Dear Soft Matter Colleagues.

Welcome to the September issue of Soft Matter World. This month’s feature article reports on research in clay-based materials from Prof. Jon Otto Fossum’s lab at the Norwegian University of Science and Technology. We also present a simulation of the behavior of responsive micro-swimmers and a study characterizing the structure of ice-cream, an interesting multi-phase system.

Complex Materials Laboratory at Trondheim University

Prof. Jon Otto Fossum’s lab specializes in soft and complex matter with an emphasis on understanding nanolayered silicates, i.e. clays. Clays are an inexpensive, abundant class of materials that demonstrate fascinating complex physical phenomena. The Fossum lab focuses on gaining new understanding of the basic physical properties and processes in soft materials. Their work ranges from self-assembly on the nano-scale, looking at the liquid crystalline properties of clay particles, clay-based nano-capsules for drug delivery, and CO2 capture, and the interaction of clay particles with fluid droplets, to more macroscopic systems including porous media, pattern formation in gels and avalanches in clays.

The lab employs a wide variety of experimental characterization techniques in their experimental work, including thermal gravimetric analysis, differential scanning calorimetry, electrorheology, magnetorheology, in-situ small angle light scattering rheometry, atomic force microscopy, and x-ray scattering.

Recent highlights from the group’s work include new papers on the “Guided self assembly of nanostructured titanium dioxide” in the journal Nanotechnology, a publication in Langmuir on “X-ray studies of Carbon Dioxide Intercalation in a Clay at Near-Ambient Conditions”, and a report on the “Swelling transition of a clay induced by heating” published in Scientific reports.

Prof. Fossum has lectured widely on the physical properties of clays, their structures and flow properties and is the leader of NORDSOFT, a new soft matter research network in Norway and across Scandinavia. The laboratory is also an integrated part of a Coordinated Research Team in Norway (COMPLEX) which involves people and labs located at NTNU as well as at University of Oslo (UiO) and at Institute for Energy Technology (IfE) near Oslo.

The group has an excellent website where you can learn more about this group’s work and the group team members.
Controllable micro-swimmers are devices that can potentially navigate through viscous environments carrying a payload. Although such a device may have the potential to transform lab-on-a-chip devices, drug delivery, and microsurgery their design and development is a challenge. In this paper, researchers from the Georgia Institute of Technology have used a hybrid computational approach to model the swimmer, integrating a lattice Boltzmann model and a lattice spring model to simulate the motion of a micro-swimmer in a low-Reynolds number environment.

The simulated micro-swimmer consists of a gel cube with two rigid propulsive flaps on the opposite faces of the cube and a pliable steering flap attached to the middle of the front face. The gel body and propulsive flaps swell or contract periodically in response to an external stimulus, such as a magnetic field, light source or a change in temperature, and propel the swimmer forward. The steering flap is designed to bend in response to an external stimulus.

Results show the swimmer’s speed and efficiency depends on the propulsive flap aspect ratio and body stiffness. The forward power generated by the swimmer is a function of the deflection angle of the flaps, which depends on the change in size of the swimmer’s body. A design with a short, elastic steering flap generated the fastest swimmer turning due to an optimal combination of sidewise hydrodynamic and asymmetric drag forces.

Read the full paper in Soft Matter.

Food science is a rich area of study for soft matter scientists with many foodstuffs exhibiting complicated phase behavior and microstructure. In the food industry there is great interest in the effects of freezing on food microstructure as this will ultimately affect texture and sensorial perception.

In this paper the authors have used an x-ray tomography technique to probe the microstructure of ice-cream. Ice cream consists of four different phases, unfrozen material, air bubbles, ice crystals and fat particles. The experimenters used iodine as a contrast agent to measure the three dimensional distribution of the air, ice and unfrozen fractions with 6μm resolution.

The material’s structure was characterized as the temperature was cycled between lower and higher temperatures designed to mimic the conditions of freezing and thawing (a heat shock protocol). When the experimenters tracked air bubbles and ice crystals in the material, they observed dramatic coarsening and ice crystal growth to be the dominant mechanisms for structural change.

To read more visit Soft Matter at RSC Publishing.

* Representative 3D tomography images from the paper showing contrast between the different phases.
This is the second call to submit your research images for the 2013 Soft Matter World Calendar Competition. This December, 12 winners will be selected and have their images printed on a custom Soft Matter World Calendar. We will not consider any images without your permission so if you were previously a featured group please submit images and get involved! Imagine your own artistic Soft Matter images in a 2013 calendar.

Please include a short description, date and due authorship for each image. The images should be 300+ pixels/inch and emailed to: gallery@softmatterworld.org

If you are an avid reader of the newsletter, please submit an image and also consider contributing to the soft matter world gallery. Click here to see some of our current images.

Biointerface 2012

The Surfaces in Biomaterials Foundation organizes the BioInterface conference annually. This is the leading applied technical conference focused on innovative biomaterial science and engineering applications. The upcoming BioInterface Workshop and Symposium will be hosted at University College Dublin, in Dublin, Ireland, October 23 - 25, 2012.

Please plan to attend and to contribute to the conference by submitting a poster now, the deadline for students is Friday, September 14, 2012.

Visit the website to read more.