

Experimental report

17/09/2024

Proposal: 9-12-692

Council: 4/2023

Title: Neutron reflectivity study of the interactions of novel alternating amphiphilic polymers (AAPs) with model lipid membranes

Research area: Soft condensed matter

This proposal is a new proposal

Main proposer: Benedetta Petra ROSI

Experimental team: Irina APANASENKO
Ralf BIEHL
Margarita KRUTEVA
Juergen ALLGAIER
Benedetta Petra ROSI

Local contacts: Nicolo PARACINI

Samples: lipid bilayer + P(C4EG4) (30 Kg/mol)
lipid bilayer + P(C8EG13)
lipid bilayer + P(C14EG47)
lipid bilayer + P(C4EG4) (2 Kg/mol)
lipid bilayer + P(C4EG4) (10 Kg/mol)

Instrument	Requested days	Allocated days	From	To
D17	3	0		
FIGARO	3	3	27/10/2023	30/10/2023

Abstract:

We propose to investigate the interaction of alternating amphiphilic polymers (AAPs) with phospholipid membranes by neutron reflectometry (NR). The AAPs are made of hydrophobic dicarboxylic acid and low molecular weight hydrophilic polyethylene glycol (PEG) units and are arranged in an alternating order. We showed in a detailed PFG-NMR study that these polymers translocate through lipid membranes without damaging them. To get a complete picture of the translocation mechanism and rationalize the polymer design, it is essential to understand the interactions between the AAPs and the lipid membrane at the microscopic level and determine the polymer location as a function of its overall hydrophobic/hydrophilic balance. To this purpose, here we propose to use neutron reflectometry (NR) to detect the location of AAPs with different composition in model lipid bilayers.

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The experiment has been performed at the FIGARO beamline. The allocated beamtime was 3 days. We planned the measurement of supported lipid bilayers (SLB) of POPC lipids in interaction with different polymers. All samples have been measured at 2 angles, covering a final Q region between 0.0045 and 0.27 AA⁻¹.

Substrate #	Polymer
1	d-POPC + h-P(C14EG44) 2-F7 (84/14) Mw=8.7 K
2	d-POPC + h-P(C8EG13) 2-7u (33/11) Mw=5 K
3	d-POPC + h-P(C4EG4) F7-ul (EK 40/1) Mw=7 K
4	d-POPC + h-P(C4EG4) F11 L (EK 40/1) Mw=2.4 K
5	d-POPC + h-P(C10EG22) F9 (EK 50/1) Mw=13 K

The list of measured samples is reported in Table 1. Each sample was measured by following the same protocol:

1. measurement of the Si substrate (20')
2. deposition of the SLB and measurement in three contrasts (D2O, H2O, and silicon matched water or SMW) (~2h 30')
3. measurement of SLB + polymer (~2h 30') plus check measurements with pure buffer (without polymer).

All samples have been measured at 25°C. For 4 samples we also investigated the temperature dependence by measuring other 3 temperatures (30°C, 35°C, and 40°C) in D2O. An example of reflectivity curves is reported in Figure 1.

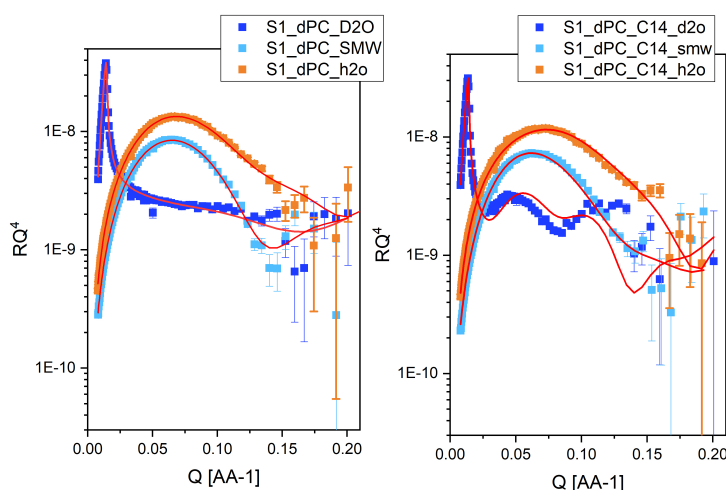


Figure 1. Reflectivity curves scaled by Q^4 for one substrate measured in three contrasts. Left: bare SLB, right: SLB + polymer.