

REU Research 2012

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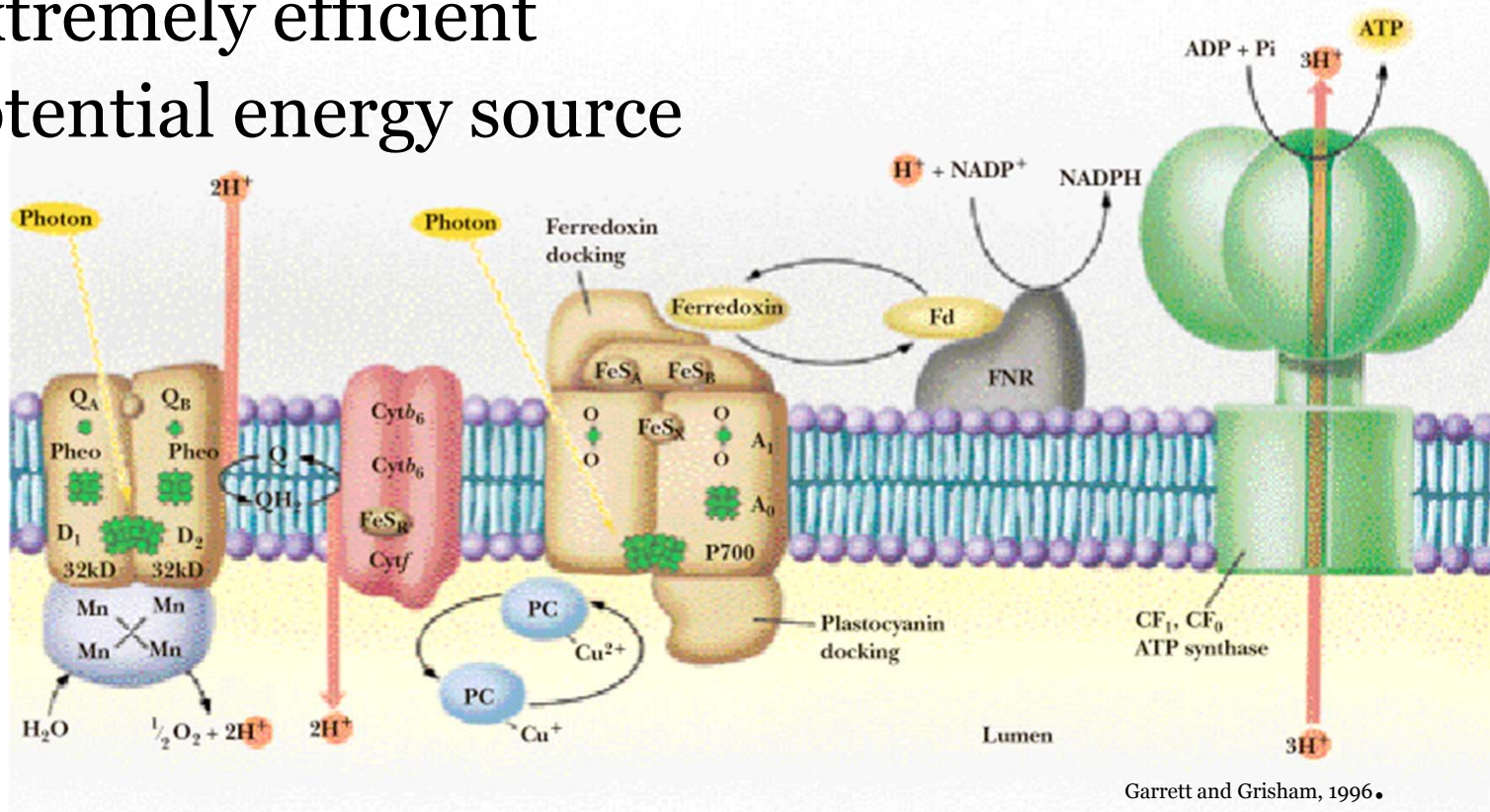


