

# SOFT MATTER WORLD NEWSLETTER

The web's foremost resource on **soft condensed matter**.



APRIL | 2013 | ISSUE #51

Dear Soft Matter Colleagues,

We hope that 2013 been as fruitful as it has for Soft Matter World: the calendar and new website have been a smashing success as our registered users are increasing fast in the past two months. In anticipation for increased submissions for conferences and noticeboard postings we have created two new emails to streamline the process, allowing us to post your submissions in as timely a manner possible. With that we bring you three new research articles as well as special online features if you visit the website.

## Responsive biomimetic networks from polyisocyanopeptide hydrogels

Kouwe, P. H. J., Koepf, M., Le Sage, V. A. A., Jaspers, M., van Buul, A. M., Eksteen-Akeroyd, Z. H., Woltinge, T., Schwartz, E., Kitto, H. J., Hoogenboom, R., Picken, S. J., Nolte, R. J. M., Mendez, E., & Rowan, A. E. (2013). *Nature*, 493, 651-655.

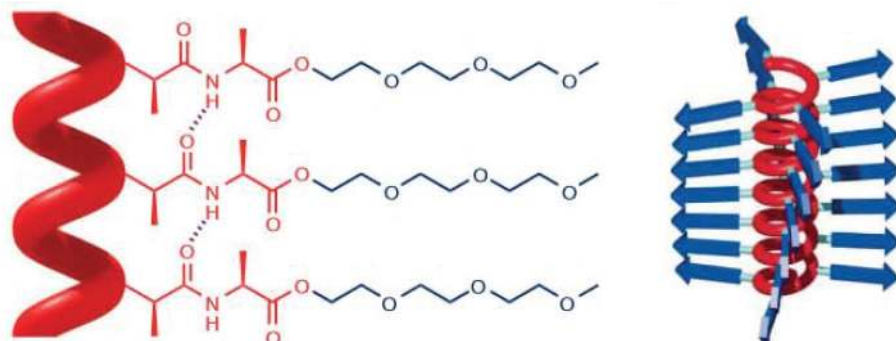


Figure 1: The left image shows how the alpha helix is created through hydrogen bonds between the isocyanide molecules, including the ethylene glycol side chains. The right image shows how the side chains protrude from the alpha helix creating a beta-sheet helix. The red helix represents the polyisocyanide backbone and the blue arrows represent the ethylene glycol side chains.

All biological systems contain proteins that exhibit mechanical responsiveness, a property that can now be completely mimicked by synthetic gels. A collaborative research team from Radboud University, Nijmegen and Delft University of Technology has developed a polyisocyanopeptide hydrogel that mimics biological matrices, including the ability to exhibit stress stiffening. Polyisocyanopeptide polymers within the hydrogel are easily manipulated making them widely applicable to biomedical applications.

This polymer hydrogel takes on a beta-helical structure of polyisocyanopeptides grafted with various lengths of ethylene glycol side chains (Figure

3). Hydrogen bonds stabilize the peptide backbone into a helical shape. This allows the ethylene glycol side chains to freely extend outward creating a secondary beta-helical structure. The length of the ethylene glycol side chains causes the polymers to respond differently to temperature and concentration.

When heated to 18°C and 44°C respectively, longer polymers (P<sub>2</sub>b and P<sub>3</sub>b) formed a transparent hydrogel and shorter polymers (P<sub>2</sub>a and P<sub>3</sub>a) did not demonstrate this behavior in an aqueous solution. Previous studies have shown that ethylene glycol grafted polymers tend to have a sharp order-disorder phase transition at the

lower critical solution temperature (LCST). Therefore, similar chains will form hydrophobic chains upon heating, forcing them to come together in an aqueous solution. In the current study, P<sub>2</sub>a and P<sub>3</sub>a precipitated out in a solution at the LCST due to their low molar mass. P<sub>2</sub>b and P<sub>3</sub>b formed gels because of their longer side chains and larger molar mass.

The synthetic gel and biologically extracted biogels exhibit similar bundling properties. The bundle dimensions of the polymer were constant and independent of concentration. When additional polymer was added to the solution the bundle number increased instead of the size. Therefore, it is clear that the gel pores could be directly manipulated by controlling polymer concentration.

