Experimental report

30/10/2020

Proposal: 6-07-58 **Council:** 10/2019

Title: Transport of water in soft confinement: influence of surface chemistry, hydrostatic pressure and mechanical stress.

Research area: Materials

This proposal is a new proposal

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Samples: PIM-1

Instrument	Requested days	Allocated days	From	To
D16	5	4	07/09/2020	11/09/2020

Abstract:

Transport of water in soft porous materials is relevant to a broad range of applications but remains unclear in many aspects because of several effects that have to be taken into account: surface chemistry, diffuse boundaries and deformations or mechanical effects. In the proposed study, we plan to experimentally investigate the interplay between mechanical deformation, structure and transport. On the two selected samples (PIM, Intrinsic Microporosity Polymer), we will first characterize the structure and porosity of the films, in dry and hydrated states. And, in a second step, follow their structural evolution at different hydrostatic pressures and mechanical stresses. For this purpose, we require 5 days on D16.

Experimental report

Context

The aim of the proposed study is to experimentally investigate the interplay between mechanical deformation, structure and transport. On the selected sample (PIM-1, Intrinsic Microporosity Polymer, see Figure 1a and b), we want to characterize the structural evolution of the PIM-1, in dry and hydrated states at different hydrostatic pressures and mechanical stresses. Quasi-elastic neutron scattering experiments have been performed under the same experimental conditions in order to probe the water dynamics.

Results

We have tested several conditions in terms of mechanical stresses and water pressures. A home-made high-pressure aluminium cell has been used for the experiment (Figure 1c).

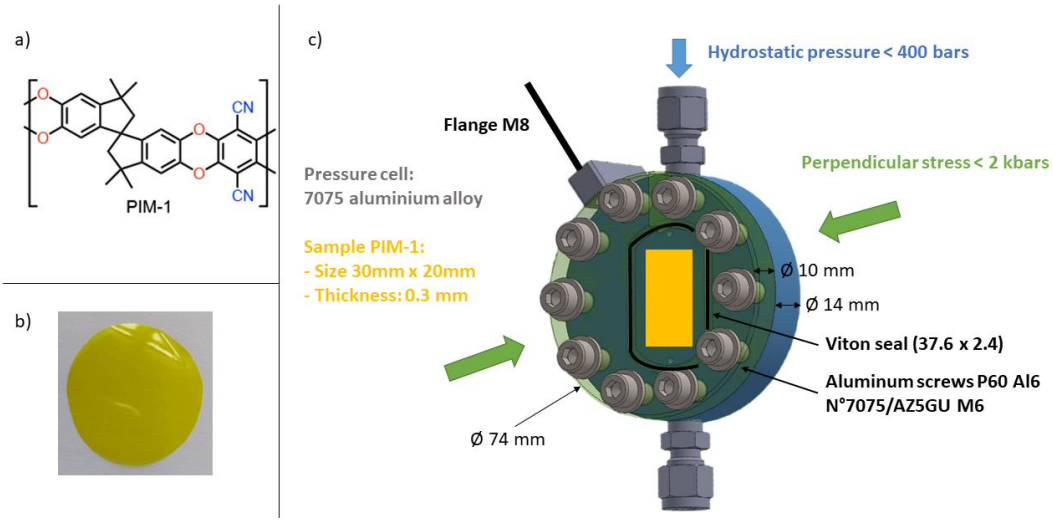

Figure 1: a) PIM-1 structure b) PIM-1 sample c) Homemade aluminium pressure cell. The mechanical stress (< 2 kbars) is applied ex-situ with a torque wrench ensuring a proper tightening level (to a fixed torque value) of the screws.

Some experimental curves are presented in Figure 2. The shift in intensity observed between the dry and hydrated (D_2O) samples is probably linked to the different contrasts (PIM/air for the dry sample and PIM/D_2O for the hydrated one).

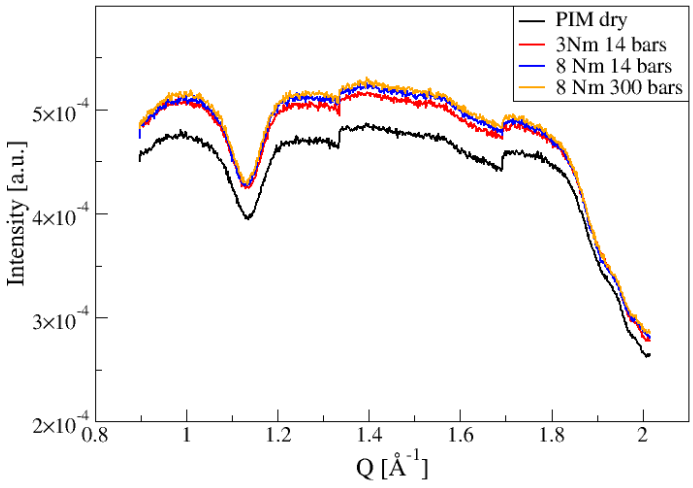

Figure 2: Example of neutron scattering spectra obtained for the dry and hydrated PIM-1 sample

Due to the poor scattering potential of the investigated sample and to the high thickness of the high-pressure aluminium cell used, it is difficult characterize the evolution of the porosity in the PIM-1. No differences have been measured due to poor scattering and also probably because of the very small pores sizes limiting their structural modification under the tested conditions.