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Neutron scattering characterization of confined fluids for energy storage and environmental science

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Much to our regret, Yuri Melnichenko passed away on the 18th of March 2016. He submitted this abstract to our conference shortly before his death. We are deeply sorry that he could not join us for the meeting.

Figure 1: Yuri Melnichenko

Fluid-solid interactions in natural and engineered porous solids underlie variety of technological processes, including hydrogen storage, capture and sequestration of anthropogenic greenhouse gases, super capacitors, membrane separation, and catalysis. The size, distribution and interconnectivity of pores, the chemical and physical properties of the solid and fluid phases collectively dictate how fluid molecules migrate into and through the micro- and mesoporous media, adsorb and ultimately react with the solid surfaces. Due to the high penetration power and relatively short wavelength of neutrons, small-angle neutron scattering (SANS) as well as quasi elastic neutron scattering (QENS) techniques are ideally suited for in situ studies of the structure and dynamics of confined fluids under pressure as well as for evaluating structure of pores in engineered and natural porous systems. It has been demonstrated recently that SANS can also be used for determination of the volume of closed pores as a function of pore sizes in the range from micrometer to sub-nanometer pores. In this talk I will overview some recent developments in the SANS and QENS methodology and give several examples of how it can be used for in-situ studies of the abnormal densification of hydrogen in activated carbons at ambient temperatures, adsorption and dynamics of greenhouse gases in natural and engineered porous materials as well as in situ monitoring the ion adsorption in electrodes of batteries and super capacitors [1].

[1] Y. B. Melnichenko, Small-Angle Scattering from Confined and Interfacial Fluids. Applications to Energy Storage and Environmental Science.

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