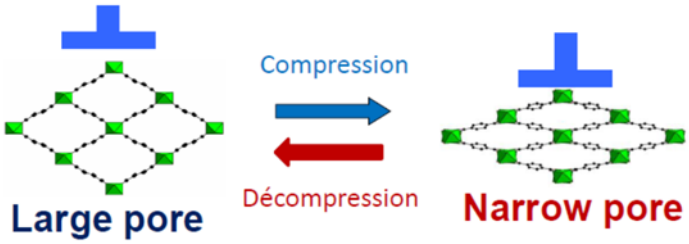
THERMODYNAMIC STUDY OF POROUS MATERIALS STRUCTURAL CHANGES UNDER MECHANICAL PRESSURE OR THERMAL TREATMENT

BEURROIES ISABELLE[1], RODRIGUEZ JULIEN[1], COULET MARIE-VANESSA[1], LLEWELLYN PHILIP[1], DENOYEL RENAUD[1], FABRY PAUL[2], DEVIC THOMAS[2]

[1]Aix Marseille Université et CNRS, MADIREL, Marseille, France
[2]Institut Lavoisier, Versailles, France

Recently it has been shown that porous materials such as Metal Organic Framework (MOF) present structural transition under mechanical pressure [1]. For instance MIL-53 samples can shift from a Large Pore (LP) to a Narrow Pore (NP) structure.



The energy involved in the structural transition between LP and NP forms observed for MIL-53 materials has been measured [2]. A specific device consisting in a high pressure pump for applying mechanical pressure up to 250MPa on the porous material coupled with a Tian-Calvet microcalorimeter has been settled. This unique set-up enables to calculate the internal energy involved in such process. This measurement is essential to investigate possible energy storage applications. According to the energy profile obtained (either partial or total or no dissipation of mechanical energy), different energy-related applications can be considered such as dampers, shock absorbers or molecular springs.

Materials with different morphologies have been tested. For some of them, combined differential calorimetric analyses and x-ray adsorption spectroscopy experiments have been performed. Thanks to those measurements, enthalpy variation and local order changes around the probed atom were followed simultaneously.

[1] Beurroies I, .Boulhout M, Llewellyn P, Kuchta B, Férey G, Serre C, Denoyel.R, (2010), Angew. Chem. Int. Ed.,49 7526 –7529
[2].Rodriguez J., Beurroies I, Loiseau T.,Denoyel R., Llewellyn P, (2015) Angewandte Chemie, Int Ed., DOI : 10.1002/anie.201411202