Dear Soft Matter Colleagues,

Welcome to the June 2014 edition of SoftMatterWorld. One of the most exciting things to happen this month is the founding of a new APS soft matter topical group - read more on page 3. It's also an exciting time for our student writers, Michael and Marcus, graduating from UC Merced this month - it's been great fun working with them over the past two years. Enjoy this month's articles and the June weather!

**Hydrogel Walkers**


Micro-gel robots can be propelled by hydro-gel “tails” that are controlled via an applied electric field but controlling the specific direction of their movement has been a challenge. To address this, researchers at North Carolina State University have constructed an entire two-legged robot body of polyelectrolyte hydrogels. This allows for them to be controlled by small and easily managed electric fields and confining their movement in a single direction, opening up possibilities for their use as millimeter-scale transportation robots within aqueous solutions.

These unidirectional gel walkers were made by attaching two appendages, one in front of the other with respect to the direction of travel, rather than to either side (figure 1). One was made of an acrylamide/sodium acrylate copolymer, and the other of an acrylamide/quaternized dimethylaminoethyl methacrylate copolymer. The two halves were bonded together via covalent amide bonding between the carboxylic groups present in the former and the amine groups in the latter. This bond lets the structure survive submersion.

The walker’s two legs possess different charges, one being anionic and the other cationic. When subject to an electric field, they bend in opposite directions. The legs expand and contract in turn, with the leading leg pulling on and the trailing leg pushing off of the flat polydimethylsiloxane (PDMS) substrate, propelling the walker forward.

Osmotic pressure results in the force behind the bending, a phenomenon analogous to processes like muscle contraction. The researchers examined how differences in the salt concentration of the surrounding aqueous solution affected how long the legs took to expand and contract. They also looked at how the amount of fixed charge in the legs affected the bending. They found that higher external salt concentrations produced less bending, and increased fixed charge in the legs lead to increased bending, to a point - should the fixed charge of the legs be too high, the mobile ions condense on the polymer backbone, reducing bending.

This research demonstrates a method of transport that is easy to construct and control while completely...
submerged in an aqueous solution. This project demonstrates a simple method for the construction of submersible soft actuators. Soft bio-mimetic devices constructed from these components could be applied to exciting new transport or sensing applications.

The full paper can be found here in Soft Matter along with supplementary videos of the walkers in action.

-Michael Lane

Stratum Corneum Molecular Mobility in the Presence of Natural Moisturizers


Dry skin is something every person has encountered at some point in their life. It is an uncomfortable and unsightly annoyance that stems from the outermost layer of skin, the stratum corneum (SC), enclosed under the cornified cell envelope. The cornified cell envelope is comprised of a covalently bounded lipid layer facing the extracellular matrix. Both the lipids in the SC and the extracellular envelope act as a barrier for molecular diffusion which, in the case of dry skin, is a prerequisite for water homeostasis. Osmolytes, known as natural moisturizing factors (NMF), are present in the SC. These NMF maintain hydration in the skin by responding to osmotic stress from dry conditions. Unfortunately some people experience decreased NMF levels in the SC, which result in the lipid membrane becoming rigid and limiting the mobility of proteins within the intracellular space. To combat this, lotions and bottled moisturizers have various compounds in which companies claim to reinvigorate the skin by replacing lost hydration.

Putting these claims made by beauty and skin care companies to the test, Emma Sparr and her team from Lund University observed how natural moisturizers protect SC against osmotic stress. In their study, intact SC lipids as well as isolated corneocytes were both observed in the presence of either glycerol, urea, pyrrolidone carboxylic acid (PCA) or urocanic acid (UCA). Natural abundance 13C solid-state NMR methods were used to reach molecular resolution for the rigidity of the SC lipid and protein components in the presence of the various compounds and water. These molecular segments in the SC were then measured by polarization transfer solid-state NMR to investigate the effect of each hydrating compound on the SC lipids. The larger effect the compound had on the SC lipids, the more molecular mobility was present resulting in a rise of the NMF effectiveness.

The skin has an initial NMF due to both glycerol and urea naturally being found in the SC, but the additional amount aided the process of keeping lipid acyl-chains fluid. This effectiveness was due to both compounds being polar with low vapor pressure and remaining in the SC membrane despite a dry climate. In the external environment the glycerol and urea thus act as a substitution for water when low amounts of it are present. UCA, on the other hand, is a less polar compound compared to glycerol and urea and thus did not increase mobility in the hydrocarbon chains as well as these two. Lastly, PCA did not act as a reliable water replacement at all as the SC was largely unaffected by its presence due to the PCA not dissolving into the water around it.

The qualities found in glycerol, urea and, to some extent, UCA lead to increased fluidity in the SC producing a more flexible membrane and softer skin in general. This study could lead to the discovery of new compounds with similar properties, which skin care companies can find a way to bottle up and sell back to you.

Read the full paper here

Congratulations to our graduating student writers

I’d like to take a minute to thank our fantastic student writers Michael lane and Marcus Rice, who are both graduating this semester from the University of California, Merced. Michael joined SoftMatterWorld in 2012 and will be graduating with a BA in anthropology. Marcus joined the team in Spring 2013 and will graduate with a BS in biological sciences. Congratulations to both of them and best of luck for the future!
GSOFT: NEW SOFT MATTER GROUP AT THE AMERICAN PHYSICAL SOCIETY

Soft Matter World is excited to report that the APS Topical Group on Soft Matter has been established! Chaired by the University of Pennsylvania’s Randy Kamien, the new group is known as GSOFT, and brings together researchers working in a broad range of disciplines - all with common interests in soft matter.

The APS council voted this month to create the group after more than 1,300 signatures were collected and the new group is currently recruiting members from the society’s full membership.

This is exciting news for soft matter scientists - once the group attracts 200 members, it can organize sessions and events at the APS March Meeting - a much needed resource for our soft matter community.

The American Physical Society membership renewals are coming up soon so make sure to sign up for GSOFT. The founders hope that you might even consider a life membership to help the new group get on its feet (just a $120 one time fee versus $8/year) and build up the treasury.

You can join the new group easily at the APS web site.
http://www.aps.org/membership/units/join-unit.cfm

The group’s new webpage is at http://www.aps.org/units/gsoft/index.cfm where you can find the executive committee list and learn more about the new group.

THANKS FOR READING

LINDA HIRST, ADAM OSSOWSKI AND THE SOFTMATTERWORLD TEAM