Soft Matter World Newsletter

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Dear Soft Matter Colleagues,

Welcome to our November newsletter. This month we are featuring colloidal research from the soft condensed matter group at the Debye Institute in Utrecht. Our highlighted research papers include a new liquid crystal/colloidal material that exhibits a self-quenched glassy state and a study of how membranes crumple into a ball. Enjoy November and have a pleasant read.

Soft Condensed Matter Research at University of Utrecht

The Debye Institute in Utrecht, a city in the heart of the Netherlands, houses one of the largest soft condensed matter research groups in Europe with five permanent academic staff members, six post doctoral researchers, nineteen current PhD students, a secretary and a technical staff. The group studies colloidal model systems through many types of microscopy, computer simulations, and fluorescent core- silica shell particles. Currently, the group has twelve running projects; notably, studies on condensation of charged spheres and swelling of clay platelets, colloidal rods at interfaces, entropic wetting in colloidal mixtures, colloidal epitaxy, inverse photonic crystals, and electro-rheological fluids. With twenty- two publications in 2011 alone, the group continues to provide prolific, insightful and well documented research.

- Condensation of charged spheres and swelling of clay platelets: Like charged attractions between colloidal suspensions and the sol-gel transition in clay suspensions are investigated through molecular dynamics simulation using a classical Car-Parinello method.
- Colloidal Rods at Interfaces: New Monte- Carlo methods for simulating fluids in contact with a single wall enable a clearer understanding of rodlike particle behavior when the particles are embedded parallel to the wall.
- Entropic Wetting in Colloidal Mixtures: Bulk phase behavior in colloid and ideal polymer mixtures and mixtures of thin and thick rod like particles is studied through theory and simulations.
- Colloidal Epitaxy: Colloidal crystals are grown epitaxally by using a corrugated wall in which the pattern of holes equals a well-chosen crystal plane. Using this method, an almost perfect, face centered cubic crystal of hard sphere-like silica particles can be grown. Currently, the group is growing a hexagonal close packed crystal.
- Photonic crystals can be manufactured through colloidal self assembly from monodisperse colloidal silica spheres or by the application of external fields to a colloid. Understanding the manipulation of colloids has many applications in industry.
- Electro-Rheological Fluids: When a sufficiently large electric field is applied to a dispersion of uncharged colloidal spheres the dielectric constant difference between particles and solvent creates dipolar interactions. Non- equilibrium, string-like structures can form and the dispersion begins to behave like a solid.

The Soft Condensed Matter research group in the Debye Institute at Utrecht continues to advance the field with cutting edge research.

Read more on their website.

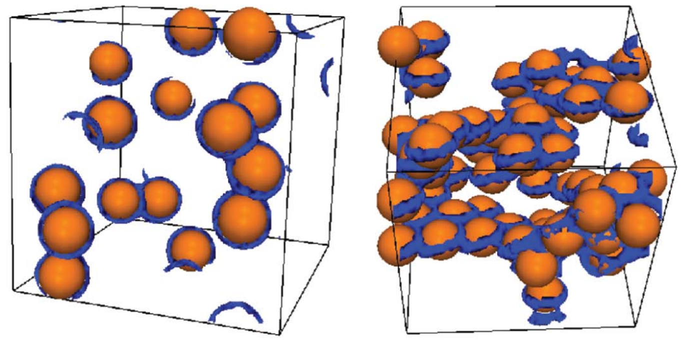
CENTER IMAGE) Dense Regular Packings of Irregular Nonconvex Particles. *DOI: 10.1103/PhysRevLett.107.155501*
A) Synthesis of Monodisperse, Rodlike Silica Colloids with Tunable Aspect Ratio. *DOI: dx.doi.org/10.1021/ja109524h.*
B) Colloidal epitaxy: Playing with the boundary conditions of colloidal crystallization. *DOI: 10.1039/b205203b.*
D) Isotropic-to-nematic nucleation in suspensions of colloidal rods. *DOI: 10.1039/b715764a*

A Self-Quenched Defect Glass in a Colloid-Nematic Liquid Crystal Composite

T. A. Wood, et al. Science 334, 79 (2011). DOI: 10.1126/science.1209997

The Edinburgh research group has discovered a new class of soft solids with shear moduli up to 10^4 Pascals composed of high concentrations of colloidal particles dispersed in a nematic liquid crystal. An analysis of defect lines through confocal microscopy and computer modeling revealed the mechanical strength of the material to lie in the self-organized percolated network of particles. Understanding the behavior of colloids with a high volume fraction may help us to understand glassy arrest and perfect the manipulation of mechanical stability in similar liquid mixtures for applications in biomedical sensors.

