Geophysical Research Abstracts,
Vol. 11, EGU2009-13226, 2009
EGU General Assembly 2009

Synchrotron X-ray Scattering from Self-organized Soft Nanostructures in Clays

J.O. Fossum

Norwegian University of Science and Technology (NTNU), Department of Physics, Trondheim, Norway
(jon.fossum@ntnu.no)

In the general context of self-organization of nanoparticles (in our case clay particles), and transitions in such structures, we study interconnected universal complex physical phenomena such as:
(i) spontaneous gravitationally induced phase separation and nematic self-organization in systems of anisotropic clay nanoparticles in aqueous suspension, including studies of isotropic to nematic transitions [1,2]
(ii) transitions from biaxial to uniaxial nematics by application of external magnetic field to self-organized systems of the same anisotropic (diamagnetic) clay nanoparticle systems [3,4]
(iii) guided self-organization into chainlike structures of the same anisotropic clay nanoparticles in oil suspension when subjected to external electrical fields (electrorheological structures of polarized nanoparticles), and the stability of, and transitions of, such structures, when subjected to external mechanical stress [5,6]
The experimental techniques used by us include synchrotron X-ray scattering, neutron scattering, rheometry. microscopy and magnetic resonance. We have demonstrated that clays may be used as good model systems for studies of universal physical phenomena and transitions in self-organized nanostructured soft and complex matter. Self-organization and related transitions in clay systems in particular, may have practical relevance for nano-patterning, properties of nanocomposites, and macroscopically anisotropic gels, among many other applications [7]. The synchrotron experiments have been performed at LNLS-Brazil, PLS- Korea, BNL-USA and ESRF-France.
Acknowledgments: Collaborators, postdocs and students at NTNU-Norway, UiO-Norway, IFE-Norway, BNL-USA, LNLS-Brazil, UFPE-Brazil, UnB-Brazil, Univ. Amsterdam-Netherlands, Univ.Paris 7-France and other places. This research has been supported by the Research Council of Norway (RCN), through the NANOMAT, SUP and FRINAT Programs.

References

1. J.O. Fossum, E. Gudding, D.d.M. Fonseca, Y. Meheust, E. DiMasi, T. Gog, C. Venkataraman, Observations of orientational ordering in aqueous suspensions of a nano-layered silicate, ENERGY The International Journal 30, 873 (2005).
2. D. M. Fonseca, Y. Méheust, J. O. Fossum, K. D. Knudsen, K. J. Måløy and K. P. S. Parmar, Phase behavior of platelet-shaped nanosilicate colloids in saline solutions: A small-angle X-ray scattering study J. Appl. Cryst. 40 292 (2007)
3. E. N. de Azevedo, M. Engelsberg, J. O. Fossum, R. E. de Souza, Anisotropic water diffusion in nematic self-assemblies of clay nano-platelets suspended in water, Langmuir 23, 5100 (2007)
4. Nils Ivar Ringdal, Master thesis, Department of Physics, NTNU (2008)
5. J.O. Fossum, Y. Meheust, K.P.S. Parmar, K.D. Knudsen, K.J. Maloy, D.d.M. Fonseca, Intercalation-enhanced electric polarization and chain formation of nano-layered particles, Europhys. Lett., 74, 438 (2006), and in the Scientific Highlights 2006 of the European Synchrotron Radiation Facility - ESRF (2007)
6. K.P.S. Parmar, Y. Meheust, B. Schelderupsen and J.O. Fossum, Electrorheological suspensions of laponite in oil: rheometry studies, Langmuir 24,1814 (2008)
7. F. Bergaya, B. K. G. Theng, and G. Lagaly, editors. Handbook of Clay Science. Elsevier (2006)