Contribution ID: **90** Type: **not specified**

Influence of pore size and fluid-wall interactions on the imbibition of a fluid in silica mesoporous materials

Wednesday, 18 April 2012 09:30 (30 minutes)

Imbibition is the phenomenon by which a liquid is able to penetrate and rise-up into a porous media. This process is often found in everyday life (for instance when a cube of sugar is dipped into coffee) and is of great interest to many areas, from biology and industrial applications through to nanofluidics. Imbibition kinetics have been well known on a macroscopic level since the 19th century: the liquid height depends on the square root of time and on pre-factors related to the liquid investigated, such as the surface tension, the contact angle and the viscosity. The first step to understanding the imbibition process on a nanoscopic scale is to determine the role of the pre-factors. Moreover, an understanding of how this is modified by using different liquids and porous media can yield important information about the interaction between the liquid and the pore walls.

We have investigated the imbibition of water into several mesoporous MCM-41 silica matrices, in order to determine the transport coefficients, such as the viscosity, in small pores and to gain an understanding of this process on a nanoscopic scale. These matrices have a well-known structure: a long range ordered framework with uniform mesopores, tunable mean pore diameter and a large surface area (about 1000 m2/g). We synthesized and characterized different mesoporous MCM-41 matrices with mean pore diameters between 2nm and 4nm, about ten times the diameter of the molecules inside the pores. In order to understand a possible contribution of a pre-adsorbed layer, we have also compared the imbibition of dodecane and toluene, which differ in their vapour pressure, with that of water.

Neutron radiography experiments on the ICON instrument, at the Paul Scherrer Institute, allowed us to follow the liquid front rising in the sample. We found that even on a nanoscopic scale the height of the liquid depends on the square root of time, with a strong dependence of the pre-factor on the confinement conditions. For all the liquids this depends on the MCM41 pore size and is larger for smaller pores. As expected, the process also depends on the liquid properties and, for example, is almost twice as fast for water as for dodecane. In addition, marked differences in the imbibition behaviour in hydrophilic and hydrophobic matrices were observed.

Primary authors: Dr PANTALEI, Claudia (Laboratoire Léon Brillouin, CEA Saclay, F-91191 Gif-sur-Yvette, France); Dr AUDONNET, Fabrice (Lab. de Genie Chimique et Biochimique,Université Blaise Pascal Clermont Ferrand 2, France)

Co-authors: Prof. ALBA-SIMIONESCO, Christiane (Laboratoire Léon Brillouin, CEA Saclay, F-91191 Gif--sur-Yvette, France); Dr HERMES, Helen E. (Condensed Matter Physics Laboratory, IPkM, Heinrich-Heine-Universität, D-40225 Düsseldorf, Germany); Dr BRODIE–LINDER, Nancy (Laboratoire de Synthése Organique Sélective et de Chimie Bioorganique, Université de Cergy–Pontoise, 5 mail Gay Lussac, 95031 Cergy–Pontoise Cedex, France.); Prof. EGELHAAF, Stefan U. (Condensed Matter Physics Laboratory, IPkM, Heinrich-Heine-Universität, D-40225 Düsseldorf, Germany)

Presenter: Dr PANTALEI, Claudia (Laboratoire Léon Brillouin, CEA Saclay, F-91191 Gif-sur-Yvette, France)

Session Classification: Water transport I