ESRF	**Single phospholipidic bilayer destabilisation under an electric field**	**Experiment number**: SC 2352
Beamline: BM 32	**Date of experiment**: from: 05/12/2007 to: 11/12/2007	**Date of report**: 03/09/2005
Shifts: 18	**Local contact(s)**: Jean-Sebastien Micha	*Received at ESRF:*

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Report:

The aim of the experiment was to investigate the effect of an electric field on fluctuationsand destabilization of a supported phospholipic bilayer floating 2-3 nm above a first bilayer grafted on a silicon substrate [1]. Earlier X-ray experiments (32-2-76, 32-2-89 and 32-2-129) enabled us to show that grazing-incidence X-ray scattering can give access to the thermal fluctuation spectrum of the membrane [2]. Previous neutron reflectivity experiments showed that it is possible to completly destabilized the floating bilayer by applying an lectric field. We interpret this effect in term of a negative surface tension [2], in agreement with theoretical results.

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$$< z(q)\, z(-q) >= \frac{k_B T}{U'' + \gamma q^2 + \kappa q^4}$$

where U'' is the second derivative of the membrane-substrate potential, γ the surface tension of the membrane and κ its bending modulus. After rigorous background substraction, we were able to caracterise the membrane fluctuation spectrum over a wide submicrometric range ($1\ \mu m^{-1} < q_z < 0.1\ nm^{-1}$), leading to the determination of γ and κ for the free-standing bilayer, in both the gel and the fluid phases.

One aim of this experiment was to adapt our experimental studied on mixed OTS-Lipid bilayer on double lipid bilayer. This was sucessfully done, leading to the determination of the fluctuations spectrum of a double floating bilayer. The second step consist in applying the electric field to the system.

Experiments were carried out on DSPC bilayers and double-bilayers samples, deposited on silicon substrates. All samples, including bare silicon wafers and first grafted layers, were characterised by specular reflectivity measurements.

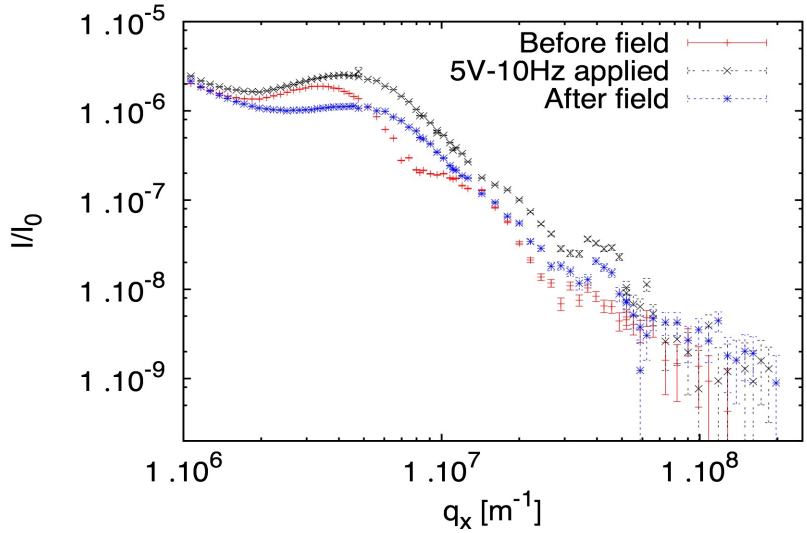

Figure 1: Effetc of an electric field (5 V, 10 Kz) on a double supported bilayer: (red +) = before applying field; (black x) = under electric field; (blue *) = after field.

The optimisation of experimental conditions give access q data at lower values of wave-vector, enabled us to distinguish particular features of diffuse scattering curves that could not be seen in the first experiments. As shown in Figure 1, we observe a clear effect of the electric on the bilayer. The experiments We also clearly observe a partial reversibility of this effect. A detailed analysis and an modelisation effort remains to be performed to give quantitative variations of the physical parameters U", γ and κ at the transition.

The beamline BM32 was working well (although the 16-bunch lead to a doubling of the acquisition time, as expected) and the beamtime was used at 100%. Sample preparation was also satisfactory, according to both quantitative (transfer rates reproducibly > 95%) and qualitative criteria.

[1] G. Fragneto, T.Charitat, E. Bellet-Amalric, R. Cubitt and F. Graner, *Swelling of phospholipid floating bilayers: the effect of chain lengt,* Langmuir **19**, 7695-7702 (2003).

[2] S. Lecuyer, G. Fragneto, T. Charitat, *Effect of an electric field on a floating lipid bilayer: A neutron reflectivity study,* Eur. Phys. J. E **21**, 153-159 (2006).

[3] J. Daillant, E. Bellet-Amalric, A. Braslau, T. Charitat, G. Fragneto, F. Graner, S. Mora, F. Rieutord, B. Stidder *Structure and fluctuations of a single floating lipid bilayer*, PNAS **102** 11639-11644 (2005).