Water Splitting in Photosystem II



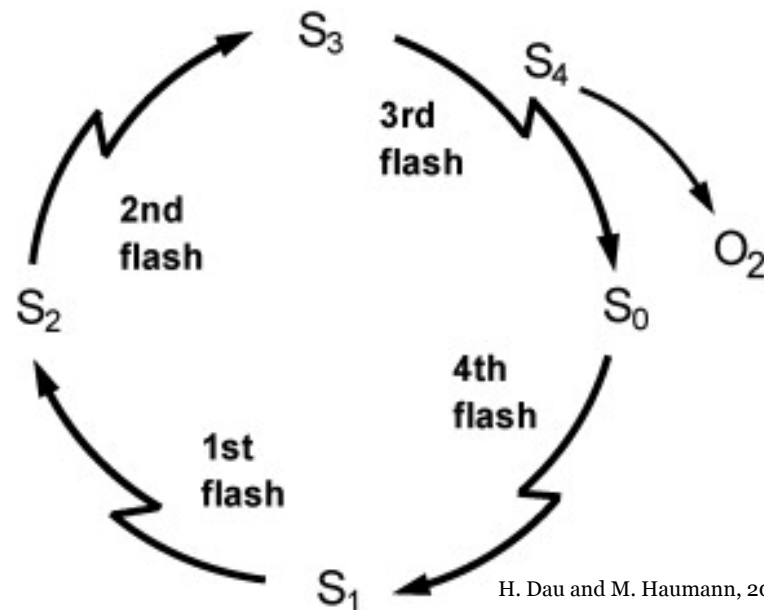
Why Photosystem II?

- Splits water: $2\text{H}_2\text{O} + 4h\nu \rightarrow \text{O}_2 + 4\text{H}^+ + 4e^-$
- Extremely efficient
- Potential energy source



Oxygen Evolving Cluster

- Catalyst in PS II for water splitting
- Loses electrons with absorption of photons
- Mn_4Ca



- S₀ $\text{Mn}_4(\text{II}, \text{III}, \text{IV}_2)$
- S₁ $\text{Mn}_4(\text{III}_2, \text{IV}_2)$
- S₂ $\text{Mn}_4(\text{III}, \text{IV}_3)$
- S₃ $\text{Mn}_4(\text{III}, \text{IV}_3)$
- S₄ ???

H. Dau and M. Haumann, 2008.

Experimental Procedure

- PS II isolated through a series of reactions with spinach leaves
- Manipulated under green light
- Analyze the protein with EPR, Raman Spectroscopy, X-Ray Spectroscopy



