

M3D5: Battery assembly and testing

5/10/2017

1. LAST Quiz ~20min
2. Prelab Discussion
3. Battery assembly demo: Belcher lab
4. Refine Research Proposal and draft figures for mini-report

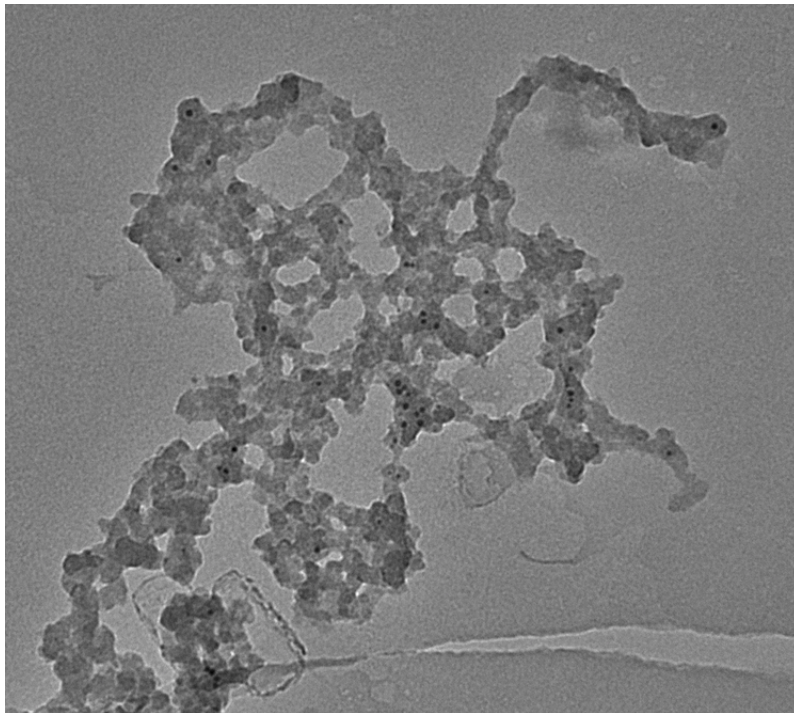
The final countdown...

- Lab notebook entry
 - M3D3 graded by Rob at 10pm tonight
- No lecture Thursday
- M3 research proposal
 - slides due on Stellar Friday, May 12th at 1pm
 - bring **one print-out of your slides** to 16-336
- M3 mini-report
 - due on Stellar at 10pm Wednesday, May 17th
 - Title, background + approach, (no methods, no abstract)
 - Possible figures: TEM images, EDX plot , EDX images, charge/discharge plot, capacity value for your batteries, class-wide data analysis
 - Short Context/Future Works
- Blog posts
 - due Friday, May 12th 10pm (*...not really checking till Monday*)

Figure: TEM images

- at low magnification:

- extent of biomineralization
- distribution of gold
- overall structure & density
- uniformity
- length of nanowires



- at high magnification:

- size of gold nanoparticles
- lattice of gold atoms
- amorphous vs. crystal Fe(III)PO_4
- diameter of nanowires

