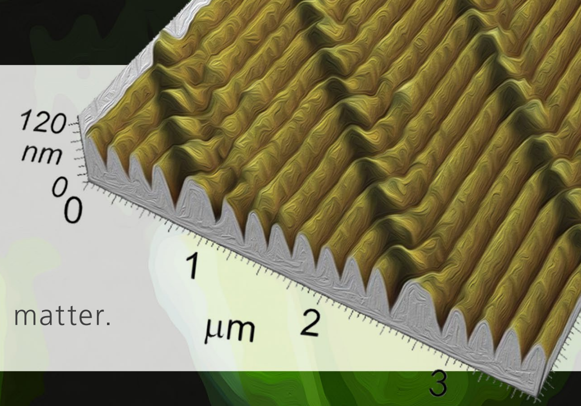
SoftMatterWorld
Newsletter
The web's foremost resource on soft condensed matter.



• *Caption to the image*
• *Charles Rosenblatt, Case Western University*

October | 2012 | #45

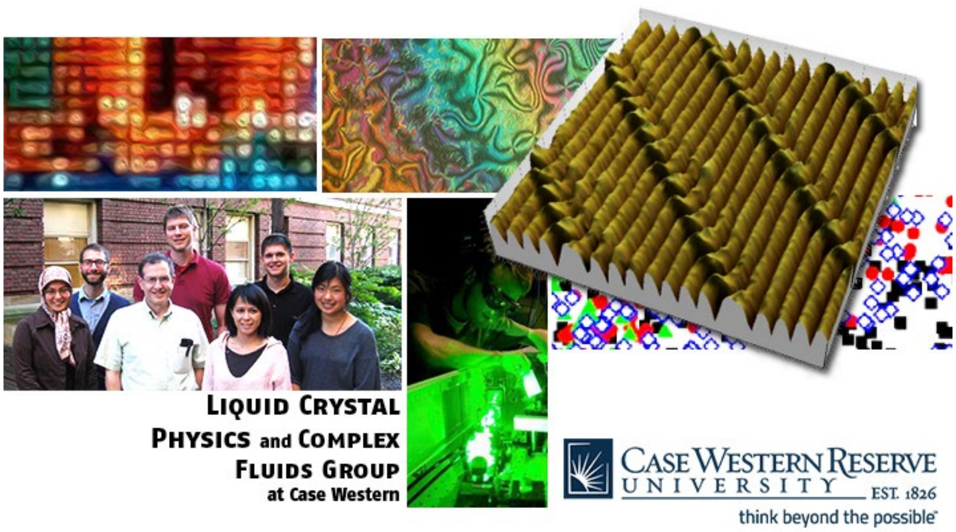
Dear Soft Matter Colleagues,

Welcome to the October edition of the SoftMatterWorld newsletter. This month we are pleased to present the Liquid Crystal Physics and Complex Fluid's Group at Case Western Reserve University. We would also like to welcome two new writers to the SoftMatterWorld team. This year UC Merced students Amanda Baijnauth and Michael Lane will spend a year interning with us. you can read their first articles in this edition.

Liquid Crystal and Complex Fluids Group

Prof. Charles Rosenblatt's group at Case Western Reserve University (CWRU) in Cleveland, USA focuses on two research areas - liquid crystal physics and fluid dynamics. The liquid crystal effort is the larger of the two, and in recent years has centered on interactions at interfaces and issues of reduced symmetry, particularly chiral symmetry in both three and quasi-two dimensions.

Rosenblatt's effort in interfacial interactions has been ongoing for nearly three decades, with work on manipulating and measuring liquid crystal anchoring properties, electrical polarizations at interfaces, and patterning surfaces at the nanoscale. In 2008 his group developed a technique called "Optical Nanotomography", whereby they immerse the fiber of a near-field scanning optical microscope into a thin layer of orientable fluid to produce a 3D image of orientational ordering with volumetric resolution ~ 500x better than confocal microscopy. The group used this technique to measure the spatial profile of the orientational order imposed by a substrate on a liquid crystal in the bulk isotropic phase. [1]



The group has also used atomic force microscopy to create nanoscopic patterns at substrates, which serve as templates for liquid crystal alignment. In one experiment they scribed a pattern that imposed a bend distortion on the liquid crystal director and observed that the smectic phase melts into the nematic because of the smectic's inability to support bend. They demonstrated that this liquid crystal behavior is analogous to the Meissner effect in a type-I superconductor. [2]