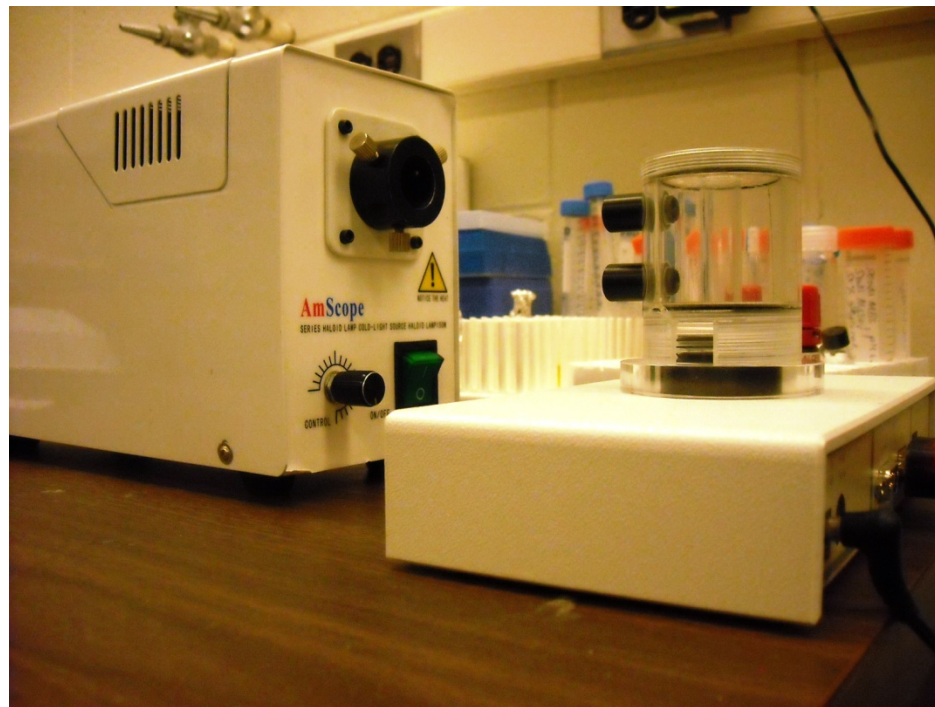
Chlorophyll II Assay

- UV-Vis spectrometer
- Concentrations of chl a and chl b tell purity of PS II sample



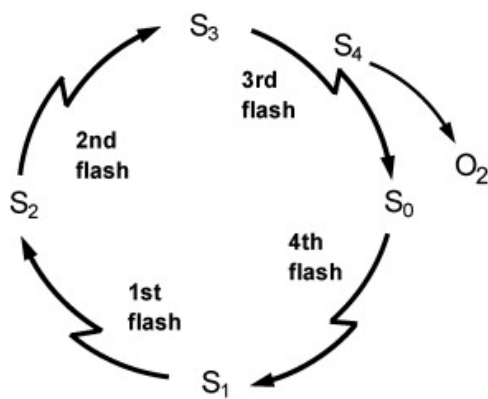
Oxygen Evolution Assay

- Need active PS II for further analysis to work



Obtaining S States

- Use 532 nm laser pulses
- Number of flashes corresponds to state (Kok cycle)

