were repeated with a flow-through cell for aged samples.

The liposomes used were multilamellar vesicles (MLV) composed of L-α-phosphatidylcholine which were mixed with the ionic liquids $[P_{14444}][OAc]$, $[P_{8881}][OAc]$, $[P_{4441}][OAc]$ and [emim][OAc] of varying concentration [0.5-50 mM]. For $[P_{4441}][OAc]$, only flow-through cell experiments were conducted.



Mixing of ionic liquids with MLV induced a reduction of the lamellar distance which was dependent on IL concentration, evidenced by a shift in the position of the diffraction peaks (Figure 1). The ionic liquids with long hydrocarbon chains, $[P_{14444}][OAc]$ and $[P_{8881}][OAc]$, induced disorder in the MLV structure and the diffraction peaks disappeared (Figure 2).

Figure 1: The SAXS pattern of multilamellar vesicles mixed with 50 mM of [emim]OAc as a function of time. Reference pattern of MLV shown in grey.

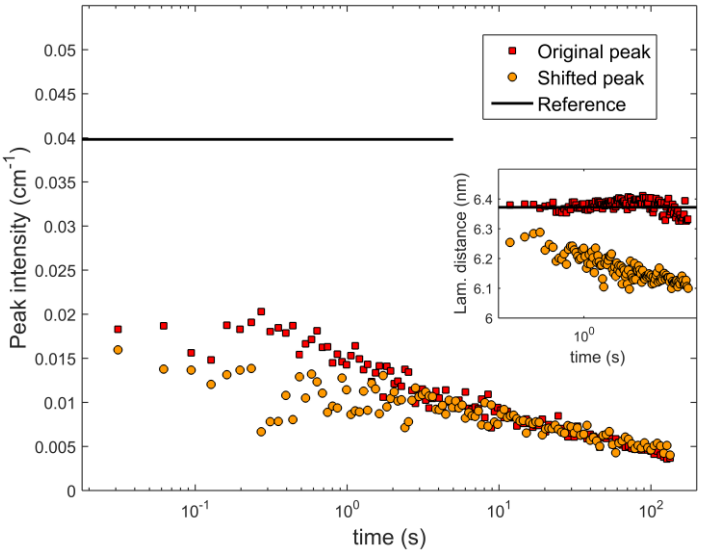


Figure 2. The intensities of the original and shifted diffraction peaks for MLVs mixed with 5 mM of [P_{14444}][OAc]. Insert: The lamellar distances based on the position of the original and shifted peaks.

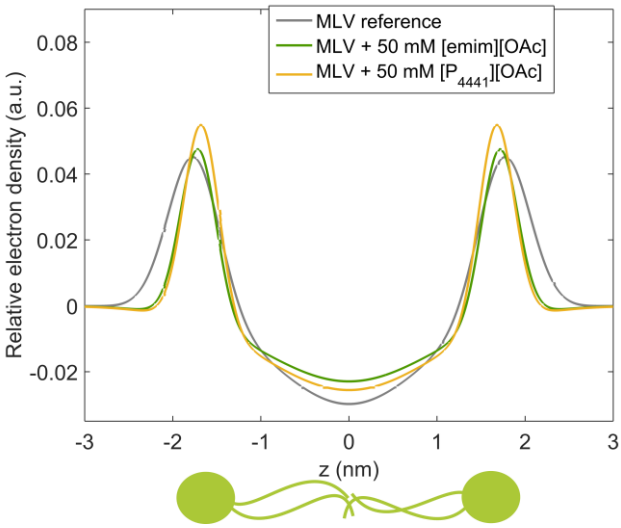


Figure 3. The relative electron density over the lipid bilayer in reference sample and samples mixed with [emim][OAc]and [P_{4441}][OAc] with a schematic of the lipids below.

[Emim][OAc], on the other hand, increased the order based on the increased intensity of the diffraction peaks. We have calculated the relative electron density of the headgroups over the lipid bilayer from the SAXS pattern, and the results indicate that the lipid bilayer is compressed so that the electron density at both head groups and tail groups increases (Figure 3). Results for [emim][OAc] and [P_{4441}][OAc] are similar.

The results indicate that the decrease in the lamellar distance is due to the increased salt concentration of the solvent and is independent of the IL type. However, as the ILs with a long hydrocarbon chain progress through the multilamellar structure, the lamellae become increasingly disordered, leading first to a further decrease in lamellar distance and eventually complete loss of order. The results give insight into the interaction mechanisms of ionic liquids with phospholipid bilayers.

Preliminary results have been presented in posters in the international conferences ISMC (September 2016, Grenoble, France) and ILSEPT (January 2017, Kuala Lumpur, Malaysia).