	Experiment title: Inelastic X-ray Scattering of aqueous laponite dispersions	**Experiment number**: HS-2428
Beamline: ID16	**Date of experiment**: From 25/04/2005 to 03/05/2005	**Date of report**: 24 May 2005
Shifts: 18	**Local contact(s)**: F. Albergamo	*Received at ESRF:*

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Report:

The high frequency dynamics of laponite dispersions in ultra pure water (with NaOH to obtain pH=10) have been studied for different concentrations (C) and ionic strengths (I) in their gel state [1]. S(Q) spectra of four different laponite dispersions were recorded in order to identify the most suitable samples (the highest concentration with an acceptable amount of small angle scattering). The results are shown in Fig.1, where we can see that the small angle scattered intensity increases with the laponite concentration, but is almost insensitive to ionic strength. In order to perform the inelastic study (IXS), we have chosen the sample with the higher ionic strength ($5*10^{-3}$ M) and 1 wt % concentration. This sample presents a strong gel structure, but IXS spectra down to 2 nm^{-1} can be safely recorded with sufficient contrast between the elastic line and the inelastic features.

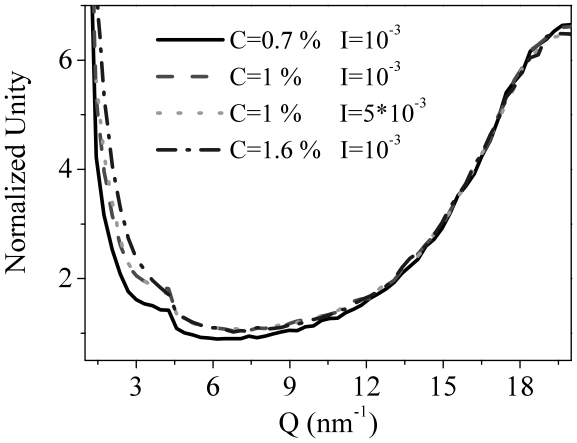

Fig. 1

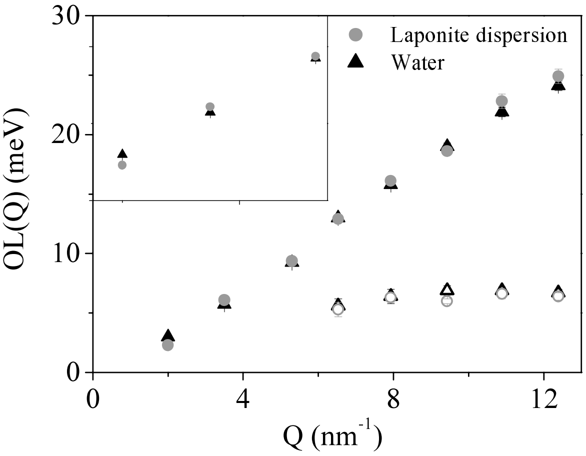

Fig. 2

The IXS spectra were recorded, utilizing the silicon (11 11 11) set-up, yielding at total energy resolution of 1.6 meV (full-width-half-maximum). Laponite and pure water sample samples were measured at 10 different momentum transfers (from 2 to 15.5 nm^{-1}). Up to three spectra of 4h each were accumulated in order to have sufficient statistics. The IXS data were fitted to a model function consisting of a Lorentzian for the central line and a damped-harmonic oscillator (DHO) for the inelastic features. The most relevant parameters thus extracted are the position (OL) and the full-width-half-maximum (GL) of the inelastic peaks, as well as the full-width-half-maximum of the central, quasi-elastic peak (GC).

Figure 2 shows the energy dispersion of the laponite and the pure water samples. They are very similar, both showing a dispersing mode, and a second, non-dispersing branch at about 5 meV. We observe a slight difference in the energy position, OL, for Q=2 nm^{-1} where the value for the laponite suspension is lower than that for pure water. Keeping in mind that previous IXS work on bulk water [2] revealed an "s-shape" trend of OL in the momentum transfer region 2-5 nm^{-1}, which has been associated with a structural relaxation process involving the H-bond network, this result might indicate that the dynamics of such rearrangements is different in laponite suspensions. A possible explanation might be the presence of the laponite fractal network that breaks the “natural” H-bond network of bulk water. To further validate this observation, additional IXS spectra should be recorded with increments of $1nm^{-1}$ in the 2-5 nm^{-1} range.

Figure 3 shows the Q-dependence of the excitations width, and, as in the case of the excitation energies, there are in qualitative agreement. In contrast to this, we observe small, but significant differences in the central line width GC, shown in Figure 4. Qualitatively, the smaller width in the case of the laponites can be explained by the presence of the nanometric platelets which should give a δ-function response at E=0 meV. We therefore simulated the laponite spectra by a weighted sum of the pure water spectrum and a hypothetical sample, consisting only of the nanometric SiO_2 discs, properly taking into account the different scattering strengths and photoelectric absorption. The result of this correction is as well shown in Figure 4.

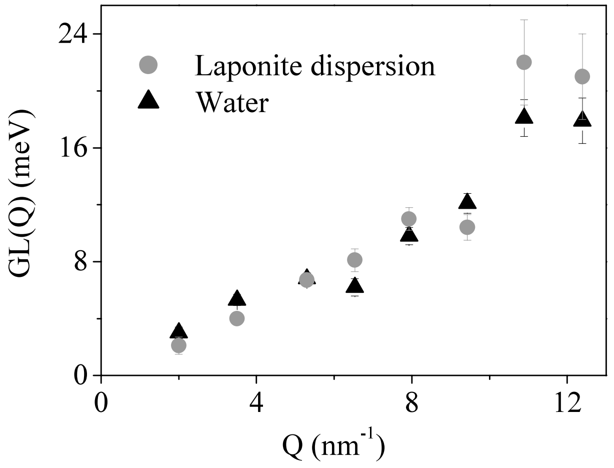

Fig. 3

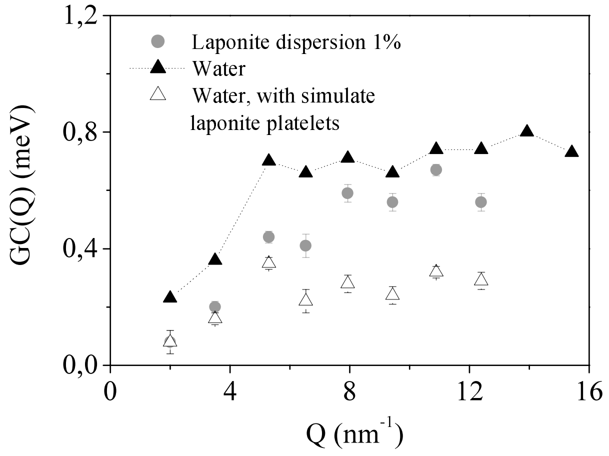

Fig. 4

This correction seems to indicate that the simple presence of laponite platelets, without interaction between laponite and water, is not able to describe the measured spectra of the 1% laponite dispersion, and therefore provides further evidence that the high-frequency dynamics of bulk water are modified in laponite suspensions.

References

[1] A. Mourchid et al.; *Langmuir* **11**, 1942 (1995)

[2] F. Sette et al.; *Phys. Rev. Lett.* **77**, 83 (1996)□□G. Ruocco and F. Sette, *J. Phys. Cond. Matt.* **11**, R259 (1999); G. Monaco et al.; *Phys. Rev. E* **60**, 5505 (1999) and references therein.