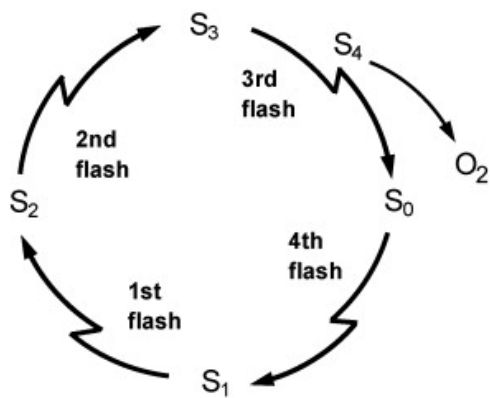


H. Dau and M.
Haumann, 2008.



Obtaining S States

- Continuous illumination gives S_2
- Kept in dry ice and ethanol



H. Dau and M.
Haumann, 2008.

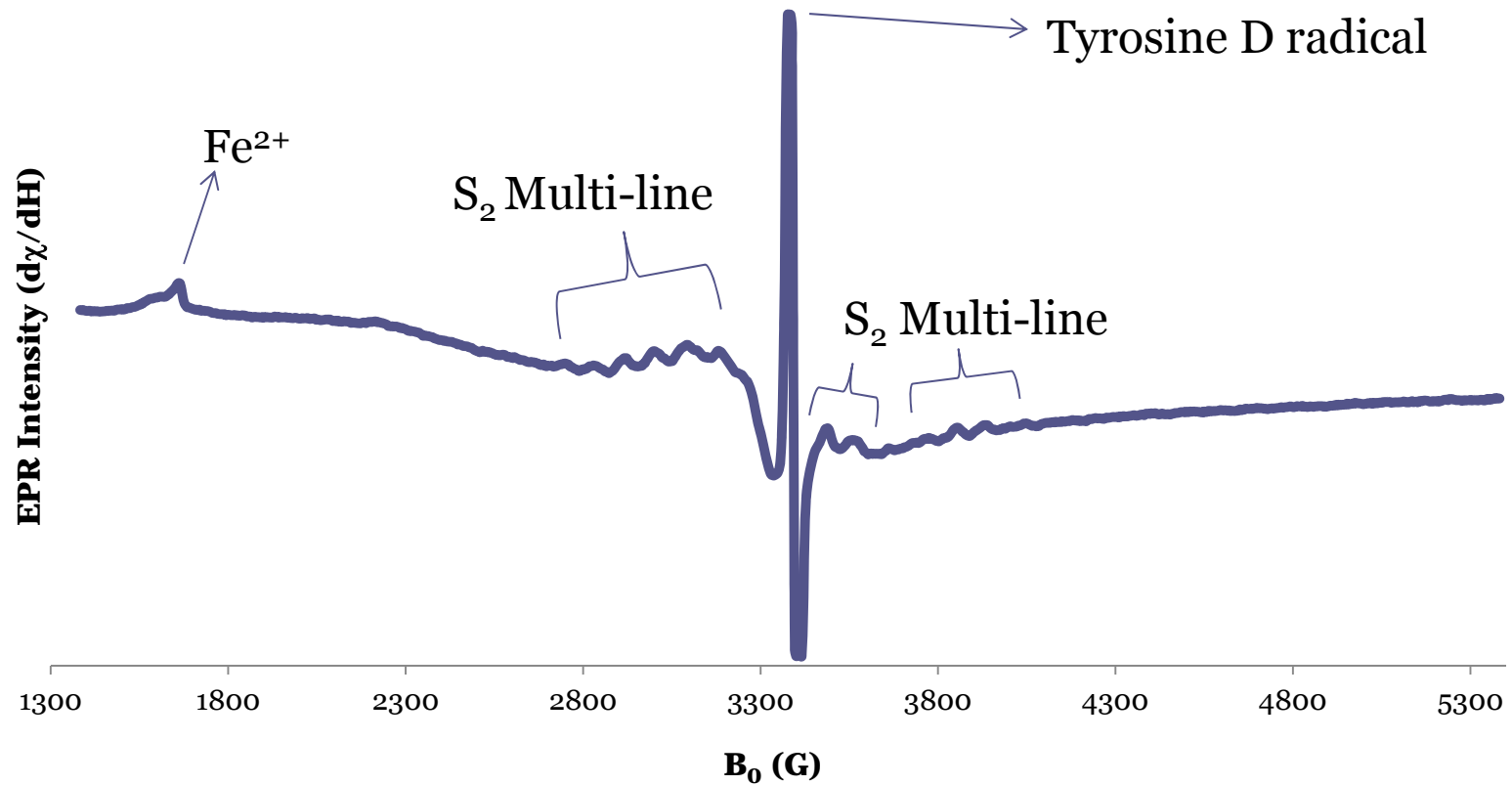


Electron Paramagnetic Resonance

- Mn atoms in OEC have unpaired electrons
- Electron spins flipped with microwaves
- Absorption recorded
- Use to verify *S* state advancement

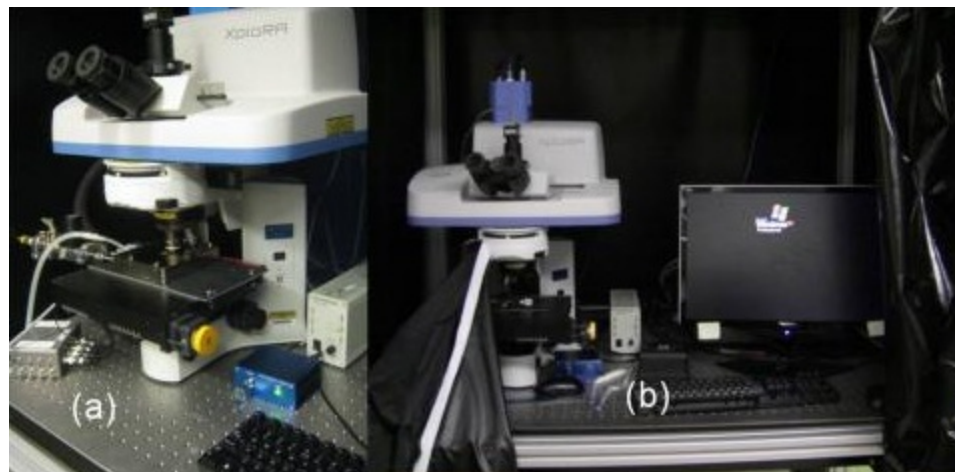
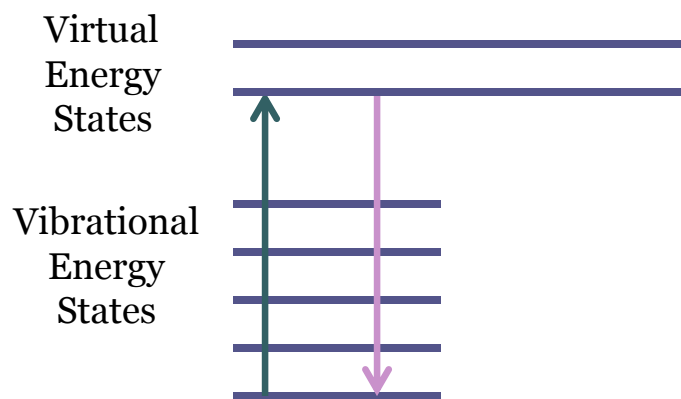


