Soft Matter World Newsletter

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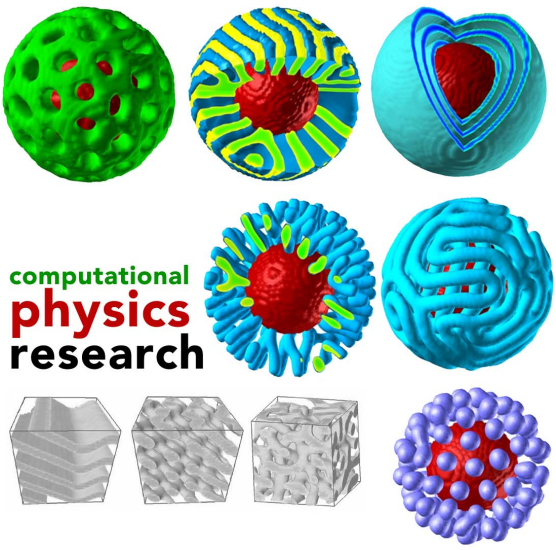
Dear Soft Matter Colleagues,

Welcome to our December newsletter. This month we are featuring the computational physics group at the University of Central Lancashire, a review article in colloid science, a work on fabricating self folding polymers and a study on phase transitions in liquid crystal shells. Have a happy holiday season and a pleasant read.

Computational Soft Matter at UCLAN

The University of Central Lancashire in Preston, UK hosts one of Europe's most exciting computational physics groups. Roberta Dessi, Doctors Manuela Mura, Dung Ly, Marco Pinna and Professor Andrei Zvelindovsky research spontaneously assembled nano and bio materials through computer modeling. Their current five research directions are:



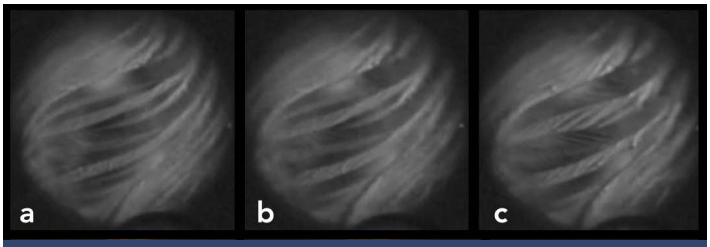
- Block polymers in confinements and under external fields: The formation of nanostructures in block copolymers under electric field, shear flow and in nano-pores and thin films is investigated through computer modelling using Cell Dynamics Simulation and Self Consistent Field Theory simulation. Molecular interactions, thermodynamic conditions and external fields are addressed as parameters for computer assisted soft nanotechnology design.
- Modeling of block copolymer-nano-particle hybrid materials: Combining coarse-grained simulation for polymers with Brownian dynamics of particles is used with the purpose to design functional nanocomposites for non-volatile memory devices.
- Multiscale modeling of biomembranes: Molecular dynamics and coarse-grained modeling is applied to study the interaction of biologically active molecules with biomembranes.
- Structure and phase behaviour of surfactant-water mixtures: Dissipative Particle Dynamics simulation is used to investigate the ability of small oil molecules (e.g. hexane, dodecane and octadecane) to control phase structures in non-ionic surfactant-water systems.
- Collective dynamics in active matter: Models for self-propelled particle motion in active matter, such as schools of fish and flocks of birds, are investigated.

The group attracts top young researchers: Dr Manuela Mura received the Tadion-Rideal Prize for Molecular Science 2010 from King's College London; Dr Marco Pinna got the best Computational Physics PhD thesis in UK, as judged by 2009 annual prize from the UK Institute of Physics Computational Physics Group.

The group's website provides a plethora of easily accessible information including galleries of photos and simulations, group events and a running group blog. A strong online presence and specialized expertise enables numerous collaborative projects throughout Europe and China. Read more on the website.

Nematic-Smectic Transition under Confinement in Liquid Crystalline Colloidal Shells

H.Liang, S.Schymura, P.Rudquist, and J.Lagerwall. Physical Review Letters, 2011, Vol.106, Issue 24, DOI:10.1103/PhysRevLett.106.247801



▲ Microscope images of the shell during the very initial stage of the N-SmA transition (a-c).

