MIT CEHS

MIT BE
BIOLOGICAL ENGINEERING

Massachusetts Institute of Technology
Center for Environmental Health Sciences
Sponsored by NIH-NIEHS Core Center P30-ES002109 and the Department of Biological Engineering

2017 Center for Environmental Health Sciences Poster Session

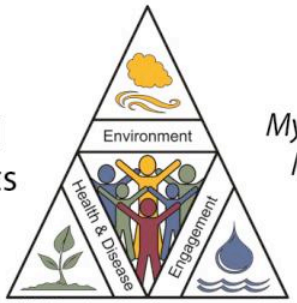
Wednesday, Jan. 18, 2017
2:30pm – 5:00pm
Lobby of Building 13

Abstract Submission Deadline: December 2, 2016

The Abstract Form can be found via the CEHS https://cehs.mit.edu/events/poster-session-2017

Prizes will be given for the Best Posters
in Engineering and Life Sciences.

1st Place: $1,000
2nd Place: $500
3rd Place: $200 and
CEHS gifts



MIT Center for Environmental Health Sciences

Supported by the Myriam Marcelle Znaty Memorial Research

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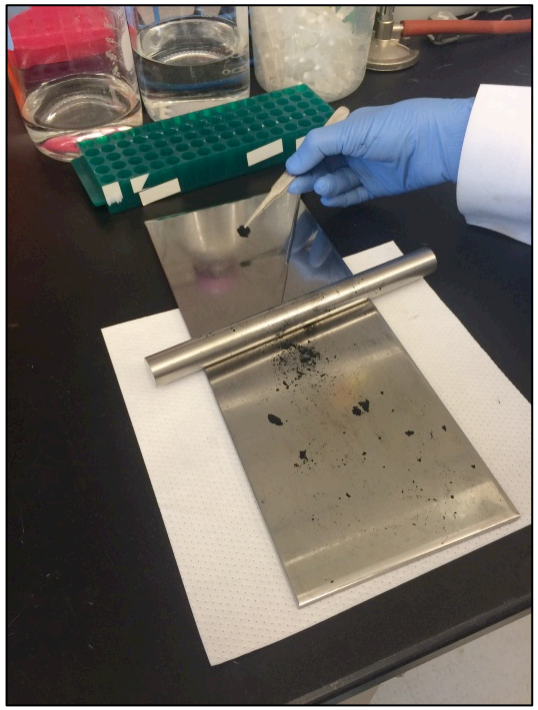
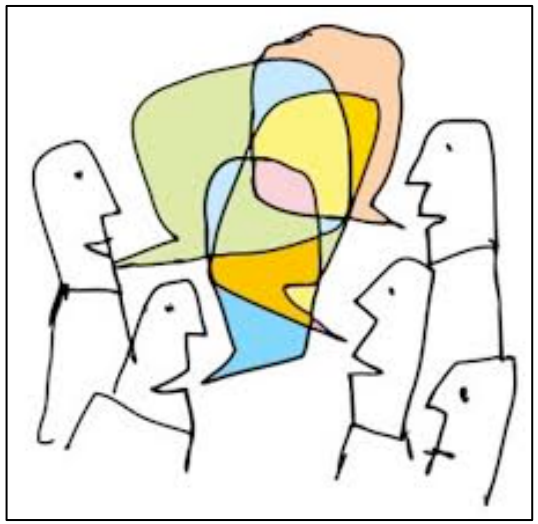
M3D3:
Cathode construction

11/30/2016





Today in lab

- ✓ Quiz
- Prelab discussion
- In 76-591: prepare material and roll & punch the cathodes
- In 56-322: research proposal peer review exercise

❖ Reflect on elevator pitch to Prof. Belcher

On the horizon for M3

- Major assignments do not change ideas after 12/01 at 5pm
  - Research proposal oral presentation (20%); Friday, December 9, 1pm
  - Mini-report (5%); Monday, December 12, 10pm

- Homework due M3D4
  - Submit both parts as a **team**
  1. Refine presentation outline, incorporate peer review feedback
  2. Background and Approach, with references

     http://belcherlab.mit.edu/publications/

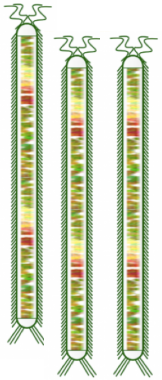
- Visit

MIT BE BIOLOGICAL ENGINEERING | Communication Lab

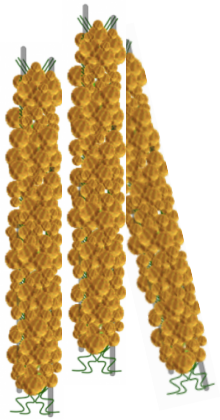
Module 3: biomaterials engineering overview