Electron Paramagnetic Resonance

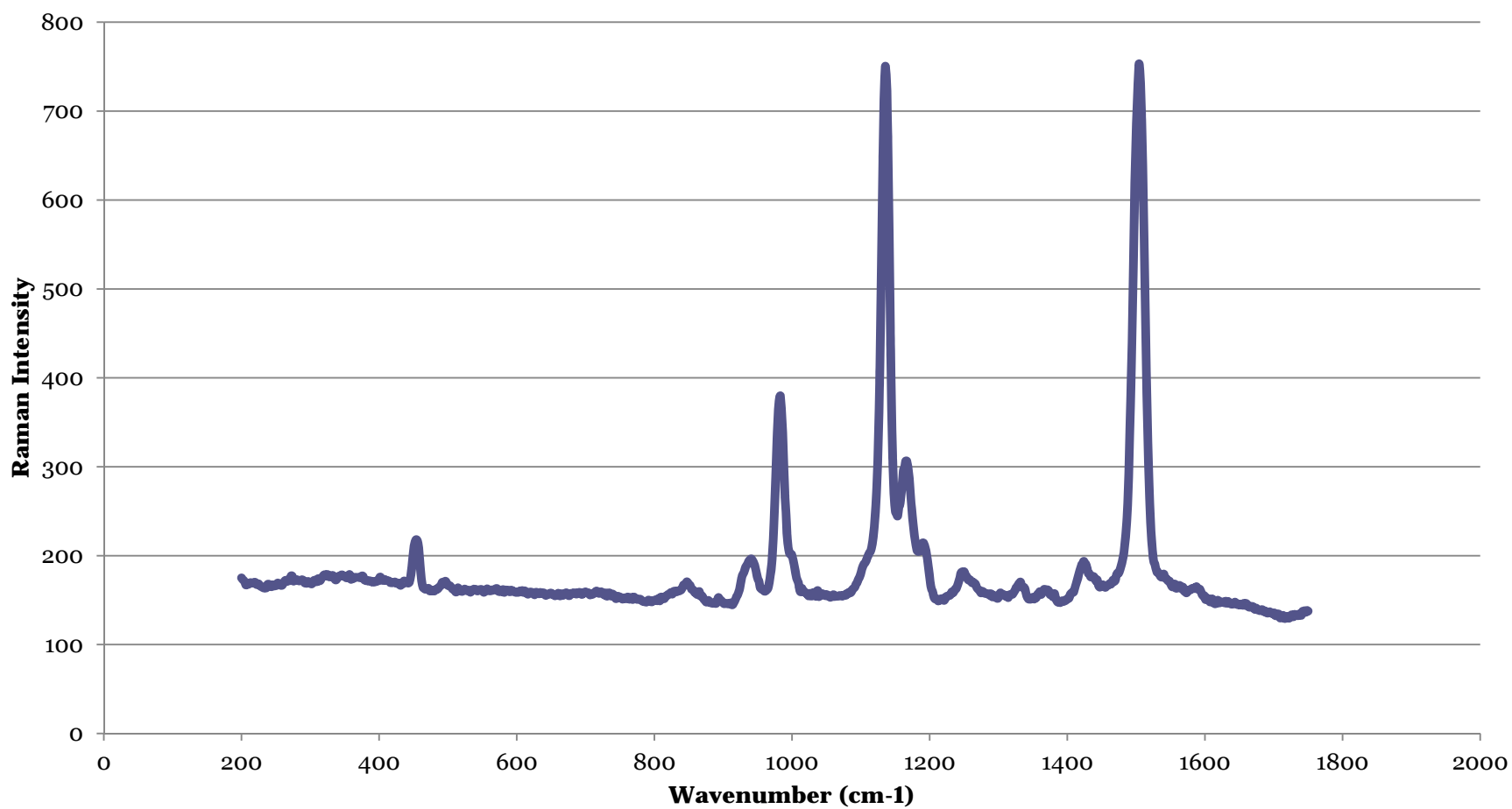


Raman Spectroscopy

- Light interacts with sample
- Laser photons up- or down- shifted
- Bonding information