Their more recent work has focused on the creation of chiral surfaces at the nanoscale by scribing a variety of patterns, such as a series of steps. By manipulating the ratio of the scribing segments along the x- and y-axes, they are able to control the chiral strength of the surface. Very recently Rosenblatt's group, including Dr. Rajratan Basu (now at U.S. Naval Academy), Prof. Rolfe Petschek (CWRU) and with Prof. Robert Lemieux's group (Queen's University, Canada), demonstrated "Top-Down chiral induction", in which an imposed macroscopic torsional strain induces a conformational deracemization of the constituent liquid crystal molecules. [3][4]

Rosenblatt's group has worked with Prof. Philip Taylor (CWRU) and Prof. Pierre Carlès (Université Pierre et Marie Curie, U. Paris 6) on magnetic levitation of fluids, a technique that Rosenblatt developed in the mid-1980s. Since 2005 Rosenblatt's and Carlès' groups have been using this approach to study the Rayleigh-Taylor fluid interface instability. Here they levitate a highly magnetically-permeable dense liquid above a magnetically-inert less dense liquid and, on turning off the magnetic field, record the behavior of the fluid interface as it transits from the linear to nonlinear to fully turbulent regime. [5]

With his eclectic interests, Rosenblatt has several collaborators around the world, including Prof. Yuri Reznikov (Kiev), Prof. Anatoliy Glushchenko (Colorado), and Prof. Emmanuelle Lacaze (Paris 6). *The group is supported by the National Science Foundation, U.S. Department of Energy, U.S. Department of Education, and the French Foreign Ministry.*

Works Cited

1. "Optical nanotomography of anisotropic fluids" De Luca et al. Nature Phys. 4, 869 (2008)
2. "Bend-Induced Melting of the Smectic-A Phase: Analogy to a Type-I Superconductor" R. Wang, et. al, Phys. Rev. Lett. 97, 167802 (2006)
3. "Spatially controllable surface chirality at the nanoscale" J. Pendery, et al, Eur. Phys. Lett 96, 26001, (2011)
4. "Macroscopic Torsional Strain and Induced Molecular Conformational Deracemization. R. Basu,et al. Phys. Rev. Lett. 107, 237804 (2011)
5. "Deforming static fluid interfaces with magnetic fields: application to the Rayleigh–Taylor instability", M.-C. Renoult, et al, Ex. In Fluids 51, 1073 (2011)

Highly Stretchable and Tough Hydrogels

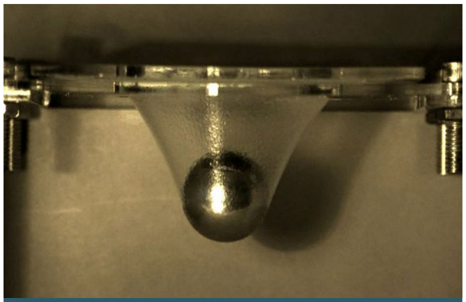
J-Y. Sun, X. Zhao, W. R. K. Illeperuma, O. Chaudhuri, K.H. Oh, D. J. Mooney, J. J. Vlassak & Z. Suo. Nature, 489, 133–136 (2012).

Hydrogels find use in a variety of fields, including tissue engineering, drug delivery systems, and consumer items. Low stretchability and susceptibility to notching have limited their range of application. Using sacrificial short-chain crosslinked networks decreases sensitivity to notching at the loss of re-usability. Conversely, using ionic rather than covalent crosslinks allows the gel to reform after loading and be used again, but decreases stretchability.

A team of researchers at Harvard University has combined two types of crosslinked polymer, alginate and polyacrylamide, leading to a highly stretchable self-healing hydrogel. The alginate is ionically crosslinked, allowing it to unzip when stretched, dissipating energy. The covalently crosslinked polyacrylamide remains connected, maintaining the structure of the gel.

Samples of the gel measuring 75.0 x 5.0 x 3.0 mm^3 were clamped in a tensile machine and stretched to over 20 times their initial length. When cut with a lengthwise notch, the stretch decreased to 17. This is an order of magnitude greater than many previous gels. The gel displayed a fracture energy of 8.7kJ m^{-2}, far higher than the 10-250J m^{-2} the polymers exhibit individually. The gel regained 74% of its initial stretchability when allowed to heal for one day.

