



	Experiment title: Fondamental study of ionics in single-digit nanoconfinement	Experiment number: A32-2-853 A32-2-846
Beamline: ID02	Date of experiment: from:05/10/2022 to: 12/10/2022	Date of report:
Shifts: 20	Local contact(s): Samuel Tardif	<i>Received at ESRF:</i>
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The results presented in this experimental report correspond to the experiments performed in april 2022 (A32-2-846) and october 2022 (A32-2-853).

The goal of these experiments were to study the filling kinetics by hard X-ray reflectometry in confinement of 2, 3 and 4 nm nanochannels with electrolytes having ions presenting various size and solubility in order to highlight ion specific effect. Today, only KCl, NaCl, RbCl, CsCl at 1M presented in Table 1 were studied.

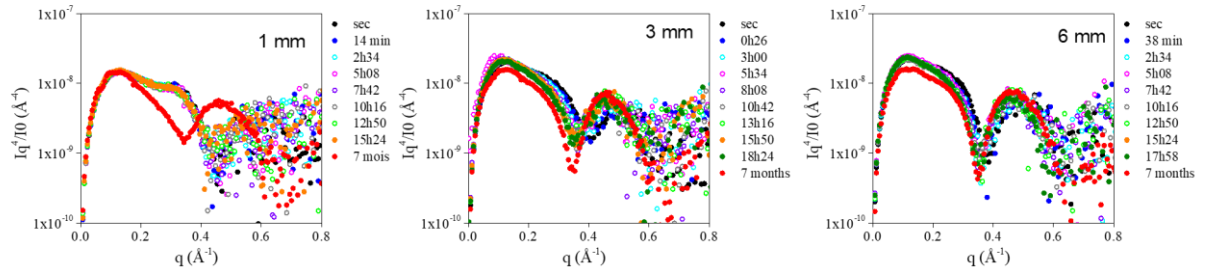
Table 1: Comparison of salt solubility in water at 20°C, and ions hydrated radii from Nightinga et al **Erreur ! Source du renvoi introuvable..**

Salts	Solubility in water [M]	Cations	Hydrated radii [nm]
KCl	4.6	K ⁺	3.3
NaCl	6.1	Na ⁺	3.6
RbCl	7.5	Rb ⁺	3.3
CsCl	11	Cs ⁺	3.3

Two types of kinetics study were done. The first one consists in the study of the filling of the nanochannels of 2 and 4 nm with the electrolyte solution. An example of X-ray reflectivity curve evolutions during the filling of the nanochannels with RbCl 1M is presented on Figure 1.

RbCl

2 nm



4 nm

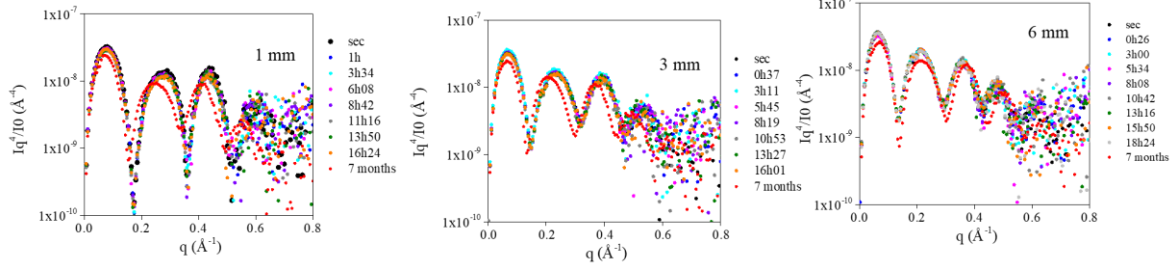


Figure 1: Example of the evolution of X-ray reflectivity during the filling of 2 and 4 nm nanochannels with RbCl 1M solution.

The second experiment consists in the study of the transport of ions in already water filled nanochannels of 3 nm. The results are presented Figure 2. An example of electron density profile in the nanochannel is also presented.

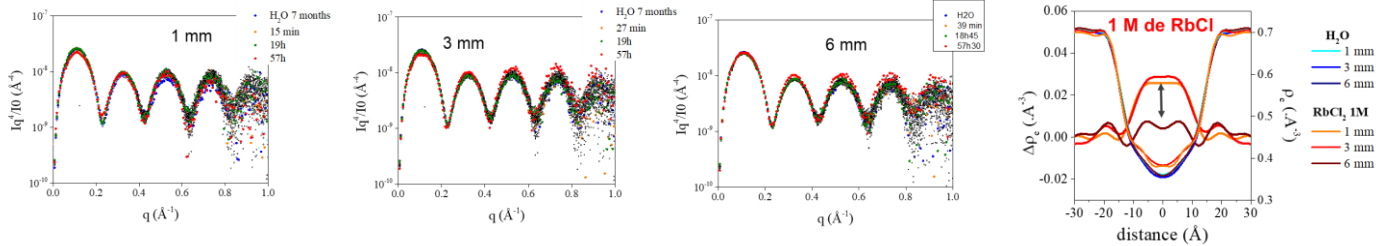


Figure 2: Example of the evolution of X-ray reflectivity when nanochannels of 3 nm already filled with water are in contact with a RbCl 1M solution. The electron density profile evolution in the nanochannels is also presented.

The results obtained are now under treatment to calculated the electron density profile as a function of the time as in 10.1016/j.jcis.2022.01.128 and the same systems at the equilibrium are simulating using molecular dynamics and PMF calculation.

Next proposal we will focus on the behavior of lanthanide elements in confinement as a function of their counter-ions.