Welcome to the December edition of SoftMatterWorld. It’s been a very busy year for our team and we enjoyed welcoming writing interns Amanda and Michael into the group. If you are interested to see what we look like, our new writing program was recently featured on the UC Merced website this month.

We have some interesting articles for you this month, looking at the diverse topics of surfactant-enhanced nanoparticle self-assembly and granular flows in a fluid medium. We also feature soft matter related research from the Gardel lab at the University of Chicago in cellular biophysics.

### The Gardel Cellular Biophysics Lab

The University of Chicago hosts Assistant Professor, Margaret Gardel’s cellular biophysics lab in the Gordon Center for Integrative Science. The laboratory studies how mechanical forces are sensed, transmitted and generated by animal cells and to investigate this problem, the cross-disciplinary lab combines a soft condensed matter physics approach with techniques from molecular cell biology.

The goal of the Prof. Gardel’s work is to understand how the physical behaviors of living cells are regulated to guide cell adhesion, shape change and force generation. The mechanical behavior of cells is supported by the protein networks that form the cytoskeleton - A dynamic material able to generate forces and support micron-scale cellular movements.

Much of Prof Gardel’s work centers on F-actin filaments, an example of a semi-flexible biopolymer and an important structural component in the cell cytoskeleton. She has published widely on the physical properties of F-actin networks, including microrheology studies of in-vitro actin networks and force traction microscopy studies on actin networks in live cells.

In some of her more recent work the lab has focused on the contractility of disordered actomyosin arrays and the organization of actomyosin bundles and networks in cells and in vitro.

In two recent papers published in the Biophysical journal, her group published the first work reporting the reconstitution of contractile actomyosin bundles.¹,²

In a new model for contractility in cytoskeletal bundles, developed with collaborator, Aaron Dinner also at the University of Chicago, two new papers explore the role of filament buckling in bundle contraction.³,⁴

Current work in the lab is categorized into four main project areas:
- Force transmission at cellular adhesions
- Cellular Force transmission
- Self assembly and biophysical properties of actin networks and bundles
- Jamming in colloidal suspensions

Prof. Gardel is adapting using her expertise in particle tracking with a project looking at colloidal jamming with the The Nagel group also at Chicago. Using high speed confocal microscopy to image particle trajectories deep into colloidal suspensions, dynamic and static signatures of the jamming transition can be studied.

This growing lab is currently home to six postdoctoral fellows and several graduate students. You can learn more about work in the Gardel lab at their website: including information on different projects, recent publications and how to apply to join the lab.

### references

1. [http://www.cell.com/biophysj/abstract/S0006-3495%2811%2900476-0](http://www.cell.com/biophysj/abstract/S0006-3495%2811%2900476-0)
2. [http://www.cell.com/biophysj/abstract/S0006-3495%2812%2900921-6](http://www.cell.com/biophysj/abstract/S0006-3495%2812%2900921-6)
Collapse Dynamics and Runout of Dense Granular Materials in a Fluid


The flow of submerged granular materials is generally poorly understood. In addition to factors affecting dry material, the study of wet granular flow must also take into account a fluid's inertia, viscosity, and effect on friction. Better understanding the flow of granular materials within a fluid can benefit many fields, including risk assessment in areas prone to natural disasters involving the collapse of dirt or rocks in a wet environment.

A group of French researchers at the University of Montpellier 2 and the Institute for Radiological Protection and Nuclear Safety used computer simulations to analyze the runout distance of the material, in this case small (1mm) grains. They used a novel technique in which a contact dynamics method was coupled with computational fluid dynamics. The research team varied the height-to-width ratio of the column of material from one to ten, as well as the viscosity of the liquid medium. The group simulated the system under three different conditions: in the absence of any liquid, within water, and finally submerged in a fluid with a viscosity 1000 times that of water.

The researchers found that the runout distance was directly related to the kinetic energy of the particles at large aspect ratios. While the viscous medium did allow the grains more time to settle and reduced inter-grain friction as expected, it also reduced the maximum kinetic energy. Although the dry grains had less time to propagate, they spread as much or more than the grains in the viscous domain due to their higher maximum kinetic energies.

