Experimental report

02/09/2022

Proposal: 9-13-852 **Council:** 4/2019

Title: Phase transition behaviour in single and floating phospholipid bilayers

Research area: Soft condensed matter

This proposal is a continuation of 9-13-759

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Local contacts: Yuri GERELLI

Samples: synthetic phospholipids

Instrument	Requested days	Allocated days	From	To
D17	3	3	01/10/2019	04/10/2019

Abstract:

Solid-supported lipid bilayers (SLBs) are widely used tools in biological and technological studies, for the investigation of interactions and molecular processes involved in cell function, disease and for sensing applications. Coexistence of ordered and disordered domains, structural and dynamic coupling
between leaflets and the structural responses to changes in the environmental parameters such as temperature, are of fundamental interest in all of the above mentioned fields. Recently, time- and temperature-resolved neutron reflectometry allowed us to perform the real-time characterization of the structural changes taking place across phase transitions in solid supported-lipid bilayers (SLBs). We identified the presence of an isothermal phase transition, characterized by a
symmetrical rearrangement of lipid molecules in both bilayer leaflets, followed by a thermotropic phase transition, characterized by an independent melting of the two leaflets. We plan now to characterize with better accuracy this unexpected isothermal process and the influence of the substrate in a SLB and floating bilayer systems.

Report for 9-13-852

The experiment 9-13-852 is a continuation of 9-13-759, in which we have collected time- and temperature-resolved neutron reflectometry (TtR-NR) data on the thermal behavior of a pure phospholipid bilayer made of d75–DPPC. In the current experiment, data on different systems were collected to determine if the observed behavior is peculiar of a solid-supported, monocomponent, single bilayer or it is a general feature of planar lipid systems.

The systems investigated were

1. d75–DPPC **SLB**
2. d75–DPPC **floating** bilayer supported by a DPhPC SLB
3. **asymmetric SLB** composed by d75–DPPC and h-DPPC

The data collected on systems 1 and 3 provided new information on the time and temperature behavior of single SLBs and were used in two publications [1,2].

The d75–DPPC floating bilayer was deposited on the top of a silicon block decorated with a DPhPC SLB by means of Langmuir-Blodgett and Langmuir Schaefer deposition techniques at the PSCM facility. The static structure of the system was measured in three contrasts at 15 °C and 60 °C, with the d75–DPPC bilayer in the gel and in the fluid phase respectively. The phase transition behavior was monitored in this temperature interval by collecting TtR-NR curves every 30 seconds, with the temperature increased by 2 °C every 10 minutes. The TtR-data measured during the heating scan for the floating bilayer are shown in Figure 1. The sudden change of intensity visible at Q<0.05 $Å^{-1}$ is not compatible with a simple melting of lipid molecules in the floating bilayer and analysis are still in progress. Similar data were measured from the cooling scan; however, the structure of the sample shows a strong hysteresis, probably induced by the high-temperature annealing.

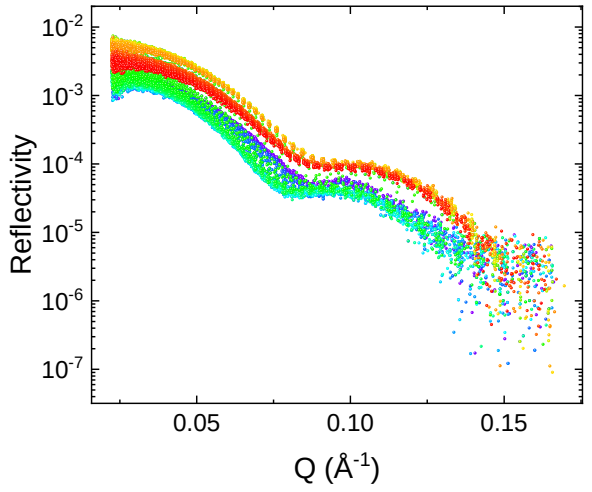

Figure 1. TtR-data measured for the d75-DPPC floating bilayer during the heating scan from 15 °C (violet) to 60 °C (red).

Manuscript resulting from this experiment:

1. Y. Gerelli, *Phase transitions in a single supported phospholipid bilayer: Real-time determination by neutron reflectometry*, **Phys. Rev. Letters**, **2019**, doi: 10.1103/PhysRevLett.122.248101
2. L. Porcar and Y. Gerelli, *On the lipid flip-flop and phase transition coupling*, **Soft Matter**, **2020**, doi: 10.1039/D0SM01161D