Experimental report

15/01/2022

Proposal: 9-10-1621 **Council:** 10/2019

Title: Neutron reflection studies on adsorption of lauroyl-L-carnitine at the silicon dioxide/water interface

Research area: Physics

This proposal is a new proposal

Main proposer: Jian Ren LU

Experimental team: Samantha MICCIULLA
Armando MAESTRO
Huayang LIU

Local contacts: Samantha MICCIULLA
Armando MAESTRO

Samples: NaCl
Lauroyl-L-carnitine

Instrument	Requested days	Allocated days	From	To
D17	3	0		
FIGARO	3	3	22/02/2021	25/02/2021

Abstract:

Acyl-L-carnitine is a new type of surfactants that have been designed and synthesized recently due to their novel antimicrobial and compatible properties. As their biological functions originate from their behavior as surfactants, this work aims to characterize how they adsorb at the silicon oxide/water interface by neutron reflection. As this interface has been widely used to screen adsorption from a wide range of surfactants, the results will enable us to establish the performance of this group of surfactants through direct comparison. We request 3 days of D17 or Figaro to complete this proposal.

Experimental report

03/2020

Proposal: 9-10-1621

Council:

Title: Neutron reflection studies on adsorption of lauroyl-L-carnitine at the silicon dioxide/water interface

Research area: Biosurfactants,

Main proposer: **Jian Ren LU**

Experimental team: Huayang LIU

Zongyi LI

Ke FA

Local contacts: Armando MAESTRO

Samples: Acyl-L-carnitines

Instrument	Requested days	Allocated days	From	To
FIGARO	3	3	22/02/2021	25/02/2021

Abstract:

Acyl L-Carnitines are a group of novel surfactants with attractive physical and biological properties associated with their head group charge features. This work proposes to use neutron reflection as the unique technique to study how acyl-L-carnitine adsorb on the silica/water interface. We request 3 days of FIGARO beam time to complete the proposed measurements

Report of experiment – FIGARO 9-13-840

PhD Project: Study the fundamental properties of acyl-L-carnitines

Huayang LIU

The purpose of this experiment is to study the adsorption of acyl-L-carnitines in silica/water under different concentrations, pH and ionic strength. We use the FIGARO to measure the different contrasts and fit them to have the structural details of adsorbed acyl-L-carnitines layers.

Materials / samples:

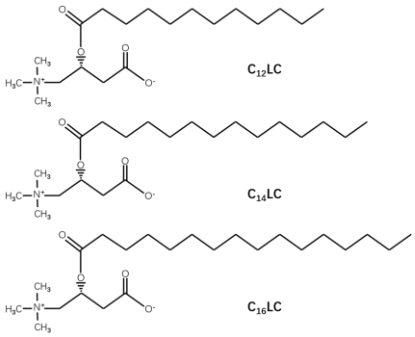

Figure 1 Chemical structure of acyl-L-carnitines

The structure of acyl-L-carnitines are shown in Figure 1. The surfactants have been purified by crystallization method to remove acid and salt, so that the samples have very high purity. The sample powder is dissolved in water with different concentrations, and the pH is adjusted with HCL solution. Then NaCl solution is added to control the ionic strength. Besides, three contrasts are measured in this experiment: h-acyl-L-carnitines are dissolved in D_2O, d-acyl-L-carnitines are dissolved in null reflection water(NRW) and D_2O. The ready samples are poured into the Teflon troughs and measured at 25℃.

Experiment and results

Firstly, $C_{12}LC$ was measured at 0, 0.8 and 2 mM at pH 7 with ionic strength of 1 mM. As shown in Figure 2, the difference between the NR profiles indicate that the amount and structure of adsorbed $C_{12}LC$ layer change under different concentrations. The best-fitted parameters showed the thickness of $C_{12}LC$ is 22 Å at 0.8 mM and 33 Å at 2 mM which increases with the concentration. Besides, the adsorption amount also has the same trend. Then the acyl-L-carnitines ($C_{12}LC$, $C_{14}LC$ and $C_{16}LC$) were also measured under different CMC concentrations (0.8 and 2 CMC). As the acyl chain length increases, the thickness and adsorbed amount also increase.

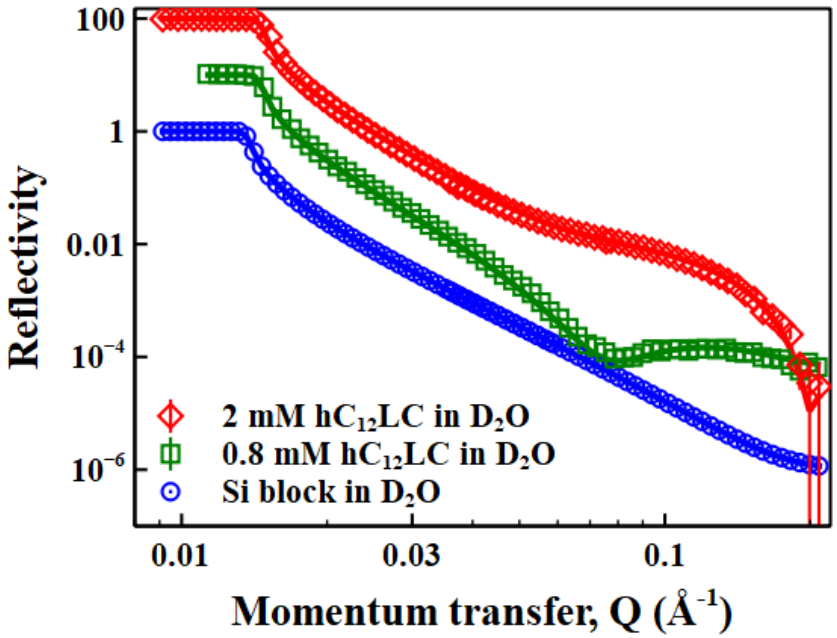

Figure 2 Neutron reflection profiles of $C_{12}LC$ at pH7 and different concentrations (0, 0.8 and 2 mM).

Segments	Scattering length density/ρ($Å^{-2} \times 10^{-6}$)
Protonanted tail ($C_{11}H_{23}$)	-0.40
Deuterated tail ($C_{11}D_{23}$, 98%D)	7.01
Protonanted tail ($C_{13}H_{27}$)	-0.39
Deuterated tail ($C_{13}D_{27}$, 98%D)	7.03
Protonanted tail ($C_{15}H_{31}$)	-0.37
Deuterated tail ($C_{15}D_{31}$, 98%D)	7.00
Head(hL-carnitine with -C=O)	1.31
Null reflection water(NRW)	0
D_2O	6.35

Table 1 The SLD of different segments used in fitting NR data

Conclusion

The adsorption amount of acyl-L-carnitines at the interface of SiO_2/water increase as the concentration increase.

The thickness of acyl-L-carnitine layer increase with the acyl chain length.