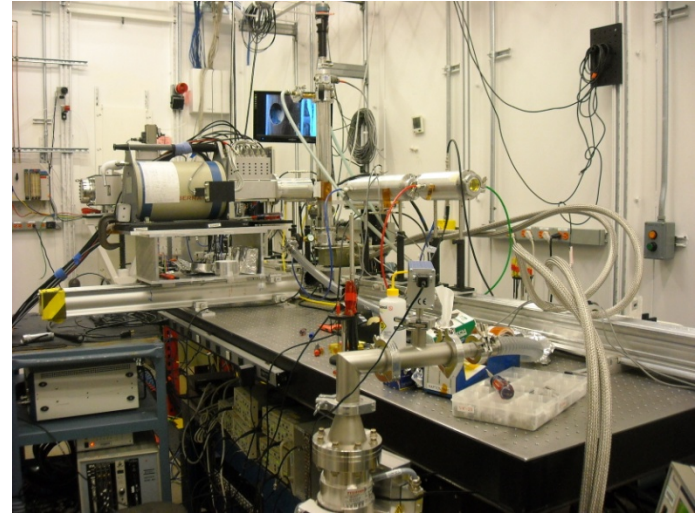


Raman Spectroscopy

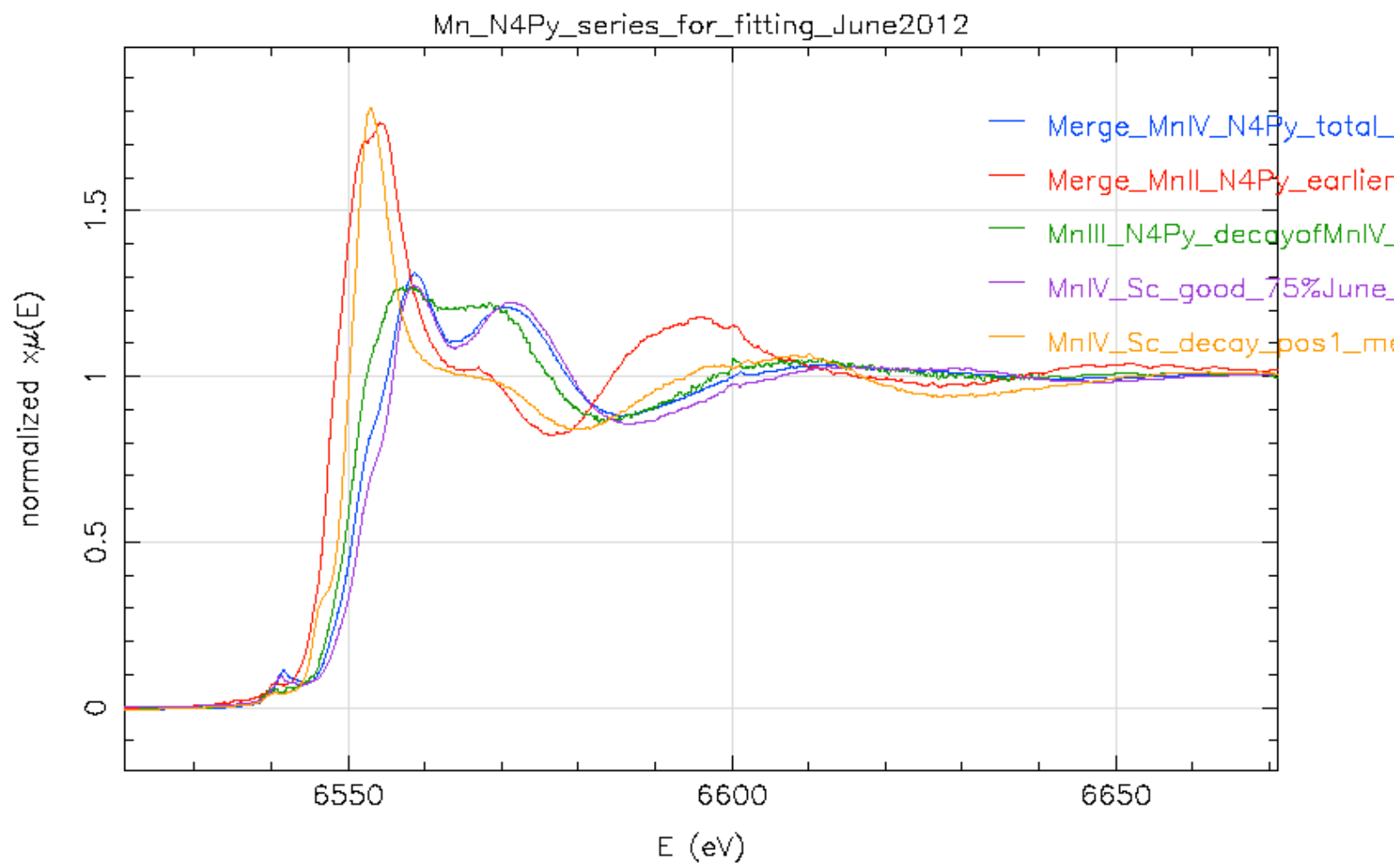


X-Ray Spectroscopy

- Absorption of x-ray photon leads to emission of a photoelectron
- Determines oxidation states and structure
- Graph of absorption coefficient vs x-ray energy



X-Ray Spectroscopy





Conclusions

