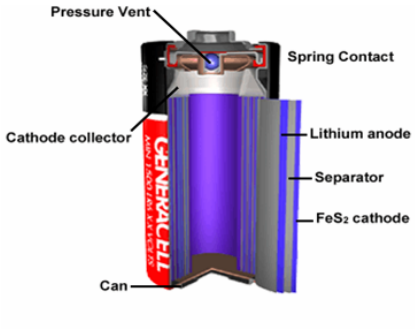
Senior Projects 2015-2016

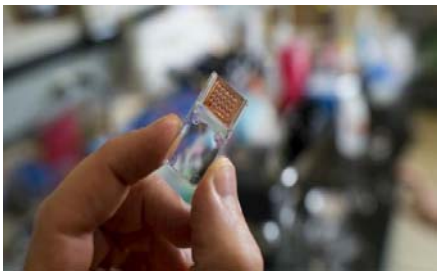
Dr. Lloyd Lee

1… Batteries for energy storage

2… Colloids and their microstructures (functionalized novel materials)

3…Nanofluidics for slip flows (reduced friction in submarines and swimsuits)





Notes: My work is mostly on computational science and engineering. If you like computers, it will be great! Also you need to have a background in thermodynamics.

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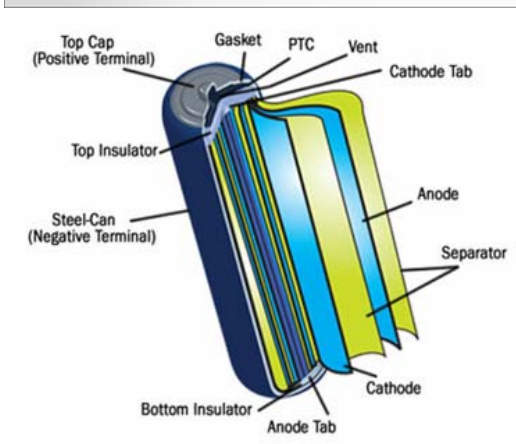
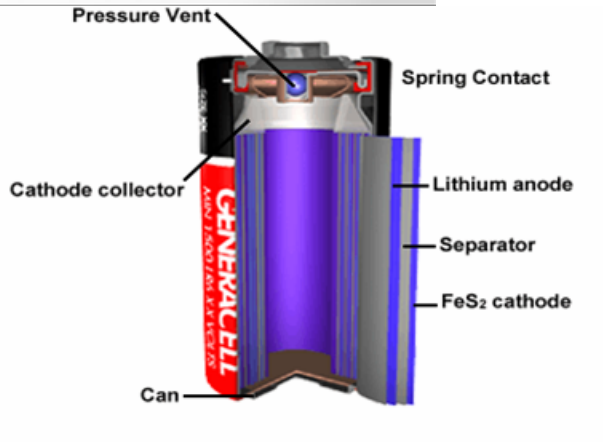
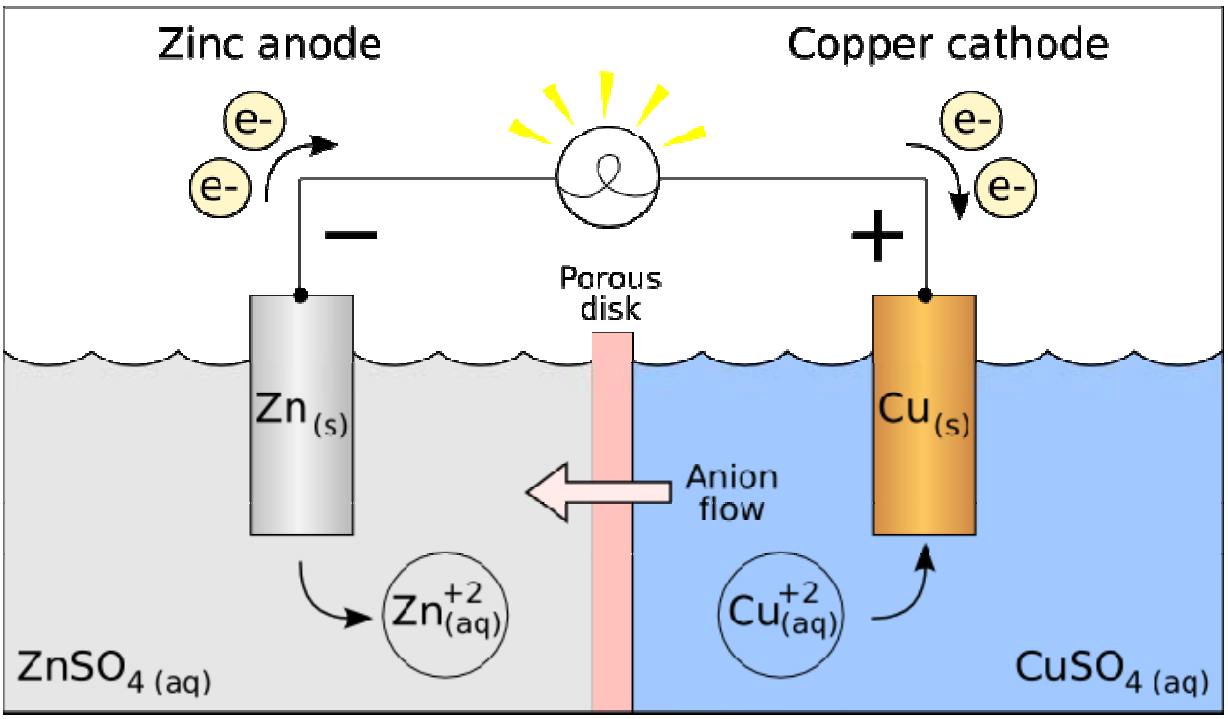
(1)….**Batteries:**