Purify
M13 phage
Add AuNP

DAY 1

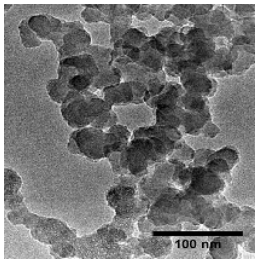


Biomineralize
Fe(III)-
phage-AuNP



Visualize
nanowires
on TEM

DAY 4



drying

Purify
active material

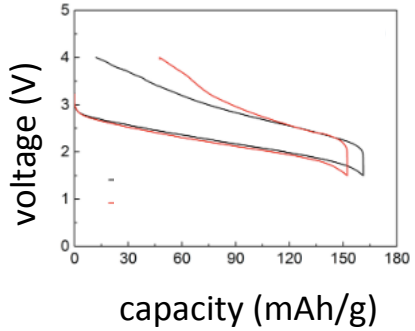
DAY 2

Construct
cathode
(and battery)

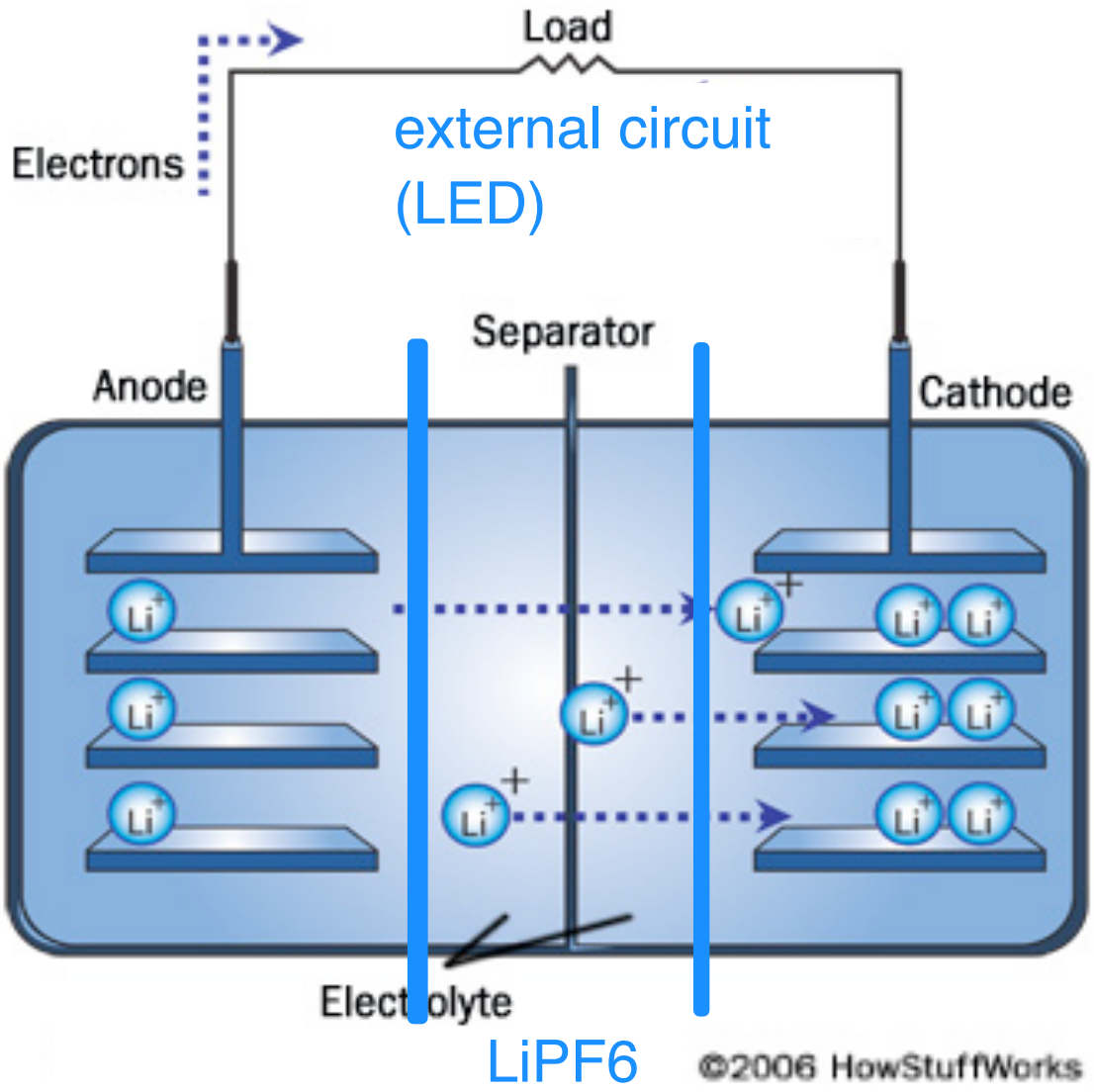
DAY 3

Measure battery
capacity

DAY 5



Is this battery discharging or charging?



