Experimental report

26/03/2017

Proposal: 9-10-1454 **Council:** 4/2016

Title: Colloidal Dynamics in Mesoporous Confinement

Research area: Soft condensed matter

This proposal is a new proposal

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Samples: SiO2, TDMAO, hexanol, decane, water

Instrument	Requested days	Allocated days	From	To
IN15	4	4	09/09/2016	13/09/2016
D11	1	0		
D33	0	1	21/11/2016	22/11/2016

Abstract:

The mobility of colloids within mesoporous systems is an interesting question both from a fundamental point of view but also of paramount importance to many applied problems (such as tertiary oil recovery or soil decontamination). In order to address this question in a systematic and well-defined way we want to study mesoporous silica (SBA15) which will be filled with an oil-in-water microemulsion that contains droplets that are somewhat smaller than the pore size. By varying the size and the charge of the droplets we will probe how these parameters control the effective interaction with the pore walls and how that affects then in turn the dynamics of the droplets within the mesoporous system. NSE is the perfect technique for this scientific question as it probes the interesting size range of displacement and by contrast matching the silica matrix one is able to focus on the signal of the microemulsion droplets, while basically all other potential methods are faced with the intransparency of the matrix material. From these model experiments we expect to gain fundamentally new insights into the principles that govern colloidal dynamics in mesoporous systems.

Experimental Report for Exp. 9-10-1454: Colloidal Dynamics in Mesoporous Confinement

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We measured the dynamics of different o/w microemulsion (ME) droplets confined in the mesoporous silica material SBA 15 on the neutron spin-echo (NSE) spectrometer IN15 using wavelengths λ between 6 and 14 Å reaching fourier times of up to 600 ns. The charge and size of the ME droplets was varied.

Complementary static measurements on D16 showed that all of the MEs enter the pores of SBA 15. The NSE measurements show, that the droplets are practically immobile on the time and length scale of the measurement. Figure 1 shows the results from fitting an expression of the form

$$S(q,t) = \exp(-D_{eff}q^2t) + bkg \tag{1}$$

to the obtained intermediate scattering functions and it can be seen that the elastic background term accounts for almost all of the signal, even though a large part of the static scattering signal at the relevant q stems from the ME droplets and not the silica. Only at the lowest q a non negligible dynamic contribution can be observed. These results point at the remarkably high efficiency of SBA 15 as immobilisation agent which might have applications in the slow release of hydrophobic compounds.

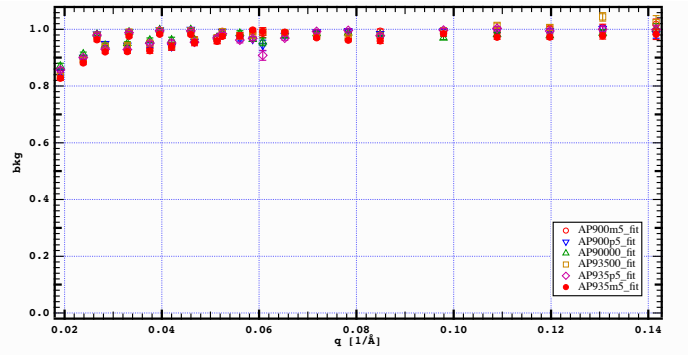

Figure 1: Results obtained for *bkg* from fitting eq. (1) to the obtained data from SBA 15 loaded with different MEs of different charge (positive: AP900p5, AP935p5; negative: AP900m5, AP935m5; neutral: AP90000, AP9350) and size (AP935xx: 3.4 nm, AP900xx: 3.0 nm).