M3D2:
Purify active material

04/22/2016

note: ~~lecture~~, but no lab on 04/28 – 04/29

your elevator pitches!
Tell us about your project ideas.

In lab today… and beyond

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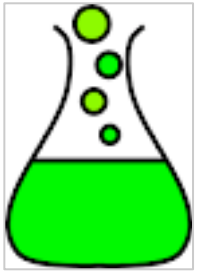
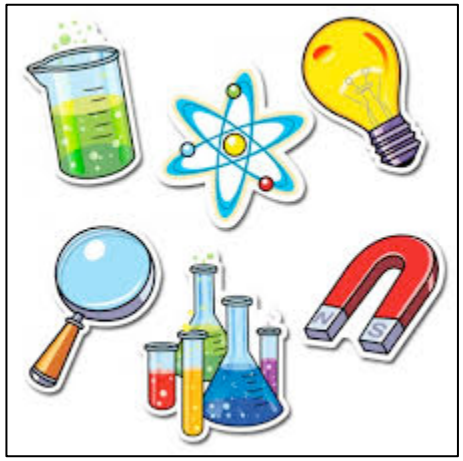
How to write your
M3 research proposal



- Demo: Fe(III)PO_4-phage-AuNP reaction
- Collect and wash active material
  - Refine your M3 proposal ideas during downtime
- Spot active material onto TEM grid
- Dry active material in 80°C vacuum oven

Congratulations! You made it through M2.

- ✓ Research report
  - returned on May 3
- ✓ And also journal club and blog!



- M3 research proposal
  - in pairs
  - due M3D3: refine your topic and approach, doesn't have to be your final proposal, **get feedback during downtime(s)**
- Quiz on M3D3

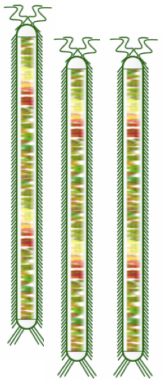
Module 3: biomaterials engineering

How does gold size/quantity affect battery capacity?

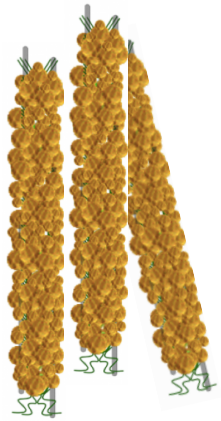
Purify
M13 phage
Add AuNP

DAY 1

T/R: 3.6 nm
W/F: 5.0 nm

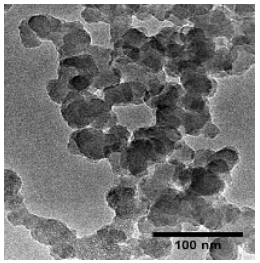


Biomineralize
Fe(III)-
phage-AuNP



Visualize
nanowires
on TEM

DAY 4



Purify
active material

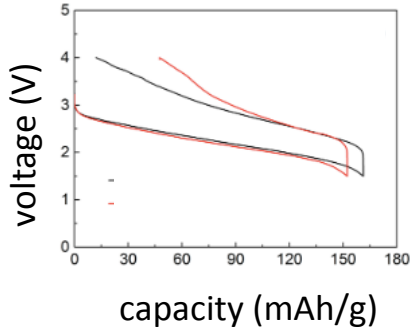
DAY 2

Construct
cathode
(and battery)

