Soft Matter World Newsletter

October | 2011 | Issue 34

Dear Soft Matter Colleagues,
Welcome to our October newsletter. This month we are featuring a discussion on the molecular cause of shear thinning and thickening, a study on liposome vectors, butterfly wing hydrophobicity and a Brazilian Complex Fluids Research Group. Have an exciting read and a stress free October.

Complex Fluids Research Group at University of Rio Grande do Sul

In southern Brazil, in the gorgeous city of Porto Alegre, located on the five river delta known as Guaíba Lake, the research group of professors Jeferson J. Arenzon, Marcia C. B. Barbosa, Heitor Carpes Marques Fernandes, Yan Levin and Daniel Stariolo studies the physics of complex fluids. The group is part of the Instituto de Fisica in the Universidade Federal do Rio Grande do Sul.

This Complex Fluids Research Group has grown significantly over the past fifteen years. In 1996, there were only five members. Now, the group has five professors, a post doctoral scientist, eleven graduate students and six undergraduates.

The Complex Fluidics group also has eleven collaborators in Brazil and seventeen collaborators outside of the country. With over fourteen papers published already this year, the research team actively performs investigations in six different areas:

1. The phase diagram of charged solutions made of electrolytes, charged colloids and polyelectrolytes.
2. Drug delivery mechanisms through polyelectrolyte and amphipathic molecules.
3. Anomalies in the dynamics of supercooled water.
4. Statics and dynamics of complex systems characterized by disorder and/or frustration such as spin glasses, structural glasses, granular media and neural networks.
5. Domain growth in magnetic and fluid systems
6. The spatial version of the Prisoner's Dilemma to understand the emergence of cooperative behavior.

Read more about the Complex Fluids Research Group on their website.

Protonation of Lipids and its Effects on Self-Assembly

M. Breton, J.F. Berret, C.Bourgaux, T.Kral, M.Hof, C.Pichon, M.Bessodes, D.Scherman and N.Mignet. dx.doi.org/10.1021/la202439s

Differences in the chemical structure of a liposome affect it's DNA affinity and therefore the capacity of the liposome to be a vector for gene delivery.

In this paper Breton et al. demonstrate how Improved DNA delivery in a liposome vector is possible by engineering the hydrophilic portion of the lipid to be more polar, increasing its affinity for DNA. Multiple hydrogen bonds and electrostatic forces from the nonpolar fatty acid heads result in tight DNA packing and small size when compared to a liposome with neutral lipids. The engineered lipids are designed with a heads made of thiourea, iminathinol or charged iminothinol. Electron microscopy, light scattering measurements and fluorescence correlation spectroscopy revealed the DNA to adsorb into the liposome and insert itself between the lipid layers. The engineered lipid was able to deliver DNA into the cells more rapidly than a neutral liposome. The authors suggest that mixing affinities for DNA and biological entities might be a new path for future generations of nonviral vectors.

Read more at Langmuir.

Imaging the Microscopic Structure of Shear Thinning and Thickening Colloidal Suspensions

X.Cheng, J.McCoy, J.Israelachvili, I.Cohen. DOI: 10.1126/science.1207032

Shear thinning and thickening are the phenomena behind non-Newtonian fluid behavior. An example of shear thinning is the flow of whipped cream when it is depressurized and shear thickening is responsible for putty shattering when rapidly impacted by a strong force. The interactions between individual particles in a suspension undergoing shear thinning and thickening are described through rapid confocal microscopy and simultaneous force measurements.

In the experiments, silica spheres 960 nanometers in diameter were suspended in a water- glycerin mixture and placed into a shear cell (a small apparatus that induces and detects shearing force) and mounted on a confocal microscope. This setup allowed researchers to visualize shear on a molecular level and hypothesize about the responsible mechanisms.

During shear thinning, stress viscosity decreased more than it increased during shear thickening. This difference lead to an entropic, not particle cluster explanation of shear thinning. Hydrodynamic coupling, not entropic forces, was the main cause of stress during shear thickening; while Brownian motion seemed sufficiently rapid to restore equilibrium during shear thinning. In a review called Through Thick and Thin, Dr. Eric Brown and Prof. Heinrich M. Jaeger take a step back from these results and suggest a more detailed model. Explaining particle interactions in tandem with structural changes is the larger challenge of rheology. Viewing shear regimes in terms of dominating stresses might provide a more complete model by accounting for fluids that exhibit behavior different from the suspension used by Cheng et al. Because changes in viscosity do not necessarily directly correspond to changes in structure, particle interactions have a significant role in shear thickening and thinning.

