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

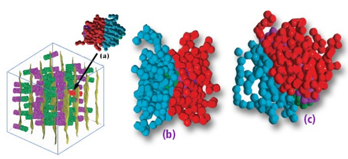
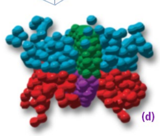
•Image Credits: (left image) Alexander Böker (right image) Parker et al: see featured article on biomimetic propulsion

November | 2012 | #47

Dear Soft Matter Colleagues,

Welcome to the November edition of SoftMatterWorld. This month we are looking at two very different applications in soft matter - printable liquid crystal lasers and a design for an artificial jellyfish. Enjoy reading and have a great month.

Alexander Böker Research Group

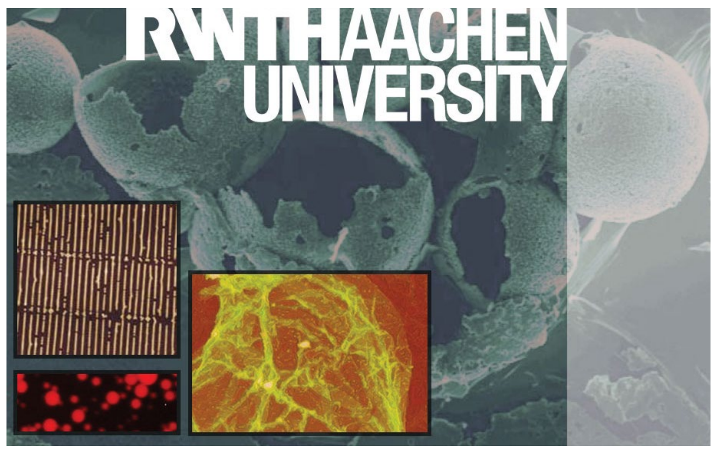



Janus nanoparticle models in diblock copolymers. These models specifically show the conformations of polymer chains. Read the article by visiting the link below [4].

Prof. Dr. Alexander Böker's research is based in the Institut für Physikalische Chemie (Institute of Physical Chemistry) at Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen University) where he heads a large group of researchers looking at self-assembled nanostructures. Dr Böker is a full Professor and the Chair of Macromolecular Materials and Surfaces at the Institute.

Dr Böker's research program focuses on the design of bio-nanoparticle-polymer conjugates and the group has designed a variety of different nanocapsules based on their novel methodologies. Bio-nanoparticles represent a new class of nanomaterials consisting of self-assembled natural protein complexes and protein cage architectures including viruses. These particles can be functionalized and modified to act as building blocks and templates in bionanochemistry and bionanotechnology applications. This subject was recently explored in a review article in the journal Polymer by Dr Böker and Günther Jutz [1]. Dr. Böker holds several of patents in polymer assembly, use and production.

Two of their recent publications involve methods of assembling and stabilizing nanoparticle capsules. These capsules can be stimulated to self-assemble via thermo-responsive polymer conjugates while remaining stable under a variety of external conditions opening horizons for nanoparticles as a medium of controlled and targeted active particle delivery [2,3].



Other areas of interest to the group include

- Guided block copolymer assembly;
- Orientation and phase behavior of block copolymers in electric fields;
- Block copolymer/nanoparticle composites;
- Self-assembly of (bio)nanoparticles at interfaces;
- Pickering-Emulsions;
- Template directed nanoparticle assembly;
- Pattern transfer

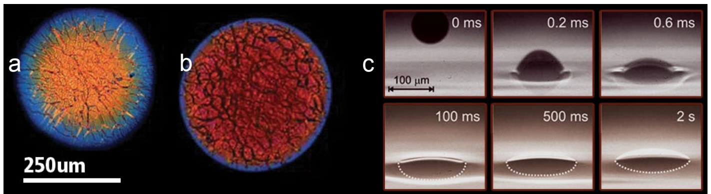
You can learn more about Dr. Böker's research group at the website including a complete publication list and open positions welcoming Bachelors, Masters and Doctoral students interested in Nanoparticle/Block Copolymer composites.