DAY 3

Measure battery
capacity

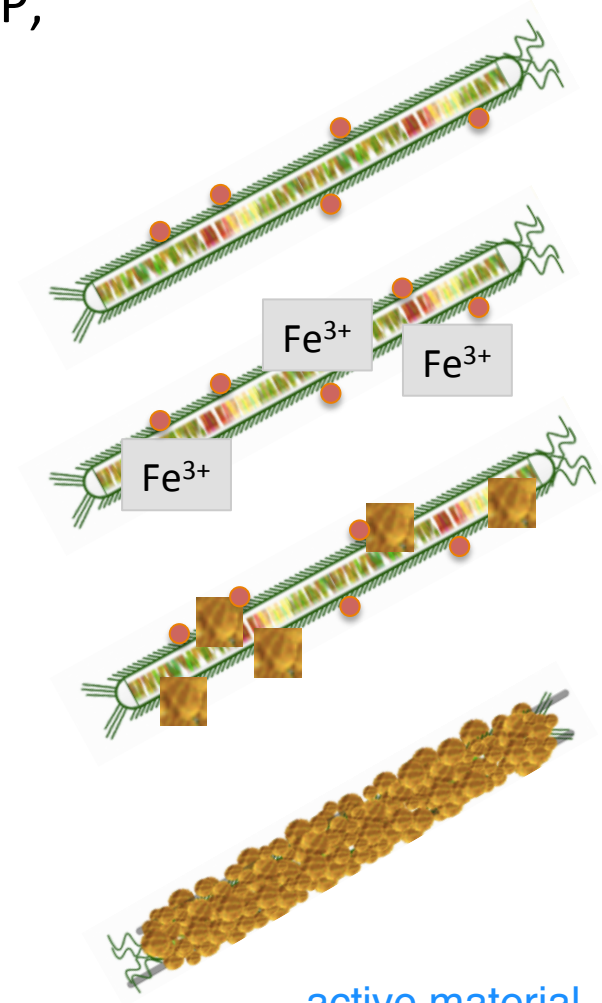
DAY 5



remove salts
completely dry

Biomineralization happened earlier this week

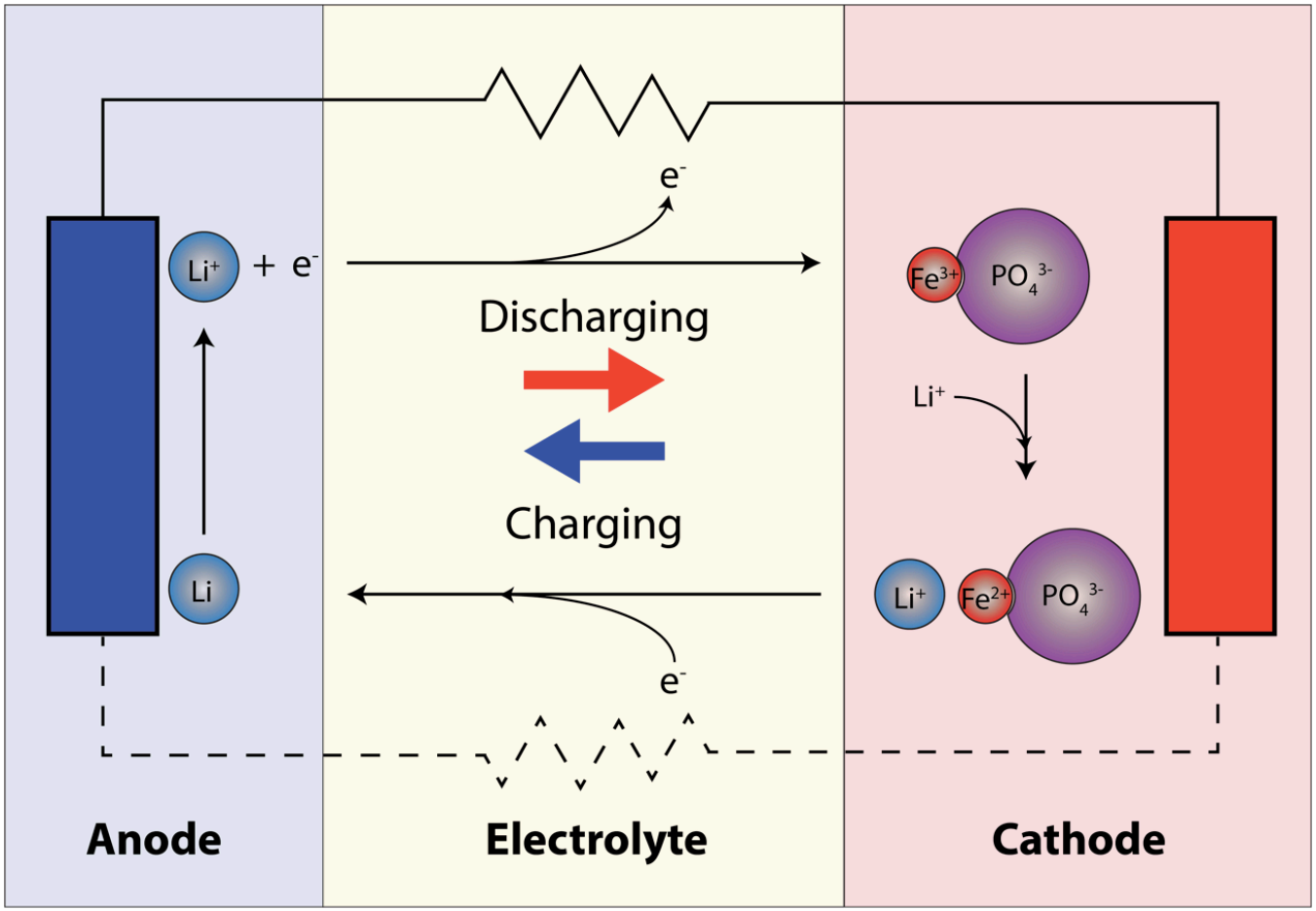
- p8 coat protein modified to include DSPHTELP, negatively charged peptide
- Gold nanoparticles (AuNP ●) incubated with phage for 4.5 days
- Electrostatic affinity between p8 and (gold and) Fe^{3+} … from $(NH_4)_2Fe(SO_4)_2$
  - 90% efficiency!
  - Fe^{3+} back into solution if wait > 12 h
- PO_4^{3-} from $NaPO_4$ precipitates Fe(III)
- nucleation / accumulation / mineralization ensues
  - amorphous a-$FePO_4$ ≠ crystal