Measurements coupling imaging and force detection are the future of rheology and may disambiguate the underlying mechanisms for shear thickening and thinning. It is now possible to relate the interactions between particles and their effect on the fluid as a whole. Read the article and the accompanying review in the September edition of Science.

Multi-level structures of butterfly wings adapt to water repellency

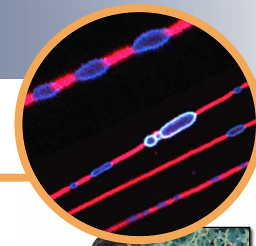
Huan Mei, Ding Luo, Peng Guo, Cheng Song, Chengcheng Liu, Yongmei Zheng and Lei Jiang. DOI: 10.1039/c1sm06347b

▲ Photo of Morpho nestira butterfly wings with light blue color. In the background are ESEM images of the Butterfly wing composed of the overlapping scales including the top scale and ground scale.

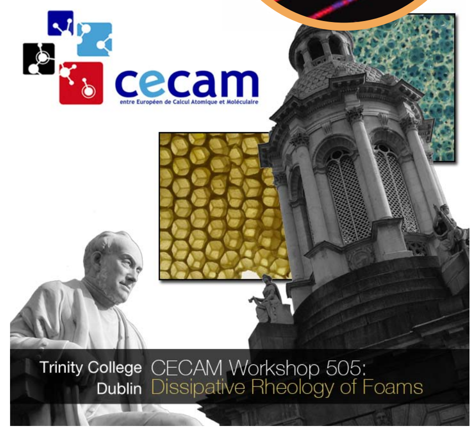
Butterflies have mastered water repellency with the structure of their wings. The micro and nanostructures that lend butterfly wings their water repellent properties were recently investigated under varying temperatures and relative humidities. Morpho nestira butterflies had their wings clipped, treated and regions without veins were cut out. A CCD and a cooling stage were used for the cooling and humidity measurements.

The researchers found that the wing maintains its highly hydrophobic properties at low temperatures. A tiered, microstructured staircase made of scales, ridges, lamella and nanotips with steps about 47μm in width give the wing its properties. The wings are capable of trapping air between the microstructures thereby uplifting the contact angle of water and making the wing hydrophobic. Surfaces with low temperature water repellency can see application in anti-icing, anti- fogging and anti- frosting projects.

Read more at RSC Publishing.



CECAM Dissipative Rheology of Foams



CECAM (Centre Européen de Calcul Atomique et Moléculaire) is a European organization devoted to the promotion of fundamental research on advanced computational methods and to their application to important problems in frontier areas of science and technology. This workshop, Dissipative Rheology of Foams, is being held January 9th - 12th, 2012 at Trinity College, Dublin, Ireland.

A groundswell of opinion in the community of researchers interested in foams and emulsions suggests that while the "quasistatic" flow of these materials is understood in broad terms, and can often be predicted with current numerical methods, the origin of the dissipation observed at finite shear rate is not so clear.

A good deal of current theoretical and experimental activity aims to understand and predict the response of disordered foams and emulsions at finite shear-rate and, in particular, to include dissipative processes due to stretching and generation of new films and bubble rearrangements at a mesoscopic level. The workshop aims to address this coupling between different length-scales (mesoscopic bubble vs film) which is one of the major barriers in progress.

More information on registration and CECAM workshops can be found at the website.

BPS Annual Meeting in San Diego

The Annual Biophysical Society Meeting is being held February 25th-29th, 2012 in San Diego, California. With over 6,000 attendees, the meeting is the largest gathering of biophysicists around the world. More than 3,500 abstracts are submitted each year, which are programmed into poster and platform sessions.

Some of the Soft Matter related symposia include;

- Biological Insights from Systems Approaches to Protein Networks
- Biophysics of Membrane Fusion and Fission
- Temperature Regulation of Channels
- Stretching and Bending Lipid Membranes
- Response of Single Molecules to Force: Bridging Length Scales
- Soft Lithography for Biology
- Large Complexes and Machines - Dissecting Mechanism
- Materials Science Meets Biology
- Dynamics and Localization of RNAs

The abstract submission deadline is October 2nd, 2011 and early registration deadline is January 8th, 2011. To read more visit the website.

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

Linda S. Hirst, Adam Ossowski and Dmitri Medvedko

SoftMatterWorld.org