The synthesized polymer exhibits molecular stiffening and bundling in a similar fashion to natural biological matrices. This new biomimetic hydrogel is widely applicable across many biomedical fields because it is readily manipulated to better mimic the internal environment of the cell.

To learn more about polyisocyanopeptide hydrogels visit [Nature.com](http://Nature.com) to read the full article.

-Amanda Bajjnauth



## Effects of Particle Shape on Growth Dynamics at Edges of Evaporating Drops of Colloidal Suspensions

Peter J. Yunker, Matthew A. Lohr, Tim Still, Alexei Borodin, D. J. Durian, and A. G. Yodh *Physical Review Letters* 110,035501 (2013)

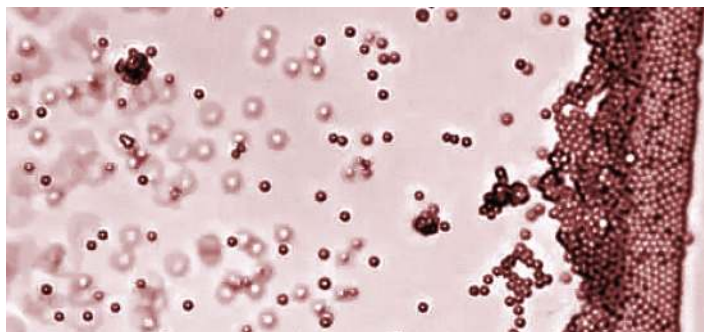


Figure 2: (a) Illustration depicting deposition mechanism. Binarized experimental images of deposits of spheres (aspect ratio 1) (b), slightly stretched particles (1.2) (c), and ellipsoids (2.5) (d)

Researchers from MIT and University of Pennsylvania have experimentally analyzed the growth processes of colloidal particle deposition upon the evaporation of a droplet. Aqueous suspensions of polystyrene spheroids were placed on glass slides and allowed to evaporate under a video microscope. Particles gathered at the edges of the drops and accumulated at the air-water interface. The depositions varied in height and in the shape of the leading edge of the deposit. Both of these characteristics varied with space and time.

It was found that particle shape had a strong effect on

the formation of the deposit. As seen in figure 1, in solutions containing spherical particles the spheres formed a relatively homogenous deposit by settling randomly into the lowest local area they could find. Standard deviation of the height (roughness) was plotted as a function of height, itself a function of time, to quantify the growth process. The height of the deposit matched a Poisson distribution. Slightly anisotropic particles, with an aspect ratio of 1.2, gathered to form a deposit represented by the Kardar-Parisi-Zhang (KPZ) universality class. Ellipsoids, with an aspect ratio of 2.5, also reflected a KPZ process, though one exhibiting quenched disorder.

These differences in deposition were a result of capillary action at the air-water interface, an effect not present in the case of the spherical particles. Once anisotropic and ellipsoidal particles started to clump in particular areas, the capillary attraction increased, causing a positive feedback loop. This led to an uneven deposition, producing areas of many particles and areas nearly void of particles.

This research may allow modeling for future study of theoretical predictions of growth processes. It is also relevant to the food industry, in particular the stability and rigidity of particles in Pickering emulsions. To read the full article visit [Physical Review Letters here](#).

- Michael Lane

## Lyotropic Smectic B Phase Formed in Suspensions of Charged Colloidal Platelets

Dzina Kleshchanok, Peter Holmqvist, Janne-Mieke Meijer and Henk N. W. Lekkerkerker *J. Am. Chem. Soc.* 2012, 134 (13), pp 5985-5990

For the first time, a smectic B (SmB) Phase has been found in a colloidal solution. This rare anisotropic liquid crystal assembly has been formed in a collaboration between Utrecht University of The Netherlands and Institute of Complex Systems. Typically seen in either smectic A or smectic C, a lyotropic smectic B phase has only been seen in computer simulation. When a material is smectic, it means the molecules are arranged in layers. In this case, SmB Phase contains hexagonally ordered particles layered in

a short range crystal-like pattern at equilibrium.

