SoftMatterWorld Newsletter

The web's foremost resource on soft condensed matter.

June | 2013 | Issue #53

Dear soft matter colleagues,

Long days, short nights and a packed conference schedule are a sign that the Summer season has officially started. This month's marquee image is taken from a recent edition of RSC's Soft Matter journal which you can read more about below. Also inluded is a feature on Colloidal Surfers and Surface Gravity Waves. Dont forget to friend us - see our social icons on the bottom of page 2 and 3!

Mapping the Mechanical Stiffness of Live Cells With The Scanning Ion Conductance Microscope

Rheinlaender, J., & Schaffer, T.E. (2013). Soft Matter, 9, 3230-3236

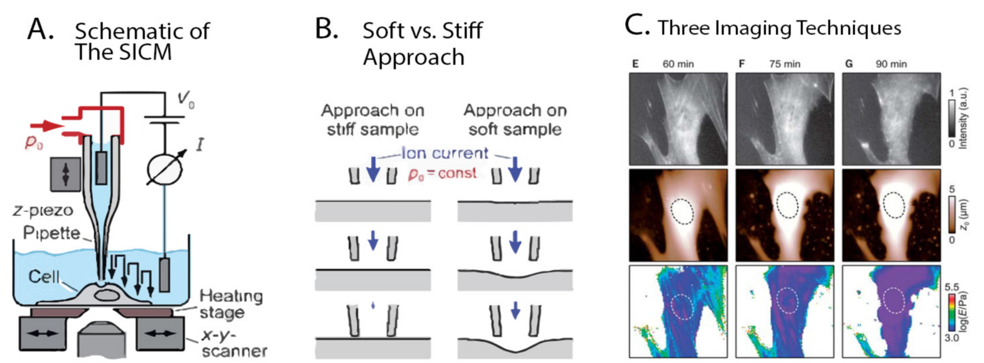

Figure 1: *(A) A schematic of how the SICM is composed, depicting where the specimen would be placed and where the voltage is applied. (B) Portrays both a stiffer cell on the left and a softer cell on the right. The softer cell leaves a larger indentation with a slower decline in ion current than the stiffer cell. (C) uses three different types of microscopes to view a cell after Cytochalasin D has been administered and acts on the cytoskeleton. The top row being fluorescent actin, the middle being SICM height and the bottom row being SICM stiffness.*

Contact between a specimen and the instrument used to observe that specimen has always been a hindrance when attempting to achieve detailed images. A new method to observe the topography of cells that improves upon past procedures has been developed. The Scanning Ion Conductive Microscope (SICM), developed by Johannes Rheinlaender and Tilman E. Schaffer of the University of Tubingen, analyzes stiffness of various points on the cell. This results in a detailed image that can determine the shape of the cell, cytoskeleton fibers and even some organelle identification.

Comprised mostly of commercially-used AFM parts, the SICM is easy to construct (Figure 1A). Where this mostly differs is the pipette at the tip of the microscope head, which emits a pressure of 5-10 kPa. A constant voltage is supplied to two electrodes, creating an ion current through the pipette. As the constant pressure is applied, the pipette is slowly lowered towards the specimen. A softer specimen receives deeper indentation and a larger ion current is observed, while a stiffer specimen does not indent on the pipette's closing position, leaving little room for the ion current to circulate (Figure 1B). Observing the ion current on multiple pressurized locations on the specimen generates data to be analyzed using a ratio of Young's modulus and the applied pressure. This data can then map out the entire image of the specimen in great detail.

As a way to test how accurately the SICM detects the indentation on the cell, cytochalasin D was applied to fibroblast cells. Cytochalasin D breaks down the fibers within the cytoskeleton, resulting in the cell being much softer in the areas affected by the toxin. As expected, the SICM mapped out the path the toxin took, as seen in figure (1C), showing that the microscope can be applied to live cells throughout structural changes.

Read the full article at the **RSC Publishing website** where you can see their image featured on the front cover of Soft Matter (see newsletter masthead).

-Marcus Rice

Observation of Star-Shaped Surface Gravity Waves

Rajchenbach, J., Clamond, D., & Leroux, A. (2013). Physical Review Letters, 110(9), 094502-1 Ð 094502-5.

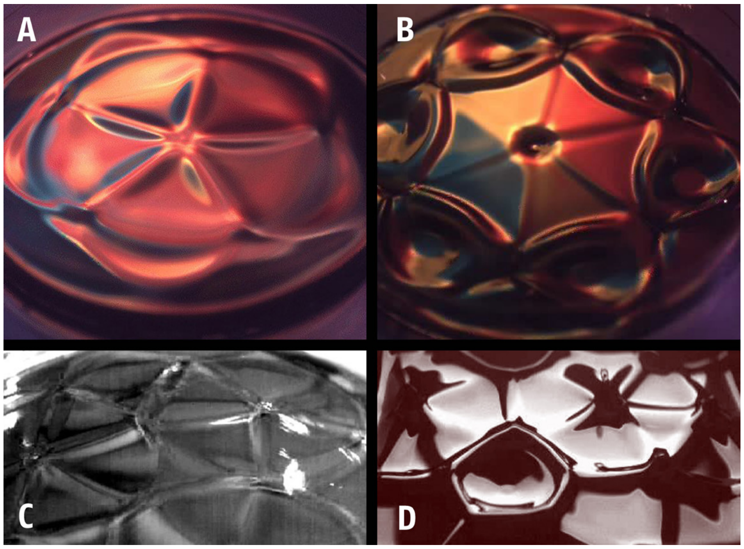

FIGURE 2: *A shows the standing wave for a vibrational amplitude of 1.95 mm alternating between a star (A) and a pentagon (B). Figures 2C and 2D show that the wave pattern is independent of container size and shape*

Many types of waves occur in different physical systems. One particularly interesting example, standing gravity waves, occur due to nonlinearity and dispersive effects in liquids. A collaborative research team from the Universite de Nice has discovered a new type of standing gravity wave formed in silicon oil that transitions between star and polygon shapes.