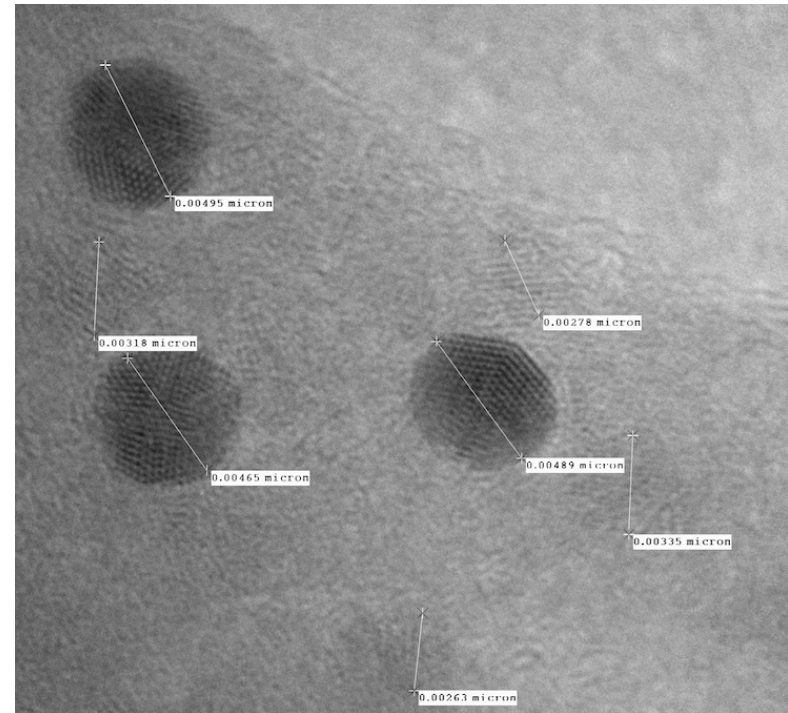
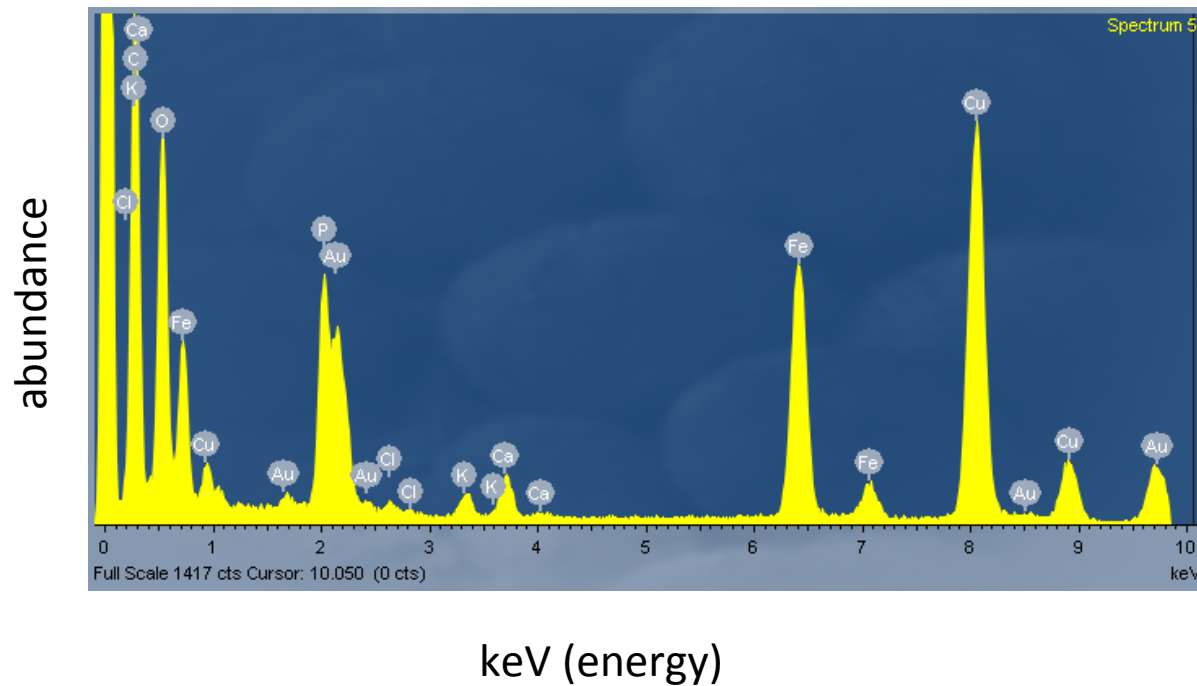