This research may help future understanding of the dynamics of granular flow in wet media. Such research can help to predict the flow of underwater avalanches and similar natural disasters more accurately, and can also lead to better use of fluids in the food and pharmaceutical industries, both of which rely on liquids as binding agents and lubricants.

The article can be viewed here, and supplementary videos here.

Michael Lane

Shape-Controlled Synthesis of Colloidal Superparticles from Nanocubes


Colloidal superparticles (SPs) are composed of nanoparticles that can be manipulated for applications such as solar cells, light-emitting diodes, and solid state catalysts. For several years, procedures have been around to create spherical SPs, but until recently less was known about how to control SP shape. Researchers from the University of Florida and Cornell University have now developed a procedure to create cube-shaped SPs.

To create spherical SPs the research team introduced water-soluble nanocube micelles into chloroform, causing the hydrophobic van der Waals interactions between the hydrocarbon chains of oleic acid on iron oxide nanocubes and the hydrocarbon chains of dodecyltrimethylammonium bromide (DTAB) to weaken. The weakening of the van der Waals interactions caused the decomposition of the micelles, leading to the inevitable formation of the spherical SPs. Solvophobic interactions between the nanocube surface and the chloroform molecules form the SPs. Adding small amounts of oleic acid into the SP growth solution modified the shape, creating cube-shaped SPs. Perfect spherical SPs are formed when the nanocubes come together and form kinks and steps (Figure 2a,b) causing a larger surface area than that of cubic SPs (Figure 2c,d). The authors explain that, “cube-shaped SPs should have a lower Gibbs free energy than the spherical SPs, and their formation should be favored thermodynamically.” But, if the particles are too small, the solvent will not effectively wet the kinks and steps of the sphere causing the spherical SP to actually have a smaller surface area than that of the cubic SP. Shape can be controlled when taking both of these concepts into consideration.
... continued from page 2

In the group’s work, iron oxide SPs have demonstrated therapeutic effects in magnetomechanical treatment of LNCaP human prostate cancer cells. Once LNCaP cells took up the spherical and cubic SPs, the culture was pulsed with a 4 Hz magnetic field. This caused a great reduction in the viability of the cancer cells by disturbing the integrity of the cellular membrane and internal organelles. Cube-shaped SPs killed LNCaP cells more efficiently due to their sharp corners and edges piercing the cell membrane. The research group’s results can be applied to expand the synthesis of size- and shape-controlled SPs for use in biomedical applications.

Click here to view the full article.

Amanda Baijnauth

ConferenceListings

dates and deadlines

APS March Meeting
- Early Bird Registration - January 18th
- Late Registration - February 15th

Julich Spring School
- Registration Deadline – December 31st

COMPLOIDS: Physics of Complex Colloids
- Registration Deadline – December 31st

BLCS Winter Workshop
- Last call for registration this week

Advanced Photonic Techniques
- Poster abstract submission – December 3rd

EMRS 2013 Spring Meeting
- Technical: May 27-31
- Exhibit: May 28-30

SMW Gallery Poster Series:

This week marks the final chance to submit your research images to the 2013 Soft Matter World Calendar competition. We want to show some recognition to the registered users who have submitted images to Soft Matter World in the past and a few of which are also submissions for the current competition. We hope that these select few images will inspire submissions: it is very possible that a few of the images below are what will be in the calendar!

Visit the special website we have made for the gallery at www.softmatterworld.org/gallery.

We would like to encourage our users to print out and pass on these flyers to any fellow colleagues and students. Remember, you have nothing to lose as participation and submission is completely free of charge!

Winter 2013 Updates to the Noticeboard and Featured Conferences Section

The time has come to update the featured conferences and Noticeboard sections of the website. Already posted on the Noticeboard are four faculty openings at the University of Colorado Boulder. Please check back within the next week for more information and a Winter Bulletin.

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

Linda S. Hirst and Adam Ossowski

SoftMatterWorld.org