We talk about the energy future all the time. There are two important sectors in energy: energy production and energy storage. Batteries are important in energy storage (in any consumer electronics, electric cars, and large energy equipment). We are interested in increasing the low-temperature efficiency of Lithium batteries.

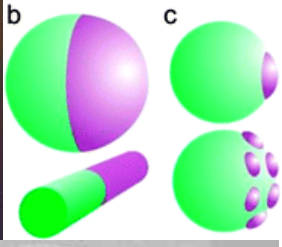


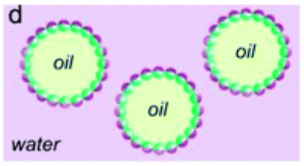


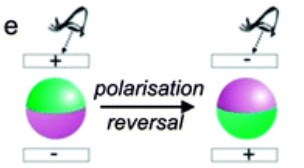

Zinc anode
Copper cathode
e-
e-
e-
e-
−
+
Porous disk
Zn (s)
Cu (s)
Anion flow
Zn+2 (aq)
Cu+2 (aq)
ZnSO4 (aq)
CuSO4 (aq)

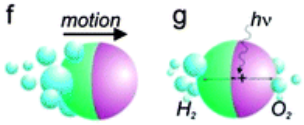
(2)….Colloids (soft-matter structures and organizations):

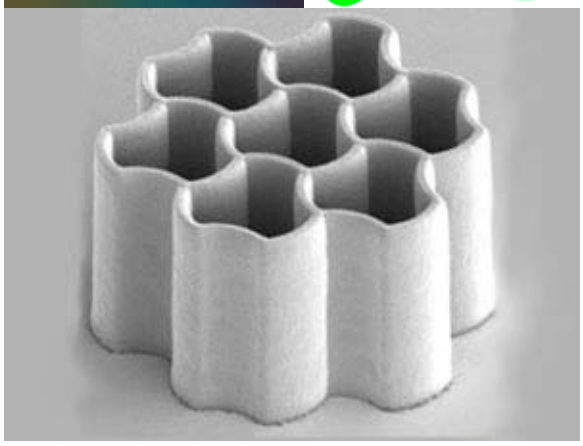
We examine the aggregation and phase transition of colloidal particles. They are important in biological processes (blood and albumins), foods and beverages, pharmaceutics and cosmetics, among many other fields. Now the technology has advanced to make microstructures out of colloid coagulation.

