



Experiment title: Surface Micelles of a semi-fluorinated alkane at the air/water interface.		Experiment number: SC2097
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Report:

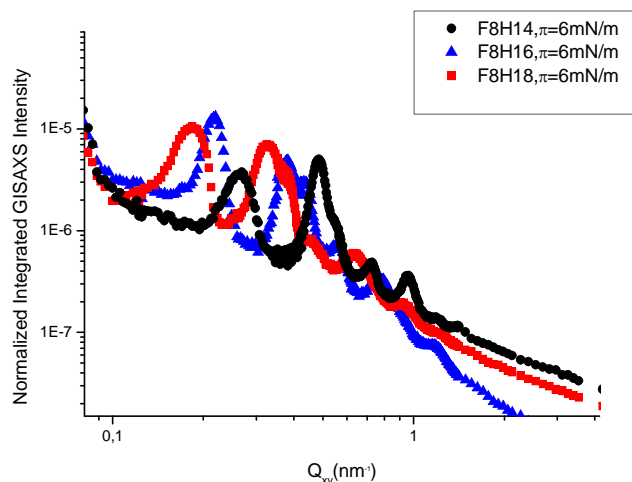
Due to their unique properties (hydrophobic and lipophobic character, chemical and biological inertial) semi-fluorinated alkanes, $C_nF_{2n+1}C_mH_{2m+1}$ (FnHm diblocks), appear as promising agent for medicinal use (i.e. ultrasonic imaging or synthetic lung surfactant^[1]). It is then crucial to understand their self-assembling properties when they interact with water or phospholipid molecules. We previously demonstrated that such molecules display a vertical phase separation from other surfactant at the air/water interface^[2]. Indeed, despite the lack of polar head group, semi-fluorinated alkanes are able to form stable Langmuir monolayers alone at the air / water interface^[3]. However their structure was controversial. Using Grazing Incidence Small Angle x-ray Diffraction (GISAXD) on F8H16 monolayer at 3 mN/m surface pressure, we demonstrated the presence of a 30 nm diameter domains organized on an hexagonal 2D lattice^[4]. The aim of the experiment was to determine how robust is the hexagonal structure with respect to surface pressure and the effect of the length of the molecule in order to understand the driving force of their formation.

To unravel the structure of semi fluorinated alkane at the air/water interface, we performed Grazing Incidence x-ray scattering on Langmuir monolayers of F8Hm on the ID10B beamline. We used a monochromatized x-ray beam of energy 8keV (0.154nm). The beam was deflected downwards to impinge on the water surface with an incident angle of 1.98mrad. The beam sizes were fixed at 300μm horizontally and 100μm vertically. Scattered photons was detected by a vertical PSD (150mm height) located at 835mm from the center of the goniometer (COG). As collimator, we used two verticals slits of horizontal gap of 300μm and 500μm and located respectively at 272mm and 803mm from the COG. The sample was deposited in a home built gas tight Langmuir through adapted to the goniometer and flushed by Helium gas. The Surface pressure measurement accuracy was 0.1mNm⁻¹.

Figure 1 presents the GISAXS spectra on monolayer of F8H14, F8H16, F8H18 deposited at the air water interface and compressed at 6mN/m. One observes diffractions peaks on each GISAXS spectra,. These peaks appear, according to the F8H14 at about 1mN/m, 0.3mN/m for the F8H16 and

0.5mN/m for the F8H18 (no peaks were observed for lower surface pressure). As for the F8H16 case, they can be indexed by using a hexagonal lattice, indicating the presence of large domains of self-assembled FnHm molecules whatever the length of the molecule. It shows that this self-assembling property of FnHm molecules is, at least, a generic phenomenon.

After indexation, the lattice parameter has been determined. Some of the results (still under treatment) are summerized in Table 1. It shows that the longer the hydrogenated part is, the larger the lattice parameter size is and thus the domains (nano-droplets or hemimicelles whatever it is) size. However, the observed variation appears as strongly not linear ; an increase of 12% on the length of the molecule induce a rise of 55% on the lattice parameter.



Surface pressure	Lattice parameter(nm)		
	F8H14	F8H16	F8H18
$\pi= 6 \text{ mN/m}$	25,7373	31,0704	40,3496
$\pi= 5 \text{ mN/m}$	27,7750	32,8434	40,2863
$\pi= 4 \text{ mN/m}$	29,8866	33,8861	40,4988

Table 1 : Hexagonal lattice parameter raffined using Eracel for different F8Hm molecules at different surface pressure

Figure 1: GISAXS spectra measured on a monolayer of F8H14, F8H16, F8H18 diblock deposited at the air water interface at surface pressure, $\pi = 6 \text{ mN.m}^{-1}$ and $T=19^\circ$

In order to determine the compressibility of the hexagonal lattice of FnHm self-assembled domains, we record GISAXS spectra for m=14, 16, 18 at different surface pressure with a step of 0.5mN/m. Some results are given in Table 1. It shows that despite of increasing pressure, the system do not coalesce to form a homogeneous layer which would lead to the disparition of the large hexagonal lattice. It shows also that the longer the hydrogenated part is the weaker the lattice compressibility is.

Due to the short time between experiment and proposal deadline, the data are still under treatment (i.e. peaks relative intensity or coherence length). However this partial analysis evidenced phenomenon which cannot be understand when simply Van Der Waals interaction between the molecules. We expect analyse the origin of this effect in the framework recent theoretical prediction[5].

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