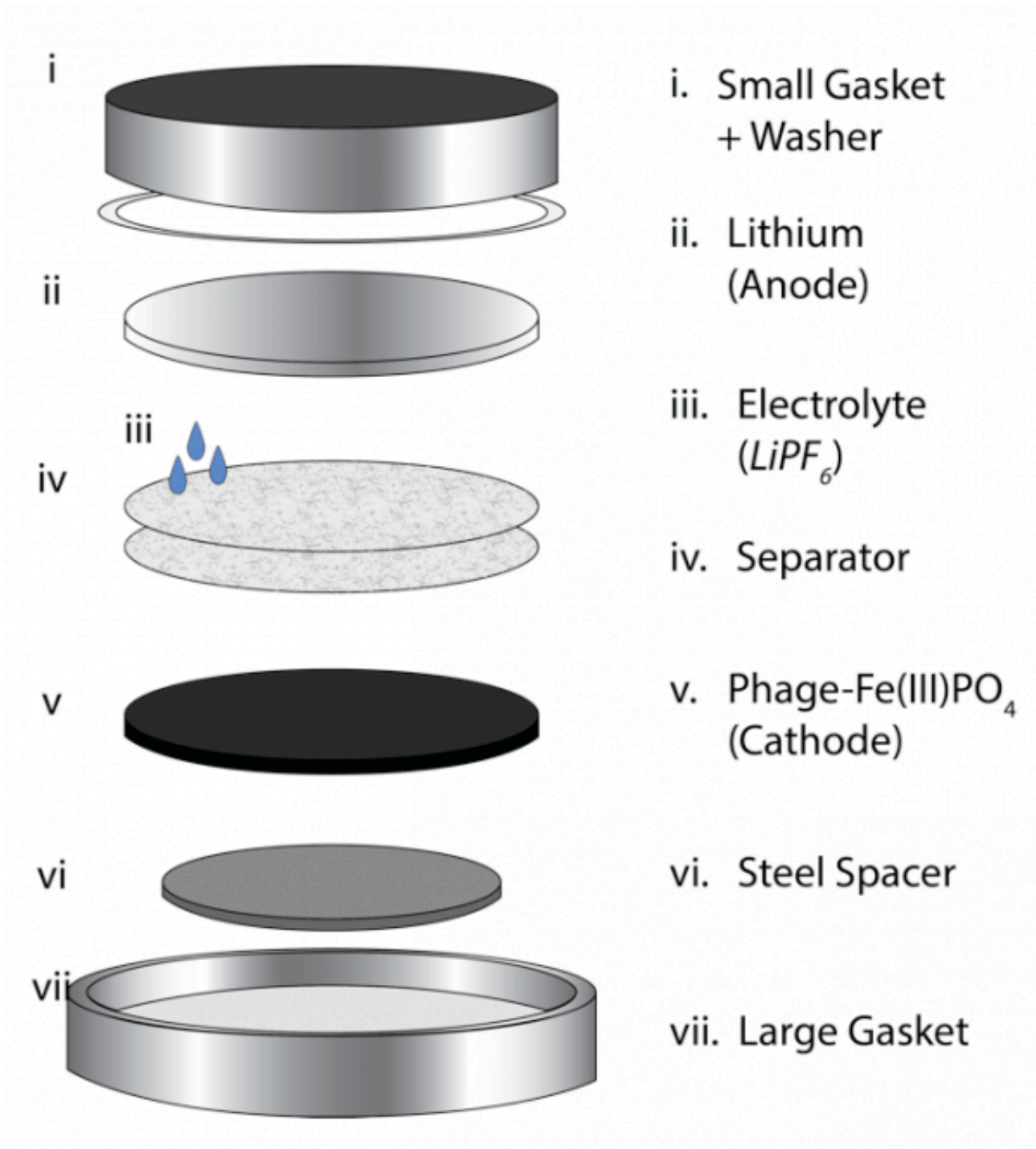


