Empa
Materials Science and Technology

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Seminar

Shaping a Soft Future

Speaker	Prof. Michael Dickey, North Carolina State University, Raleigh NC
Moderator	Dr. Artur Braun, Empa Dübendorf, Laboratory for High Performance Ceramics
Audience	open to everybody
Date	Tuesday, July 18, 2023, 16:00 – 17:00
Venue	Empa, Dübendorf, Theodor-Erismann-Auditorium, VE102

Abstract Existing devices—such as cell phones, computers, and robots – are made from rigid materials, which is in direct contrast to the soft materials that compose the human body. In this talk, I will discuss several topics related to studying and harnessing soft materials within the context of creating devices with tissue like properties.

- **Liquid metal**: Gallium-based liquid metals are often overlooked despite their remarkable properties: melting points below room temperature, water-like viscosity, low-toxicity, and effectively zero vapor pressure (they do not evaporate). They also have, by far, the largest interfacial tension of any liquid at room temperature. Normally small volumes of liquids with large tension form spherical or hemi-spherical structures to minimize surface energy. Yet, these liquid metals can be patterned into non-spherical shapes (cones, wires, antennas) due to a thin, oxide skin that forms rapidly on its surface.
- **Shape reconfiguration**: Perhaps the most fascinating aspect of liquid metals it the ability to use interfacial electrochemistry chemistry to remove / deposit the oxide to manipulate the surface tension of the metal over unprecedented ranges (from the largest tension of any known liquid to near zero!). This allows manipulating the shape and position of the metal for shape reconfigurable devices.
- **Ionogels:** Soft materials that are tough (that is, they do not readily tear or fail mechanically) are important for a number of applications, including encapsulation of devices. Recently, we discovered a simple way to create ulta-tough ionogels, which are polymer networks swollen with ionic liquids. These materials are tougher than cartilage and compatible with 3D printing.

This work has implications for soft and stretchable electronics; that is, devices with desirable mechanical properties for human-machine interfacing, soft robotics, and wearable electronics.

Bio

Michael Dickey received a BS in Chemical Engineering from Georgia Institute of Technology (1999) and a PhD from the University of Texas (2006) under the guidance of Professor Grant Willson. From 2006-2008 he was a post-doctoral fellow in the lab of Professor George Whitesides at Harvard University. He is currently the Camille and Henry Dreyfus Professor in the Department of Chemical & Biomolecular Engineering at NC State University. He completed a sabbatical at Microsoft in 2016. Michael's research interests include soft matter (liquid metals, gels, polymers) for soft and stretchable devices (electronics, energy harvesters, textiles, and soft robotics).

Focus Areas – Soft Materials, Interfaces, Microfabrication, Liquid Metals, Polymers / Gels, Stretchable & Wearable Electronics, Energy Harvesting, Soft Robots.