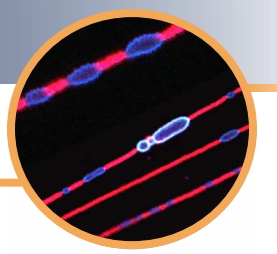
In this paper the authors have investigated the internal structure of smectic liquid crystalline shells using microfluidics and polarizing microscopy. For the first time, development of smectic structure in these shells is observed on cooling from the nematic to the smectic phase and the authors find that the smectic defects generated are dependent on director configuration in the nematic phase. In the experiments, Isotropic 8CB shells are stabilized by a PVA, water/glycerol mixture in a capsule at 60°C then cooling is carried out and images recorded on a polarizing microscope stage. The authors observed that the strong interaction between shell geometry and molecular ordering results in a final shell configuration of two defect pairs. As the liquid crystal cools, the frustration between curvature and non-zero thickness of the shell, a locally non-uniform director field as well as the well-defined smectic layer thickness leads to several instabilities, producing several types of regular texture. Understanding topological defect interactions is important for understanding fundamental soft matter physics and the authors suggest that these results may have further applications in colloidal science and that colloidal control on smaller scales will be possible through deeper understanding of the smectic phase. Read the full paper in Physical Review Letters.

Self-folding of polymer sheets using local light absorption

Ying Liu, Julie K. Boyles, Jan Genzer and Michael D. Dickey. Soft Matter, Advance Article, DOI: 10.1039/c1sm06564e

▲ Photographs of 3D structures created by self-folding of Shrinky-Dinks patterned with a desktop printer.

Converting two dimensional designs into three dimensional structures is possible by exposing a shrinky dink (pre-stressed polysterine sheet) marked with black bands to infrared light. The marked region of the shrinky dink locally heats to about 120°C, past the glass transition of the polymer and relaxes, causing a bend. Simulations and experiments varying band width and exposure time showed local absorption and heating to be responsible for the folding. The width of the band and time before bending were inversely related. Three dimensional objects, like pyramids, cubes and zig-zags were made with bands 2mm across and exposed to light for approximately 15s. The three dimensional structure of the polymer disappears if the entire polymer reaches a temperature above the glass transition state, optimal local absorption and folding can be achieved with a balance of band width and exposure time. Easy manipulation of shape memory polymers can see application sensors, drug delivery systems, solar cells and reconfigurable devices. Printing on a shrinky dink is far easier than preprogramming a shape memory polymer. Read more at RSC Publishing.



From Soft to Hard: Colloidal Monolayers for Nanolithography

Nicolas Vogel, Clemens K. Weiss and Katharina Landfester. Soft Matter, Advance Article, DOI:10.1039/c1sm06650a

Nanolithography is an exciting field that heavily contributes towards sensors and detection techniques. Understanding colloidal monolayers would enable controlled mass production of nanolithographs. The review deals extensively with techniques used for polymeric colloid fabrication, critiquing classic crystallization methods with respect to ease of handling, accessible areas to be covered and the quality of the resulting monolayer. New techniques for non-close-packed and binary monolayer fabrication and the application of colloidal monolayers in lithography are discussed in the last portion of the review. Read the entire review in Soft Matter.

E-MRS SPRING

European Materials Research Society

The European Materials Research Society Spring meeting will be held in Strasbourg, France from May 14th through 18th and will include 25 parallel symposia, one plenary session, an exhibition and much more.

Over 60 international exhibitors will display a full spectrum of equipment, instrumentation, products, software, publications and services. Registration and abstract deadline is January 12.

The scientific program includes:

- Materials for Energy
- Bio/Organic/Polymeric Materials
- Materials for Electronic/Photonic/Plasmonic
- Advanced Materials and Nano Materials
- Methods and Analysis

To read more or register visit the website.

Gordon Research Conference: Colloidal, Macromolecular & Polyelectrolyte Solutions

The Gordon Research Conference on Colloidal, Macromolecular & Polyelectrolyte Solutions presents the frontiers of research about solution properties of charged, macromolecular and colloidal systems and their interfaces. The conference will be held February 5-10, 2012 at the Four Points Sheraton in Ventura, California.

This conference has a strong interdisciplinary tradition bringing together materials scientists, soft-matter and complex fluids physicists, engineers, chemists, biophysicists and biochemists.
The program topics are:

- Polymer Brushes & Lubrication
- Charged Polymers and Ionomers for Energy Applications
- Self-Assembly & Polyelectrolytes in Ionic Liquids
- Polymeric and Biological Networks and Gels
- Polymers & Nanoparticles for Drug Delivery
- Nanoparticles
- Layer-by-Layer Assembly
- Dynamics, Microrheology & Rheology

Applications are due by January 8, 2012. For more information on poster presentation and program information visit the website.

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Linda S. Hirst, Adam Ossowski and Dmitri Medvedko

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