active material
for the cathode

Diagram of M3 battery

M13 phage scaffold
AuNP electrical conductivity
Fe(III) PO_4 electrical and ionic conductivity

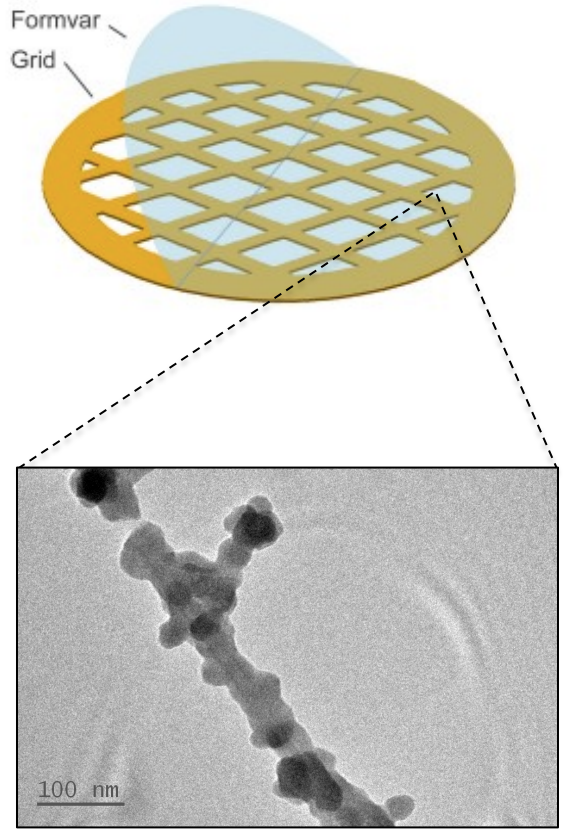


Set aside Fe(III)-phage-AuNP for TEM inspection

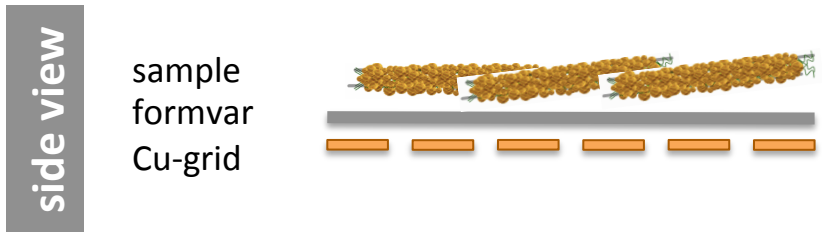
- The Fe(III)-phage-AuNP active material is in its purest form
  - no impurities, binder, etc.

- Formvar coated Cu-grid
  - copper-orange side
  - ✓ <u>silver/black side</u> where droplet deposited

  ➢ Practice handling it with tweezers



side view



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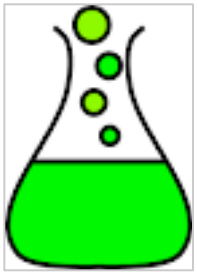

- Demo: Fe(III)PO_4-phage-AuNP reaction

- Collect and wash active material
  - Many long spins!
  - Refine your M3 proposal ideas during downtime
- Practice, then prepare TEM samples
- Prepare active material for 80°C vacuum oven