PHD OFFER

Molecular and colloidal transport in multi-scale porous media:

In situ studies coupling temporal and spatial scales

Understanding the molecular and colloidal transport within complex and multi-scale porous media is essential for the knowledge and development of many environmental, cultural or industrial processes. As examples we can cite : (i) the assessment of the life-cycle of construction materials in the city of tomorrow where durability will depend in part on the degree of water damage linked to diffusive transport; (ii) the *optimal design* of catalyst supports. Currently, the modelling of diffusive processes within the confined space of catalyst supports remains at a description at the chemical engineering level. A statistical physics approach could undoubtedly open up new perspectives in the field. (iii) A better understanding of soil remediation processes as part of the significant and predictable expansion of the cities of tomorrow. For the latter, a comprehensive understanding of molecular, ionic and colloidal transport in pore network confinement is needed.

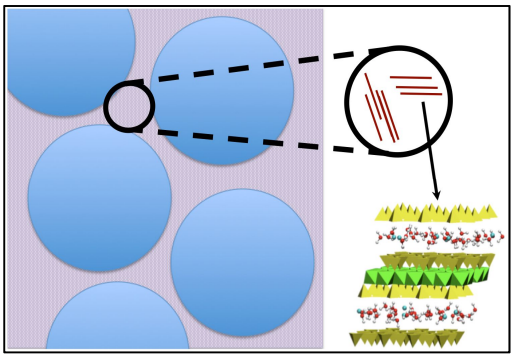

Fig. 1. Assembly of spherical (e.g. silica) and plate-like (clay) particles forming a 3D porous architecture.

The PhD subject proposed at PHENIX laboratory (Sorbonne University, Paris) in collaboration with IPCMS-Strasbourg (group of O. Ersen) and IFPEN-Rueil-Malmaison (group of L. Barré) will involve, on two or three reassembled porous media, a multi-scale determination of pore network geometry coupled with an *in situ* experimental analysis of molecular diffusive transport. Porous systems under investigation will be granular porous media made of one or several particle types (clay / silica / PMMA-poly methyl methacrylate) as well as extruded monoliths. The pore architecture will be studied by coupling micro-tomography, X-ray microscopy, environmental Transmission Electron Microscopy (TEM) and small angle X ray and neutron scattering (SAXS, SANS). Multi-scale molecular transport will be probed using the NMR relaxometry platform in PHENIX and will benefit from recent developments in the domain of pulsed gradient and 1D-2D NMR relaxometry.

The PhD will be a co-tutelle between Sorbonne and Strasbourg Universities; the work will be performed in large part in the PHENIX laboratory (Paris) but also at IPCMS (Strasbourg) for TEM analysis. Several experiments throughout the PhD are to be carried out at Large Scale Infrastructures (synchrotron and neutron sources) in France and abroad.

PHENIX is a laboratory with a long-standing experience in the study of colloidal systems and fluids under confinement. Its strength lies in a combination of experimental and modeling activities (numerical simulations). Several international projects and networks are in place in Phenix, providing a rich and multinational environment.

IPCMS is an excellence center for research and training in materials and nanoscience. IPCMS is an interdisciplinary laboratory gathering chemists and physicists developing experimental approaches and modeling for the synthesis of inorganic, organic or hybrid materials and for better understanding of magnetic and electronic properties at the nanoscale, with expertise in ultrafast optics and nanophotonics, and in the investigation of chemical or physical phenomena at surfaces and interfaces. Characterization of

functional materials or nano-systems down to atomic and ultra-short time scales is particularly under focus using up to date instrumentation.

Keywords: porous media, hierarchical porosity, molecular and/or colloidal transport, 3D imaging, TEM, scattering, characterization in situ, pulsed gradient and 1D-2D NMR relaxometry, multiscale modelling

Candidate: The candidate must have a very strong background in physics and physical-chemistry. No specific prerequisites for the techniques used in the project are requested but a strong motivation for experimental work with a link to modeling.

Salary: 2135€/month (gross salary), funded by the CNRS for 3 years, starting in October 2019.

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