negative

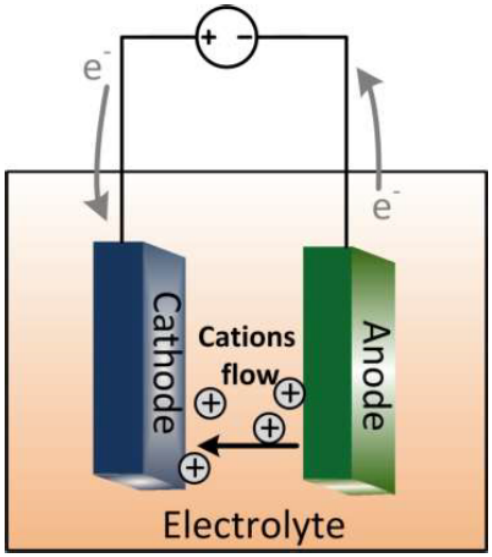
pure Li
(foil)

positive

Fe(III)PO4 /
Li

(phage)

Main components of a battery

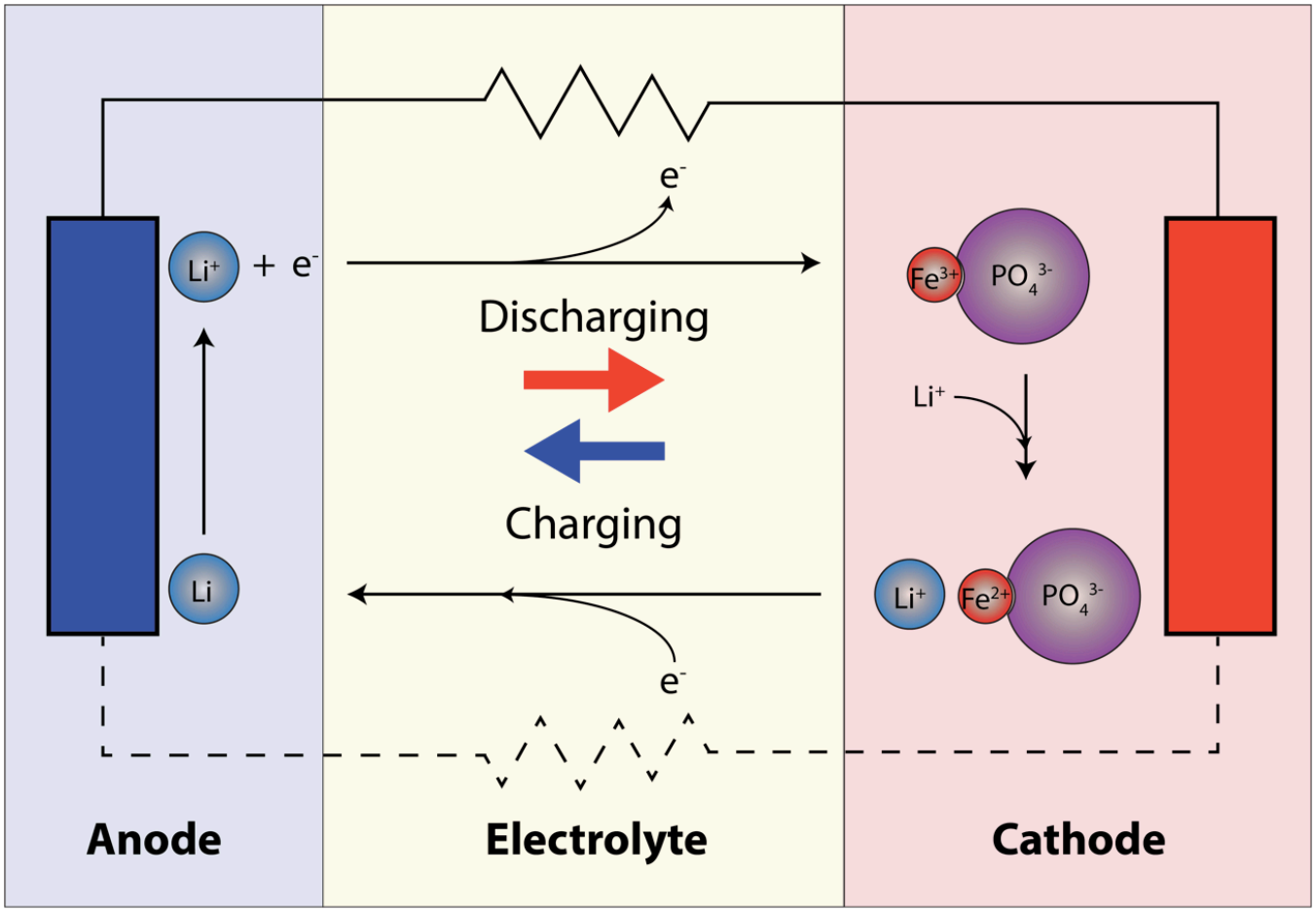


from Dr. Maryam Moradi

- During discharge,
  - cathode accepts electrons e^- and lithium ions Li^+
- Battery consists of two electrodes:
  - cathode = positive electrode, accepts electrons
  - anode = negative electrode, gives electrons
  - In rechargeable battery, when is electrode polarity defined? discharge
  - electrolyte allows for flow of ions
- What is capacity?
  - quantity of electricity (charge) involved for the electro-chemical reaction within the battery
  - for our Fe(III)-phage batteries, the theoretical capacity is 178 mA*h/g

Diagram of M3 battery

M13 phage
AuNP
Fe(III) PO_4 / Li Fe(II)PO_4