http://www.ipc.rwth-aachen.de/groups/ipc-rwth/ak-boeker/home.html

1. "Bionanoparticles as functional macromolecular building blocks"
2. "Hybrid Capsules via Self-Assembly of Thermoresponsive and Interfacially Active Bionanoparticle–Polymer Conjugates"
3. "Pickering emulsion templated soft capsules by self-assembling cross-linkable ferritin–polymer conjugates"
4. "Self-Assembly of Janus Nanoparticles in Diblock Copolymers"

Printed Photonic Arrays from Self-Organized Chiral Nematic Liquid Crystals

Gardiner, D. J., Hsiao, W., Morris, S. M., Hands, P. J. W., Wilkinson, T. D., Hutchings, I. M., & Coles, H. J. (2012). Soft Matter, 8(39), 9977-9980. doi: 10.1039/c2sm26479j



▲ *Figure 1 - (a) Liquid crystal droplet printed onto clean glass, (b) liquid crystal droplet printed onto wet PVA films and (c) Imaging droplet deposition in the PVA film.*

Chiral nematic liquid crystals (LCs) are photonic materials that can replace solid-state devices, like semiconductor diodes, in modern laser systems. The Cambridge group has developed a new method that precisely controls LC droplet size, allowing for the formation of consistent single-mode laser emissions. They used an inkjet deposition technique to print uniform LC droplets onto different types of glass slides using a single-nozzle MicroFab printing device.

Initially, the LC droplets formed disclination lines and appeared non-uniform in color when they were printed onto clean glass slides. Because of this, the droplets did not form a strong single-mode laser emission when optically excited (Figure 1a). After photo pumping the sample, a broad fluorescence emission curve was observed due to multi-mode lasing.

To improve droplet uniformity, the glass surface was coated with a rubbed polyimide alignment layer. The LC droplets would significantly wet the surface of the glass, making devices impractical.

To combat this problem, a glass slide was covered with a wet film of 10 wt% polyvinyl alcohol (PVA) polymer solution in deionized water. The Cambridge group learned that when droplets are printed onto wet films and allowed to dry, the lasing output was uniform in color and chiral nematic pitch (Figure 1b). These samples had a single-mode behavior with a linewidth of less than 1 nm. The LC and PVA polymer complex improved laser performance because of the interactions and mechanical forces between the two, causing the LC to form a well-defined helical structure.

The Cambridge group's research could be expanded on, by finding alternative polymeric solutions to increase the functionality of the LCs. The inkjet deposition technique can be used in many technological fields. Currently, a use being looked at is fluorescence tag-based bio-assays in which, LC layers are incorporated into sample wells.

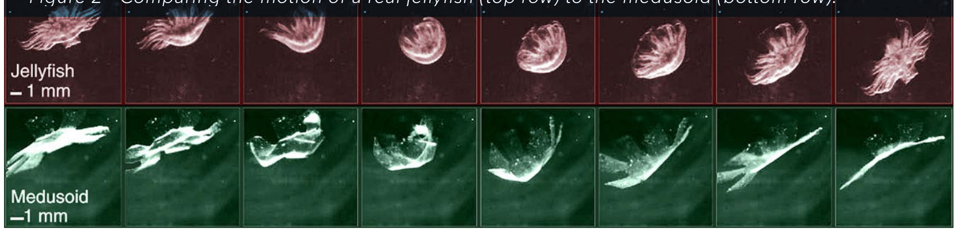
Click **here** to view the full article.

Amanda Baijnauth

A Tissue-engineered Jellyfish with Biomimetic Propulsion

J. C. Nawroth, H. Lee, A. W. Feinberg, C. M. Ripplinger, M. L. McCain, A. Grosberg, J. O. Dabiri & K. K. Parker

Figure 2 - Comparing the motion of a real jellyfish (top row) to the medusoid (bottom row).



Reverse engineering biological forms and functions requires extensive understanding of biosynthetic compound materials, computer-aided design, and soft robotics, as well as the development of necessary methodologies.

Researchers at Caltech and Harvard have developed freely swimming synthetic jellyfish dubbed "medusoids". They combined rat cardiac cells with a polymer backing to replicate the movements jellyfish use for locomotion and feeding.