In order to achieve SmB, charged gibbsite was introduced to dimethyl sulfoxide (DMSO), suspending the gibbsite and creating a colloidal mixture. Gibbsite platelets were prepared with a hydrothermal treatment of aluminum alkoxide placed in an acidic environment. To increase the stability,  $Al_{13}$  and  $Al_2(OH)5Cl_2 \times 3H_2O$  were adsorbed to the surface of the gibbsite. The gibbsite was added into the DMSO where it completed its stabili-

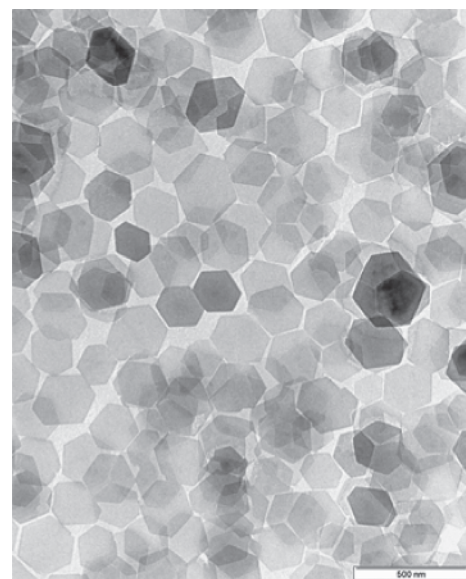


Figure 3: A TEM image of the hexagonal gibbsite platelets in colloidal suspension in DMSO



seen, signifying equilibrium.

To achieve the hexagonally ordered smectic phase, platelets with a high diameter/thickness ratio were used. Long Range repulsive interactions resulted in the platelets fitting in a hexagonal pattern. The distance between each plate edge was 65 nm and the interlayer center to center distance was 284.1 nm.

The SmB formation was verified in multiple ways. One of them using an X-ray scattering experiment. The hexagonal phase produced two sets of Bragg peaks. The first set gave

a ratio of 1:2:3:4, signifying qualities of smectic ordering. The other set gave ratio of  $1:\sqrt{3}:\sqrt{4}:\sqrt{7}$ , demonstrating that each layer had a hexagonal structure. Another verification method was the use of birefringence, in which crossed polarizers were oriented to demonstrate that the structure was a liquid crystal. Perhaps with this new phase, liquid crystal studies will find innovation in future research.

The full article can be found [here](#).

-Marcus Rice

## CONFERENCE LISTINGS

DEADLINES AND SUBMISSIONS FOR THE SUMMER CONFERENCE SEASON ARE APPROACHING RAPIDLY.

### APRIL 5<sup>TH</sup>

- REGISTRATION DEADLINE | Soft Solids and Complex Fluids, UMASS Summer School
- ABSTRACT SUBMISSION DEADLINE | Materials Today Webinar

### APRIL 7<sup>TH</sup>

- APPLICATION DEADLINE | GRC Presents Self Assembly & Supramolecular Chemistry

### APRIL 10<sup>TH</sup>

- PARTICIPATION FELLOWSHIP APPLICATION DEADLINE | ICAMP 2013

### APRIL 15<sup>TH</sup>

- EARLY REGISTRATION DEADLINE | E-MRS Spring Meeting

### APRIL 22<sup>ND</sup>

- HOTEL BOOKING DEADLINE | AMN 2013: ADVANCES IN MICROFLUIDICS & NANOFUIDICS 2013

### APRIL 24<sup>TH</sup>

- POSTER ABSTRACT DEADLINE | 6th International Granulation Workshop

### APRIL 30<sup>TH</sup>

- REGISTRATION CLOSES | International Soft Matter Conference 2013

## SITE UPDATES

NEW EMAIL ACCOUNTS

### POSTINGS@SOFTMATTERWORLD.ORG

- AIMED AT HAVING USERS SEND SUBMISSIONS DIRECTLY TO THE WEBMASTER RATHER THAN REPLYING TO NEWSLETTERS OR SENDING IT TO THE EDITOR OR WEBMASTER ACCOUNTS.

### NEWSLETTER@SOFTMATTERWORLD.ORG

- IF YOU NOTICE ANY DEAD LINKS, PROBLEMS WITH YOUR ARTICLE, OR EVEN JUST A THANK YOU, THIS IS THE BEST EMAIL TO REACH US AT FOR A QUICK PUNCTUAL RESPONSE.

WE HOPE YOU ENJOY BROWSING AND COME BACK SOON

Linda S. Hirst & Adam P. Ossowski

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