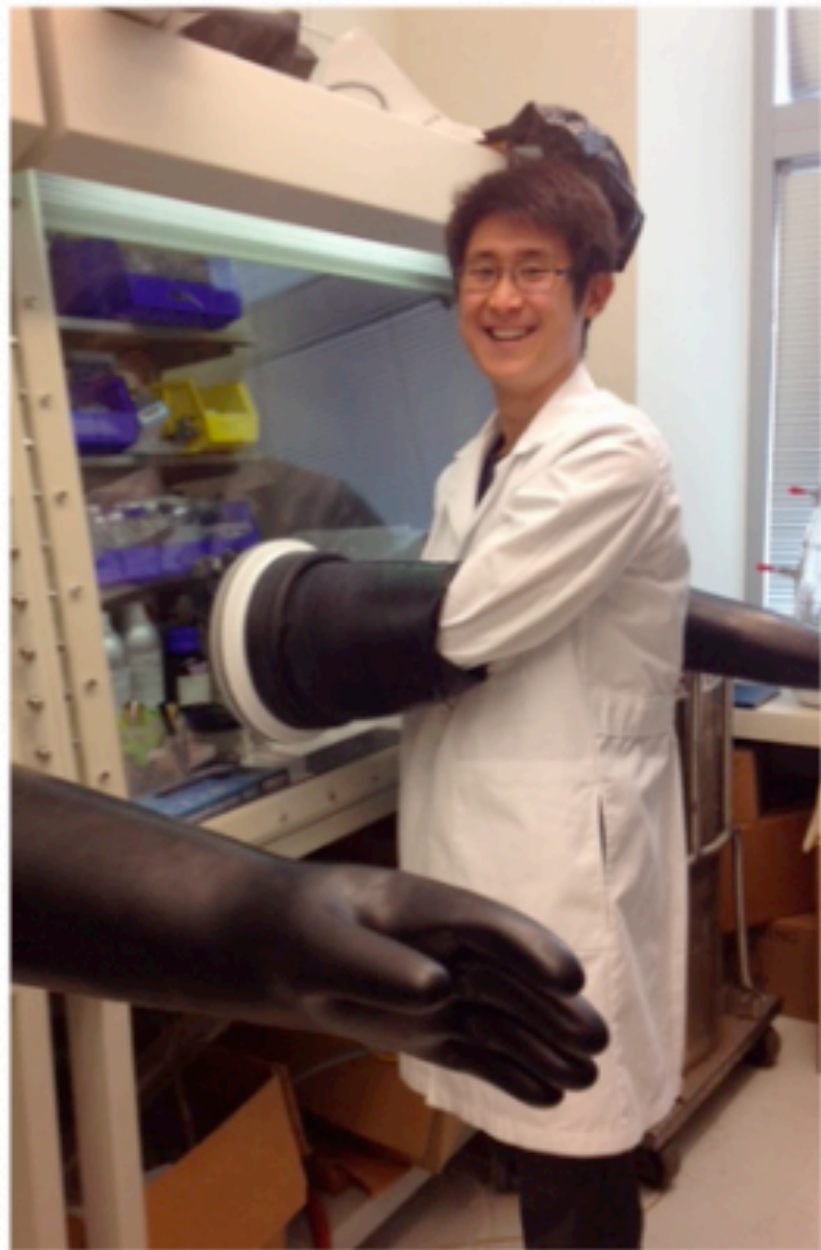
Figure: EDX elemental mapping

- expected: Fe, P, O, Au, (Cu)
 - contamination? Na, Cl, K, Ca (from diH₂O)
 - Si
 - stoichiometric ratios?