- Frozen samples give the same EXAFS data as room temperature samples

My Jobs

- Isolate PS II from spinach
- Make samples
- Help with EPR, Raman, and X-Ray spectroscopy
- Test sample delivery systems

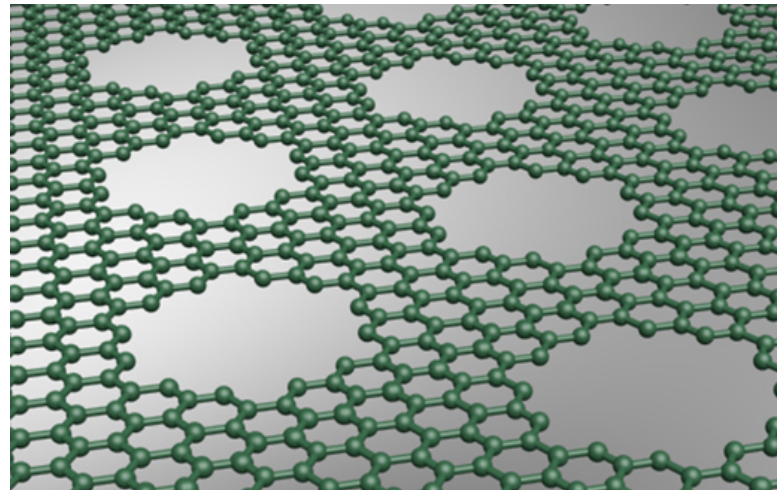




Graphene Nanomesh

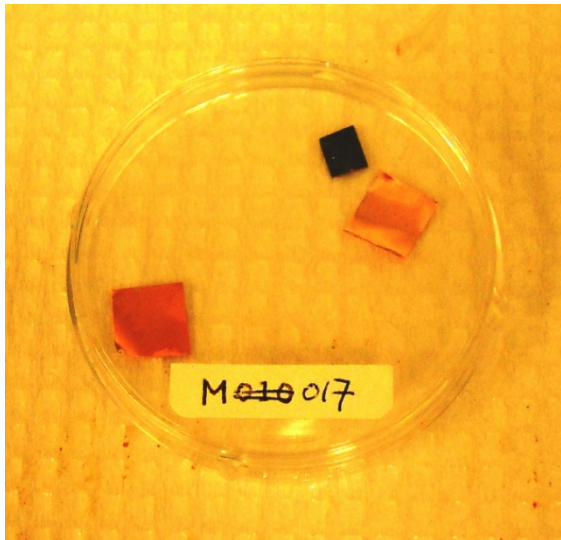
Why graphene nanomesh?

