Complex Physical Phenomena in Clays: Structures, flow, and fluid transport

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In our research group, we have for several years studied interconnected physical phenomena in clays, thus using clays as model systems for soft and complex matter. Within this general context, we have experimentally studied phenomena such as:

(i) spontaneous gravitationally induced phase separation and self-organization in systems of anisotropic nanoparticles in suspension, including isotropic to nematic transitions [1,2,3]
(ii) transitions in magnetic field from biaxial to uniaxial nematics of anisotropic (diamagnetic) nanoparticle systems [4,5]
(iii) guided self-organization into dipolar chain-structures of anisotropic nanoparticles in suspension when subjected to external electrical fields [6,7]
(iv) stability of soft self-organized nanoparticle structures subjected to external mechanical stress [8,9]
(v) role of structured water in the context of (i)-(iv) [10,11]
(vi) diffusion and spontaneous imbibiton of fluids in nanoporous materials [12,13]

The experimental techniques used include (synchrotron) X-ray scattering, neutron scattering, rheometry. microscopy and magnetic resonance. Synchrotron experiments have been performed at LNLS-Brazil, PLS- Korea, BNL-USA, Maxlab Sweden and ESRF-France, rheometry studies at NTNU and also at ENS-Paris/University of Amsterdam, and MR studies at UFPE, Recife, Brasil.

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