The muscle structure of the juvenile form of the *Aurelia aurita* jellyfish was used as a template for the design. The jellyfish was also used as a comparison in tests of the artificial medusoid. Researchers used radiating wedge-shaped leaflets inspired by the form of the jellyfish, as seen in Figure 2. The shape was chosen to avoid folding and compression of the polymer and to produce overlap in the viscous boundary layers formed at the edges. This overlap prevents the backflow of water when attempting forward movement.

In the construction of this design, neonatal rat ventricular cardiomyocytes were seeded on a backing of polydimethylsiloxane (PDMS). The polymer backing served to provide the rebound force after the muscle cells had contracted, restoring the medusoid to a flat shape. Electrical stimulation induced contraction of the rat cells via 2.5 V/cm, 10 ms monophasic square pulses at 1 Hz. This served as the signal they would normally receive from neurons.

Digital particle image velocimetry was used to analyze the velocity gradients of both the natural jellyfish and the artificial medusoids. This enabled researchers to observe how much water was pushed into the bell, the mechanism through which jellyfish feed. The efficiency of the feeding mechanism was determined through a frame-by-frame analysis of the recorded data. The constructed medusoids showed a feeding efficiency 75% that of the natural jellyfish and

Tissue-engineered Biomimetic Propulsion
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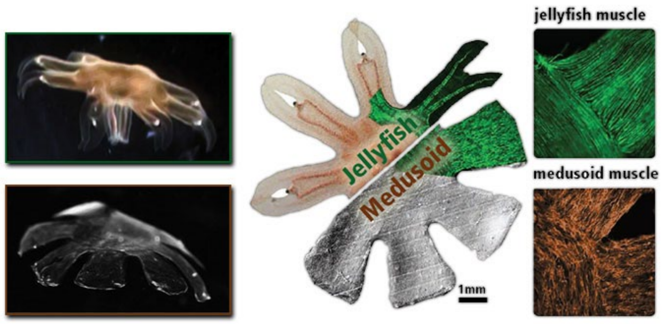


matched them for speed.

This project has provided important data and precedent that will be useful in further developing methods to reverse-engineer biological mechanisms. Future research, particularly involving synthetic muscular organs and simple life forms, will benefit from this demonstration of quantitative performance analysis and related methods.

The paper can be found on Nature **here**.

Michael Lane

Final Call for Images: 2013 Soft Matter World Calendar Competition

This is the final call for image submissions for the Soft Matter World Calendar Competition. On December 8th we will be closing all submissions to begin the difficult process of judging which fantastic images will be featured in the first Soft Matter World Calendar.

All submissions are free of charge. Please email your images to gallery@softmatterworld.org. If you have submitted an image but have not received an acknowledgement of submission within a week please contact the editor at editor@softmatterworld.org as this could be due to email issues.

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

ConferenceListings
dates and deadlines

DYNAMICS DAYS 2013
- Early Registration - Dec 12th, 2012

BIOPHYSICAL SOCIETY 57TH ANNUAL MEETING
- Housing – Dec 1st 2012
- Early Registration – December 21st 2012
- Late Abstracts – January 3rd 2012

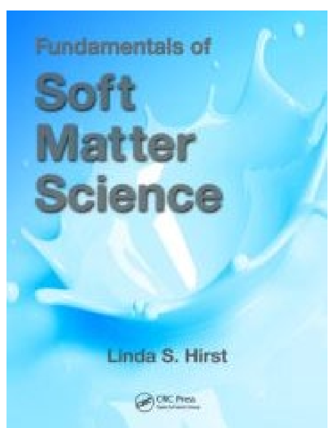
44TH IFF SPRING SCHOOL
- Application Deadline – December 31st 2012

PHYSICS OF COMPLEX COLLOIDS: COMPLOIDS
- Submission of Abstracts – December 17th 2012

NoticeboardOpenings
jobs and internships

POSTDOC FELLOW IN SOFT MATTER PHYSICS
- North Dakota State University

Special Offer for SoftMatterWorld Subscribers



Use the discount code KZL27 to obtain a special 25% off the list price of "*Fundamentals of Soft matter Science*" by Linda Hirst.

http://www.crcpress.com/productisbn/9781439827758

This offer will be good for any orders placed before Nov. 30th.