Experimental report

29/07/2022

Proposal: 9-12-641 **Council:** 10/2020

Title: Interaction of non-ionic alternating amphiphilic polymers with lipid membrane - SANS

Research area: Soft condensed matter

This proposal is a continuation of TEST-3122

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Samples: POPC-d64 liposomes (C42H18D64O8P)
Anphiphilic polymers (C, H, O)

Instrument	Requested days	Allocated days	From	To
D11	1	0		
D22	1	0		
D33	1	1	26/08/2021	27/08/2021

Abstract:

We found that non-ionic alternating amphiphilic co-polymers (NAAPs) with a balanced amphiphilicity can passively translocate through lipid bilayers without damaging the membrane. The translocation through lipid bilayers is currently investigated by PFG NMR and fluorescent microscopy. We found that it consists of a relatively fast membrane saturation with the polymers and a slow release process. We would like to use SANS to study the structural changes of the lipid bilayer caused by the NAAPs. A comparison of the different NAAP compositions and molecular weight will allow us to obtain information about the polymer-lipid interaction and the translocation mechanism.

Experimental report

We measured SANS from the mixtures of deuterated large unilamellar vesicles (LUV) with the protonated non-ionic alternating amphiphilic polymers (NAAP) in D2O to study the influence of the NAAPs molecular weight and composition (different length and mass ratio of hydrophobic and hydrophilic blocks) on the lipid membrane. The contrast of this method allows us to distinguish small changes in the lipid bilayer structure especially at higher Q.

LUVs of about 90 nm diameter made of tail-deuterated POPC lipids and perdeuterated POPC lipids of a concentration of 1 wt. % in D2O were used for the experiments. The NAAP concentration was 1 wt. % for all the measurements. The NAAPs are self-made polymers produced by copolymerizing dicarboxylic acids (C4 – C12) with ethylene glycol (EG) oligomers (3 – 16 EG units), e.g. C5EG6. The deuterated POPC was produced by ANSTO Deuteration Facility.

We studied the effect of molecular weight using C4EG4 polymer (2.5, 5, 10 and 16 kg/mol) and of composition (C5EG6, C8EG13). Pluronic-F127 was measured as a reference material.

The resulting scattering curves for the molecular weight dependence are presented in figure 1B. The expected effect (Figure 1A) was not observed, it is still not clear why. The results for perdeuterated lipids (Figure 2) are under investigation.

From the experimental side the measurements went very well, and the instrument responsible was very helpful.

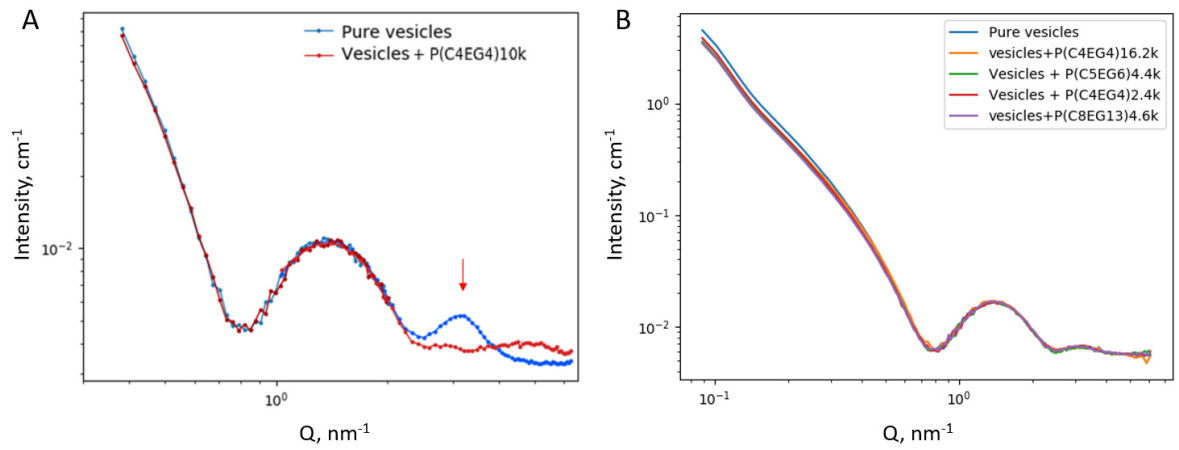

Figure 1. A: SANS measurement from KWS-1. Blue: tail-deuterated POPC vesicles. Red: tail-deuterated POPC vesicles + amphiphilic polymer P(C4EG4)10kg/mol after the subtraction of free polymer scattering; B: SANS measurement from D33. Blue: tail-deuterated POPC vesicles. Other colors: tail-deuterated POPC vesicles + amphiphilic polymers after the subtraction of free polymer scattering.

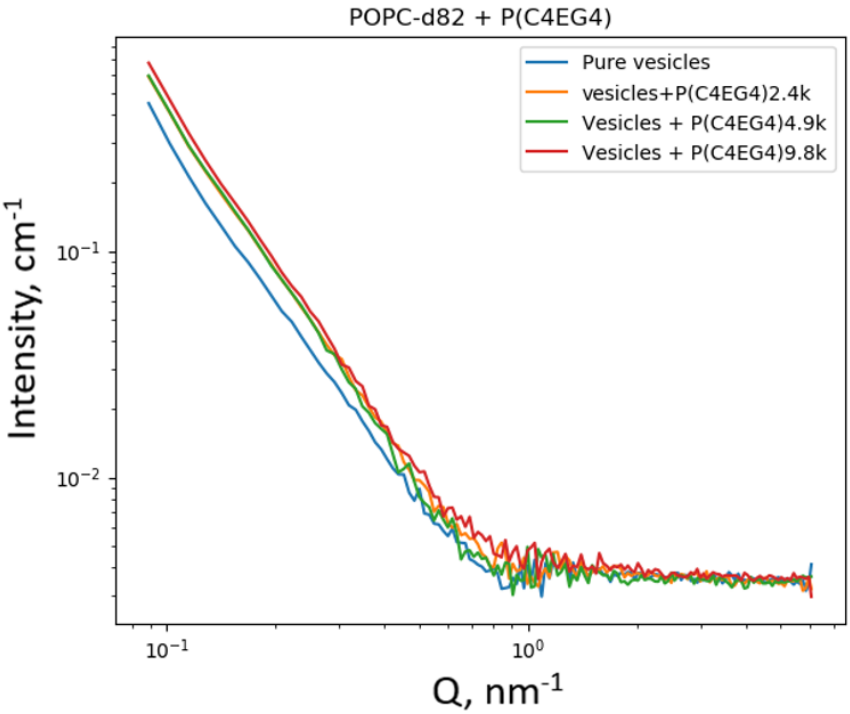

Figure 2. SANS measurement from D33. Blue: perdeuterated POPC vesicles. Other colors: perdeuterated POPC vesicles + amphiphilic polymers after the subtraction of free polymer scattering.