Today: Battery assembly





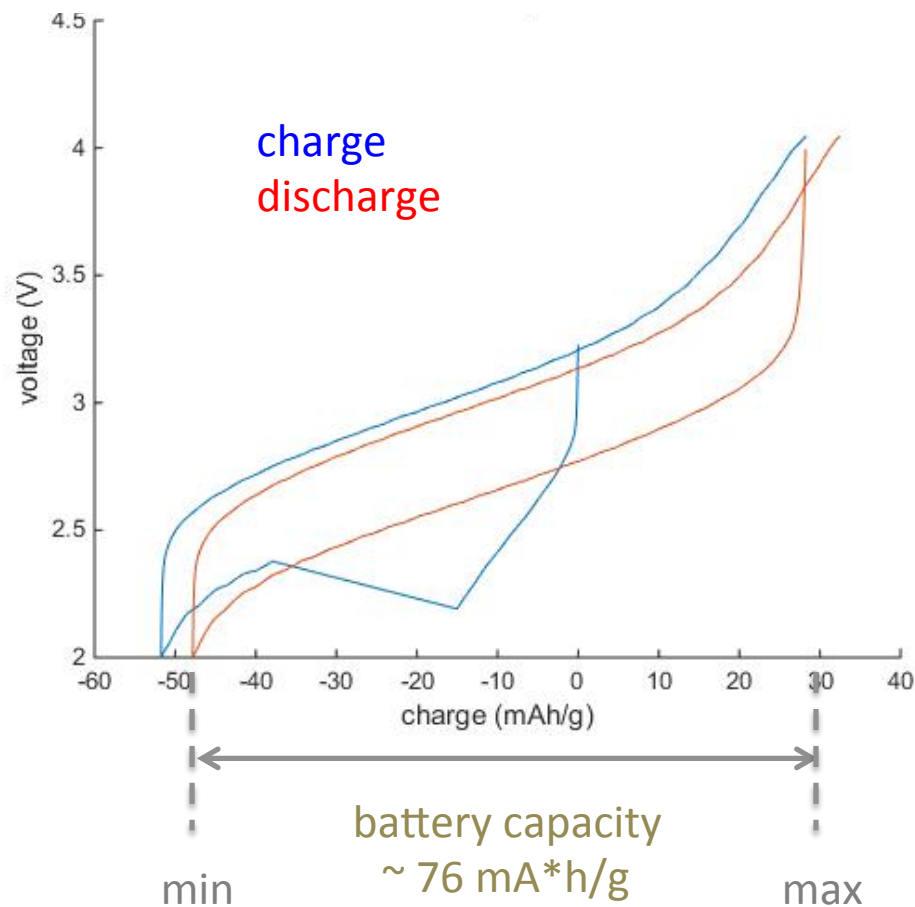


Figure: Battery capacity

- Theoretical capacity of Li – LiFe(II)PO₄ battery: 178 mA*h/g
- Practically
 - analyze cycling data (.csv files)
 - compare to plots (.jpg files)

- Galvanostat:

- keep current constant (- 89 mA/g for 10h discharge)
- record voltage (ideally constant)
- as charge (capacity) stored in battery fluctuates (drops during discharge)

Battery capacity calculation

- 1) Ensure capacity units are A*h/g, then convert to mA*h/g (*not mg!*)
- 2) Remember cathode is (in grams)
 - **70% active material:** 63% Fe(III)PO₄ + 7% phage
 - 25% Super P carbon
 - 5% PTFE binder
- 3) Battery capacity = Max capacity – Min capacity for one discharge cycle (2 or 3)