How can a phage scaffold improve battery?

surface/volume higher

- ion diffusivity → nano structuring active material
- electronic conductivity → integrating additives ("doping")

screening by phage display

Example: adding carbon nanotubes to phage cathode

from Dr. Moradi, Belcher Lab

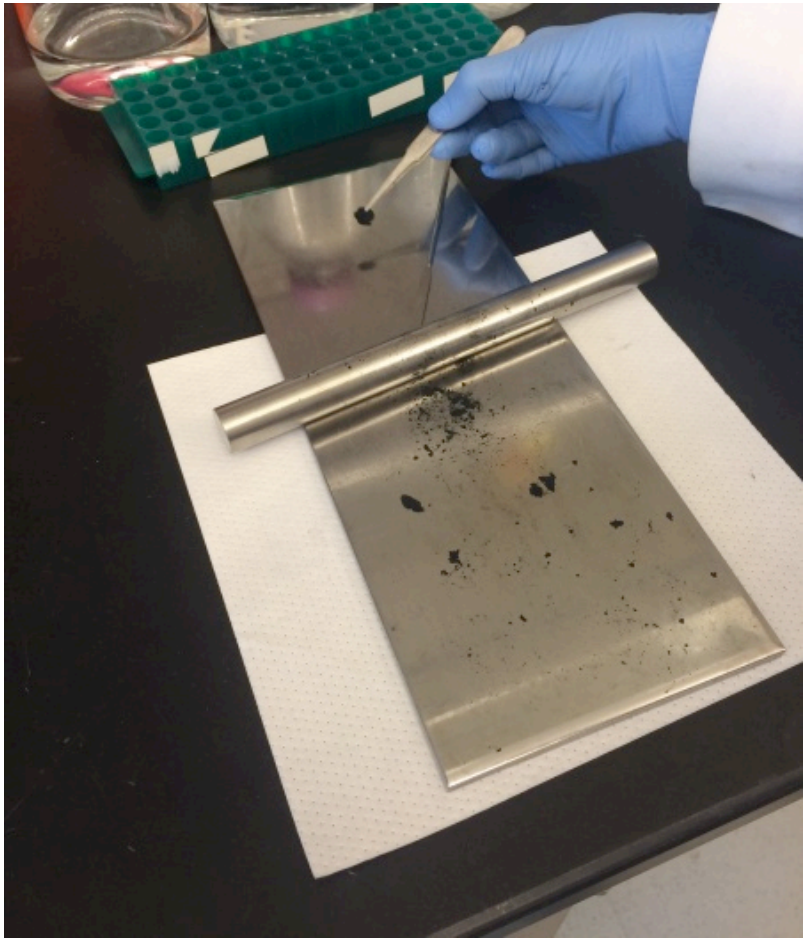
➢ How might AuNP size affect your battery capacity?

– experimental variables:

4 nm or 9 nm

How will you construct your cathode?

1. Weigh Fe(III)-phage-AuNP nanowires (active material)
2. Mix with Super P: carbon and PTFE: teflon binder
3. Roll material into thin sheet
4. “Punch out” cathode disc
5. Weigh cathode
6. Dry cathode



One large W/F team:

- Part 1: cathode construction in the Belcher Lab

- Part 2: peer review in the 20.109 Lab