M3D2:
Purify active material

04/25/2017

In lab today… and beyond

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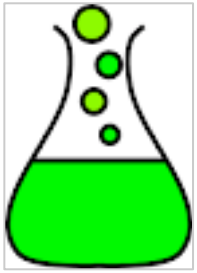
How to write your
M3 research proposal



- 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

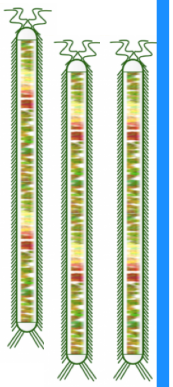
Module 3: biomaterials engineering

How does gold ~~size~~ amount affect battery capacity?

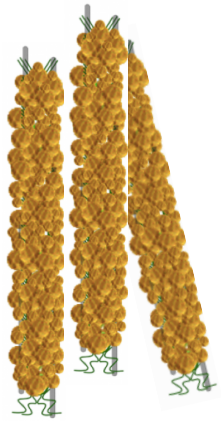
Purify
M13 phage
Add AuNP

DAY 1

4 nm

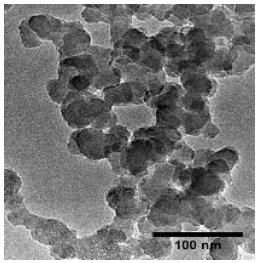


Biomineralize
Fe(III)-
phage-AuNP



Visualize
nanowires
on TEM

DAY 4



Purify
active material

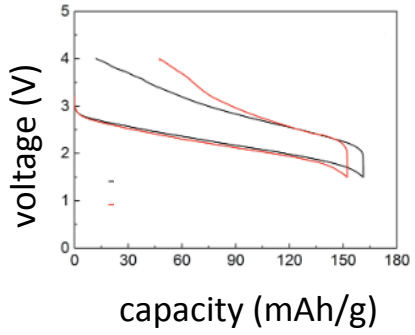
DAY 2

Construct
cathode
(and battery)

DAY 3

Measure battery
capacity

DAY 5



Biomineralization happened this week

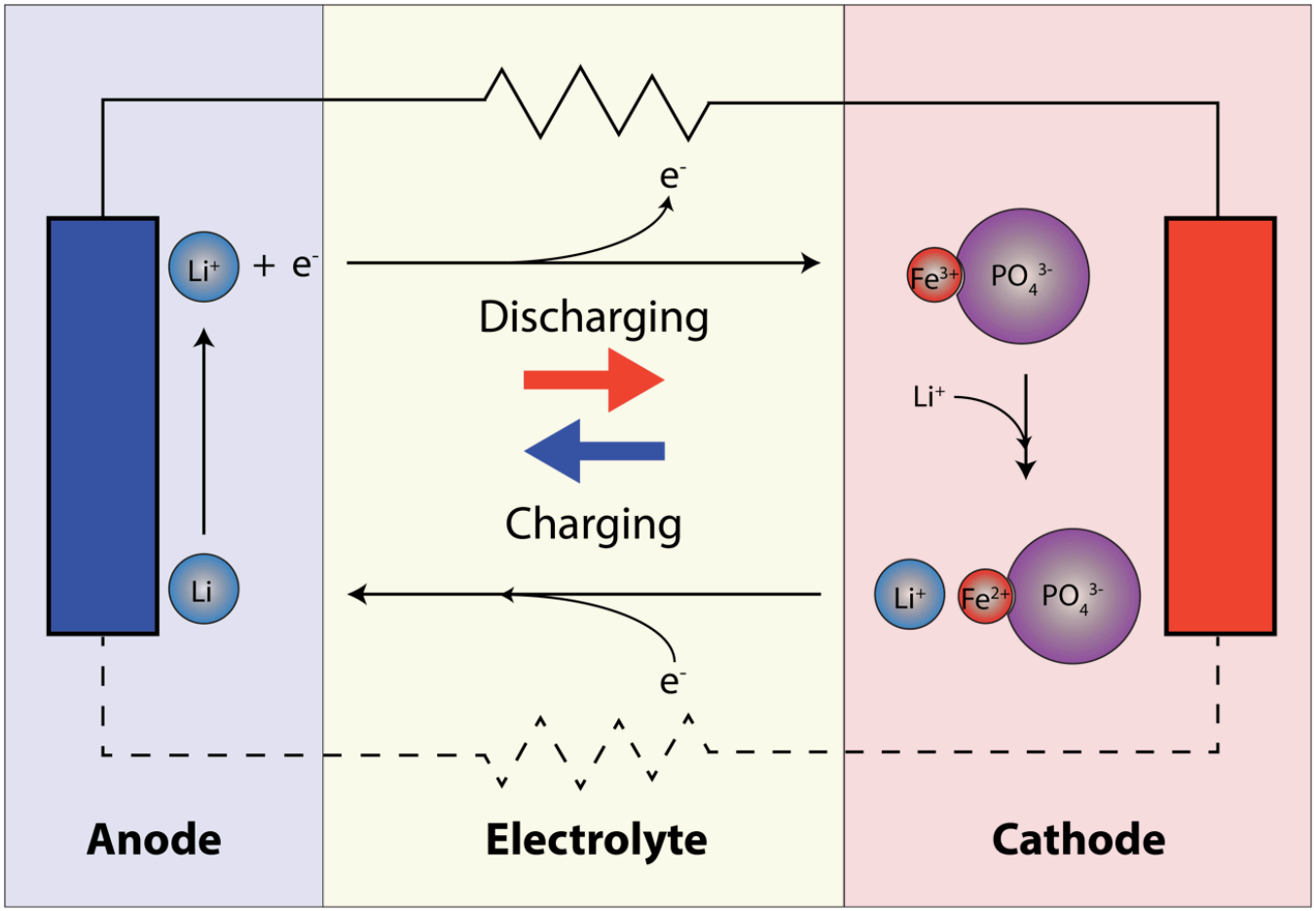
- p8 coat protein modified to include DSPHTELP, negatively charged peptide
- Gold nanoparticles (AuNP ●) incubated with phage for 4 days
- Electrostatic affinity between p8 and (gold and) Fe^{3+} … from $(NH_4)_2Fe(SO_4)_2$
  - 90% efficiency!
  - Fe^{3+} back into solution if wait > 12 h
- PO_4^{3-} from $NaPO_4$ precipitates Fe(III)
- nucleation / accumulation / mineralization ensues
  - amorphous a-$FePO_4$ ≠ crystal