The experiment involved placing oil filled containers of varying size and shape onto a shaking apparatus. Once mounted, the containers experienced a vertical sinusoidal motion resulting in surface waves that were dependent on frequency and vibrational amplitude. After reaching a specific vibrational amplitude, the oil waves alternated between a star shape and polygon shape.

When a cylindrical container vibrated at a frequency of 8 Hz and vibrational amplitude of 1.55 mm, the oil would create two axisymmetric gravity waves that moved toward the center of the container. Once the wave reached the center, the silicon oil would jet up and fall down back into the container as a droplet. Increasing the vibrational amplitude to 1.85 mm caused the crest line of the waves to form five corners, the tips of the corners representing the break of rotational symmetry. At an amplitude of 1.95 mm the wave geometry alternated between a star shape and polygon shape (Figure 2 A-B). The shape alteration was due to a phase shift between the waves.

The forming gravity waves were independent of container size and shape. Alternating star and polygon shapes were observed when a cylindrical container was used; the square container resulted in similar shapes adjacent to one another (Figure 2 C-D).

The research group attempted to derive a theoretical explanation for the results based on previous theories in quasicrystals and the formation of quasipatterns in capillary waves. The proposed model explained the formation of the gravity waves, but could not predict the final symmetries of the waves as they relate to the forcing parameters of the experiment. Future studies may focus on the design of a theory to explain steep cnoidal standing waves in shallow water.

Visit **PRL to read the full text** and to see some of the supplemental material included with the text.

-Amanda Baijnauth

Living Crystals of Light-Activated Colloidal Surfers

Jeremie Palacci, Stefano Sacanna, Asher Preska Steinberg, David J. Pine, Paul M. Chaikin. 2013. Science 339, 936 DOI: 10.1126/science.1230020

In order to study self-organization of colloids, U.S. researchers have created a planar system of self-propelled particles, the motility of which can be turned on and off with blue light. The colloidal particles consisted of a cubic hematite core mostly enclosed in a polymer sphere, and they can be steered by a magnetic field within the containing basic solution.

When subjected to blue light, the particles moved randomly, colliding and creating dynamic crystalline structures while continuously breaking apart and reforming (Figure 3 A-C). When a magnetic field was applied, the particles aligned with the field and the break up of the crystals was suppressed. In effect, they moved en masse in a single direction. Alternatively, when the magnetic field was applied before the blue light was activated, the particles again aligned. When the blue light was applied, they moved en masse with no collisions, and therefore no crystal formation occurred.

The researchers tested each part of the system individually to better understand the mechanism behind the motility. When subjected to blue light, an uncovered hematite cube catalyzed decomposition of hydrogen peroxide present in the surrounding basic solution, producing thermal and chemical gradients. Through the chemical diffusion gradient, the silica tracers were attracted to the cube via a process called diffusiophoresis. The converse was also true – hematite cubes were attracted to a fixed silica surface.

The effect of surface area fraction ϕ_S was also analyzed. Above 7%, crystallites began forming after 25 seconds of exposure to blue light. Cluster size, averaging 35 particles, was not dependent on ϕ_S when above 10%. Fluctuations in the number of local particles followed a power law $\Delta N \sim N^{\alpha}$.

The researchers suggest this demonstration of self-assembly through non-equilibrium driving forces may be applied to directed self assembly, opening a new area for design and the creation of novel motile structures.

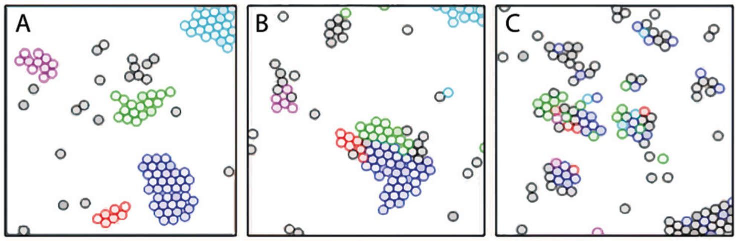

Figure 3: *The false colors show the time evolution of different clusters. The clusters rearrange, exchange particles, merge (A), break apart (B),become unstable and explode (blue cluster, C).*

Visit **ScienceMag to read the full article**.

- Michael Lane

SITE UPDATES

Conferences

- We have released a seperate bulletin pertaining to all the upcoming conference deadlines and features. It is never too late to have your conference, featured ***free of charge.***

  postings@softmatterworld.org

Gallery

- For any of our readers who missed out on a chance to receive a hard copy of the 2013 Soft Matter World Calendar it is now available for download in the Gallery section in high resolution PDF format.

- Feel free to print them out for yourself and remember that the Soft Matter World 2014 Calendar is not far away.

We hope you enjoy browsing and come back soon

Linda S. Hirst & Adam P. Ossowski

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