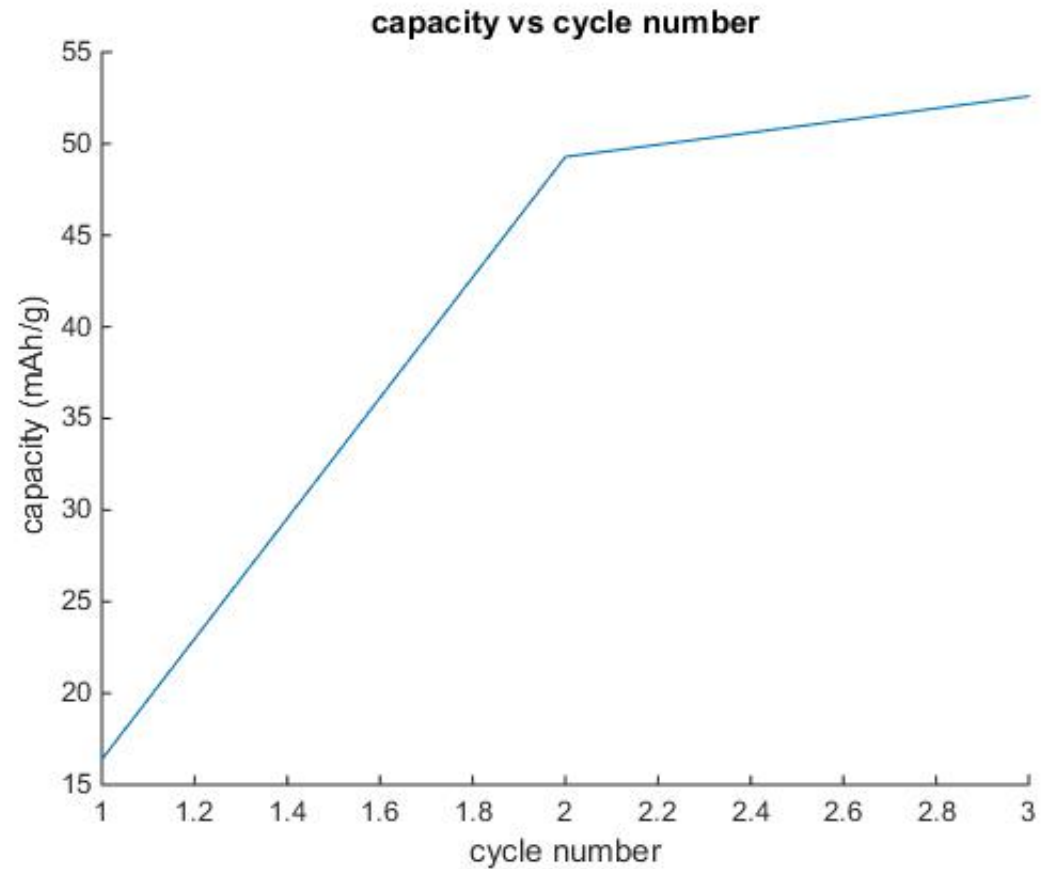
Result Number	Time	Sample Rate	Unit Number	Channel Number	Step Number	Step Repeat	Schedule Repeat	Voltage (V)	Current (A)	1st Aux V (V)	2nd Aux V (V)	3rd Aux V (V)	4th Aux V (V)	Aux T (K)	Charge (Ah)
1	01:00.0	0.01	2	4	1	1	1	2.9621582	-2E-09	-	-	-	-	-	-3.3E-11
2	01:10.0	0	2	4	2	1	1	2.92492676	-2.189E-05	-	-	-	-	-	-6.084E-08
3	01:20.0	0	2	4	2	1	1	2.9128418	-2.188E-05	-	-	-	-	-	-1.216E-07
4	01:30.0	0	2	4	2	1	1	2.90466309	-2.189E-05	-	-	-	-	-	-1.824E-07



5	Step Number	Charge (Ah)
1474	2	0.000110124
1475	2	0.000110063
1476	2	0.000110003
1477	2	0.000109942
1478	2	0.000109881
1479	2	0.00010982
1480	2	0.000109759
1481	2	0.000109698
1482	2	0.000109637

Step Number 2= discharge
Step Number 3= charge

Check your capacity calculation



Today in lab...

- Battery Assembly in Belcher lab
 - 1:45pm: purple/blue/yellow
 - 2:15pm: pink/green/red
- Capacity calculations in lab: How does the ratio of AuNP/ phage affect battery capacity?
- *Use your time wisely:*
 - Improve your research proposal slides
 - Practice your presentation
 - Ask for feedback!