Diagram of M3 battery

M13 phage
AuNP
Fe(III) PO_4

negative electrode

oxidation
loss of e-



positive electrode

reduction
gain of e-

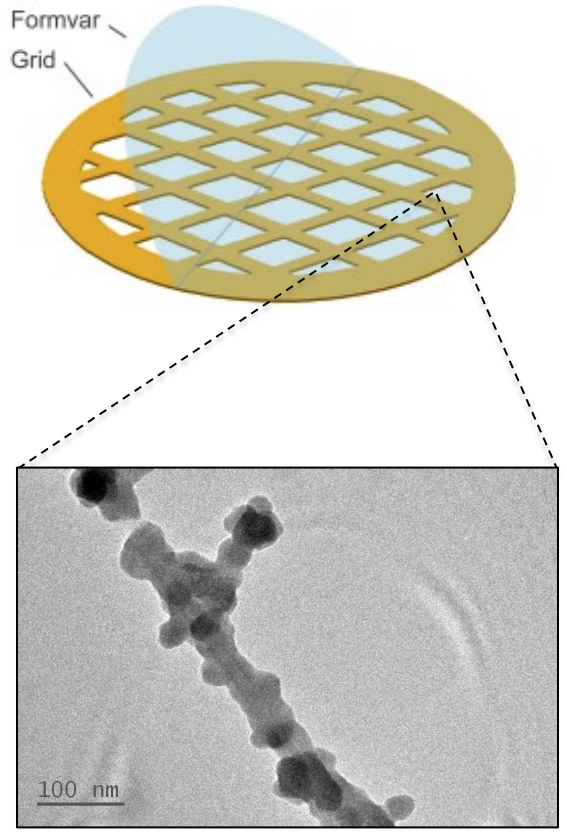
Li+

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

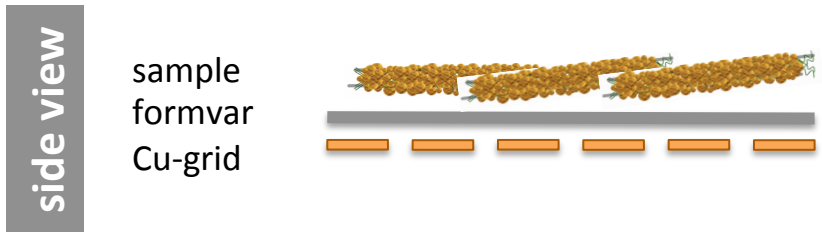
- The Fe(III)-phage-AuNP active material is in its purest form
  - no impurities, binder, etc

- 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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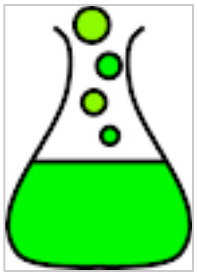

- Demo: Fe(III)PO_4-phage-AuNP reaction
- Collect and wash active material
  - Many long spins!
  - Refine your M3 proposal ideas during downtime
- Practice, then prepare TEM samples
- Prepare active material for 80°C vacuum oven

➢ 05/02: elevator pitches to Prof. Angie Belcher