Sterically stabilized PMMA particles, up to 2μm in diameter, were directly introduced into the bulk nematic phase of 5CB. The authors report that samples with a PMMA volume fraction between 5 to 50 % were malleable and that the elasticity of the samples rapidly increased at high particle volume fractions. At volume fractions above 15%, colloidal structures were observed to be densely knitted around small nematic domains, exhibiting a novel regime of gel behavior. An elegant simulation helped describe the transition from the single cluster to space filling network regime.



Snapshot of a configuration with a nonpercolated defect line at f=4% (left) and f=16% (right). In the snapshots, blue ribbons are defects, and oranges spheres are particles.

In the steady state configuration of samples with high particle volume fractions, clusters interact and hold each other in place through long range elastic distortions in the liquid crystal. The particles generate and pin the defects in the liquid crystal, spontaneously organizing into a jammed percolating network, a "self-quenched glass".

Read more in Science.

Three-dimensional Structure of a Sheet Crumpled Into a Ball

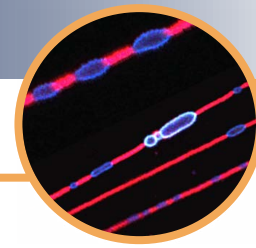
Anne Dominique Cambou and Narayanan Menon. PNAS August 22, 2011. DOI: 10.1073/pnas.1019192108

The department of physics in the University of Massachusetts, Amherst investigates the internal geometry and mechanical properties of a crumpled sheet through x-ray microtomography. Their findings show crumpled ball structures are isotropic and homogenous in many respects. Local nematic ordering of a sheet into stacks occurs from the outer surface inwards and layering increases with volume fraction or degree of compression. Surprisingly, from the vantage point of a location in the interior of the ball, no local measurement of geometry points the way to the exterior of the ball.

Reconstructed slices through an equatorial plane of three crumpled spheres. All reconstructed images are thresholded before analysis.

The crumpled state spontaneously develops structural rigidity at very low volume fractions without externally imposed design. Stacking or layering are two proposed mechanisms behind the rigidity. Stacks may be formed through radial compression, strengthening the structure against forces in any direction. Because most of the features are geometrical and isotropic, they are amenable to statistical treatment. Simultaneous studies of structure and dynamics hope to further explain sheet crumpling.

To read more visit PNAS online.



43rd IFF Spring School & Scattering Methods in Jülich

This year's annual Jülich Spring School is titled, Scattering Methods for Condensed Matter Research: Towards Novel Applications at Future Sources. It is being held 15-16 of March, 2012. IFF Spring School is a series of talks and seminars on applications of synchrotron scattering to soft matter and life sciences systems. Registration is open until December 9, 2011.

The spring school is a two-week Course with about 50 Hours of Lectures for Students and Young Scientists. The topics covered include;

- Neutron and X-ray scattering
- European Spallation Source
- X-ray Free Electron Laser
- Structure of Crystals and Complex Fluids
- Complementary Techniques
- Dynamics of Disordered Systems and Large Molecules
- Applications in Nanostructures, Life Sciences, …

To read more visit the website.

Glasgow Workshop in Soft Tissue Modeling

One of the greatest challenges in mechanical modeling is to extend its success to fields outside traditional engineering, in particular to biology, biomedical sciences, and medicine. This workshop on Soft Tissue Modeling will provide an opportunity for modeling specialists and medical experts to present and exchange opinions on current developments and challenges in the field of soft tissue modeling, with particular applications (though not exclusively) to human biliary and circulation systems.

It is being held March 14th to 16th, 2012 at the University of Glasgow School of Mathematics and Statistics.

Some of the important deadlines are:

- Early registration fee (payment before 15/11/11): £100
- Late registration fee (payment between 16/11/11 - 15/2/12): £125
- Registration will be closed on 16/2/12

Read more on their website.

We hope you enjoy browsing softmatterworld.org and come back soon

Prof. Linda S. Hirst, Adam Ossowski and Dmitri Medvedko

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