The researchers' data suggest that by combining weak and strong crosslinks, the fracture energy of hydrogels can be significantly increased. Many different materials can be used in the creation of such hybrid gels. Further research may result in improvements in current applications, including contact lenses and cell encapsulation, and create new areas of application for hydrogels such as tissue replacement.



A large, recoverable deformation is observed when a metal ball drops on a membrane of the hybrid gel

The full paper can be found at Nature Magazine.

Michael Lane

How the Cucumber Tendril Coils and Overwinds

Sharon J. Gerbode, Joshua R. Puzey, Andrew G. McCormick, and L. Mahadevan. Science 31 August 2012: 337 (6098), 1087-1091. [DOI:10.1126/science.1223304]

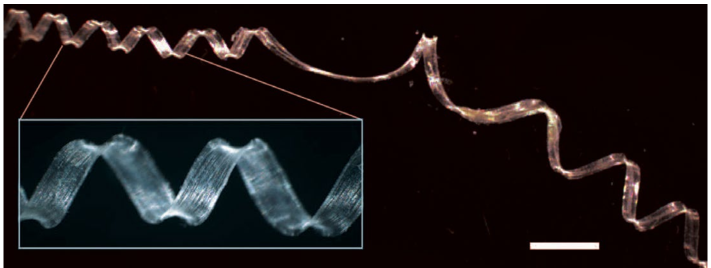
Cucumber tendrils start off as long structures reaching for a hard surface. Once they attach to a suitable surface the tendril will coil. The coiling will begin in one direction, form a kink, and then continue to coil in the opposite direction causing the plant to lift toward the attached surface.

Science Magazine recently published the findings of\ Prof. L. Mahadevan and his research team in which they discuss cucumber tendril coiling. The research focuses on how specialized fibers deemed "fiber ribbons" contribute to tendril coiling and the overall strength of the plant by the manipulation of water in cellulose microfibrils. The discovery of fiber ribbons lead the team to further expand their research on how cucumber tendrils spontaneously stiffen while forming helices.

To investigate the physical mechanisms behind this tendril phenomenon the research group observed the tendrils using microscopy, created physical models using silicon rubber ribbons, and expanded on the implications of their results using mathematical modeling. Of the models, perhaps the most important was the finalized physical model of the tendril that successfully overcoiled when pulled due

How the Cucumber Tendril Coils and Overwinds

continued from page 2 . . .



▲ *Fiber ribbons from a cucumber tendril show helical overwinding.*

to the addition of external copper wiring and inextensible fiber ribbon to a silicon bilayer. Also, after applying extreme strain, both systems would eventually straighten. The silicon model mimicked the original fiber ribbon of the tendrils giving the group insight into how the fiber ribbons were able to mechanically perform as they do.

Mahadevan's research has uncovered a lot of questions about the evolution of this winding mechanism. They revealed that although other species with tendrils work in a similar way to the cucumber tendrils, the differences between species must have evolved independently from each other. This research about the curvature of tendrils can therefore be applied to diverse areas of science from the physics of materials to evolutionary biology.

Visit Science Magazine online to view the full article and a video showing cucumber tendrils in action.

Amanda Baijnauth

ConferenceListings
dates and deadlnes

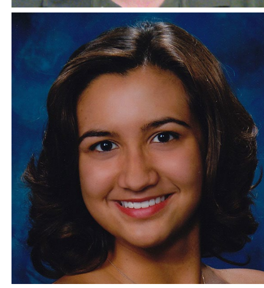
INTERMAG: International Magnetics Conference
- **Abstract Submission - October 1st**

APS 4-Corners Regional Meeting
- **Online Registration - October 15th**

Advanced Energy Conference and Expo 2012
- **Online Registration CLOSE - October 19th**

Soft Matter World welcomes two new writing interns to the team

Michael Lane



Amanda Baijnauth

SoftMatterWorld would like to welcome two new writing interns to the team. Amanda Baijnauth and Michael Lane are both undergraduate students at UC Merced and will be writing for us throughout the year. This new internship program will provide our students with an exciting educational opportunity and our growing newsletter with a dedicated writing team.

All we need now is articles and user submitted content! Remember to always feel free to submit articles, images or conferences to us at editor.softmatterworld.org.

We hope you enjoy browsing softmatterworld.org and come back soon
Linda S. Hirst and Adam Ossowski

SoftMatterWorld.org