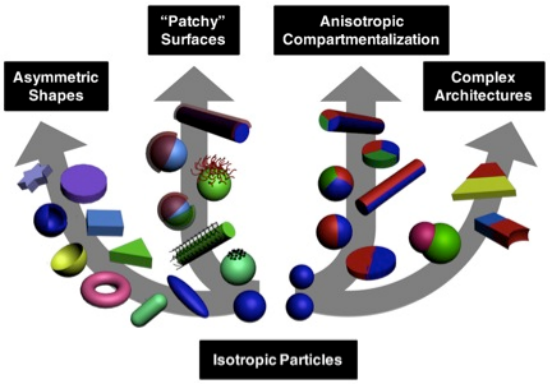












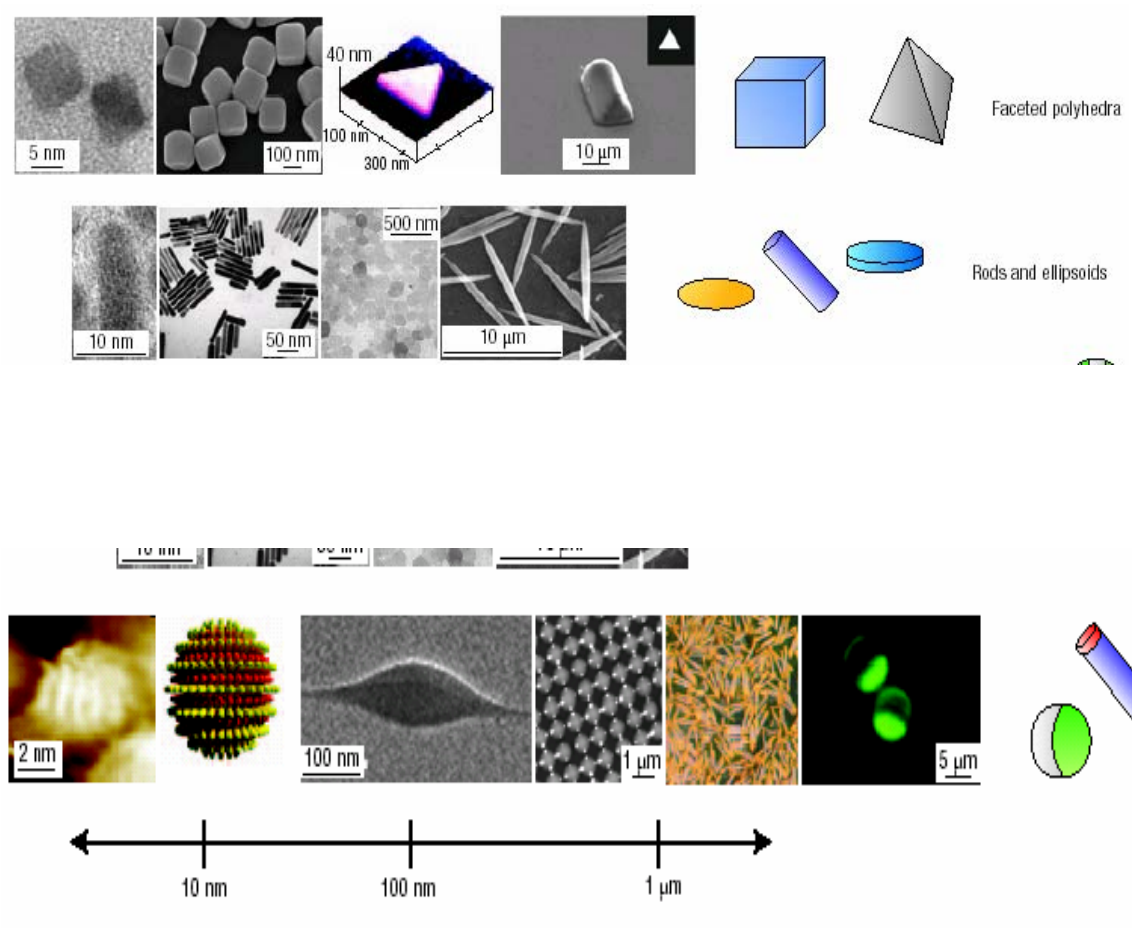


Figure 1: **Colloids with surface patches can form various structures.**
(Sharon GLOTZER 2007 Nature Materials)

(3)….Nanofluidics:

Nanotechnology is developing by leaps and bounds. One aspect of its applications is medical diagnostics. Currently, medical samples (blood, urine, and other fluids) are collected at one place and send to another place (Labs) for analysis. It takes days to get back the results. Nanofluidic chips promise to analyze in situ (or in vivo) and yields results in minutes.

We are interested in the slip flow of liquid samples in channels of micrometer or nanometer-size. It will accelerate the flow and reduce the time of residence. This has applications in drug delivery, pathogen (gas) detection, as well as smooth swimming suits (shark skin) and speeding submarines.