- One of strongest known materials
- Possible application in filtration of blood plasma
- Testing mechanical, not electrical, properties



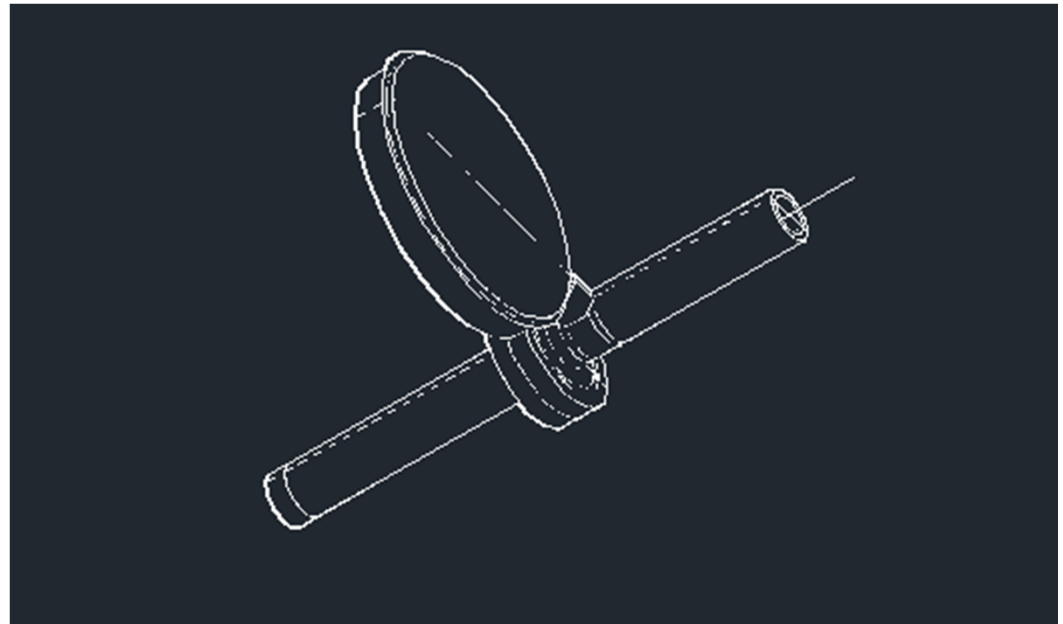
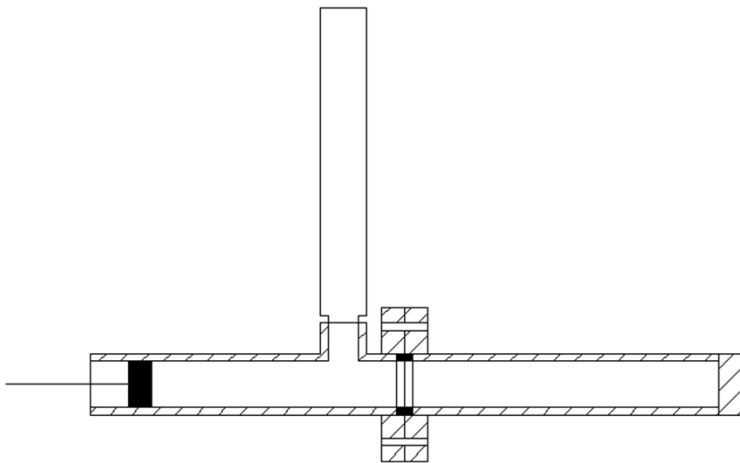
Experimental Procedure

- Series of spin-coatings and etchings of pure graphene
- Test GNM strength



My Jobs

- Designing static testing chamber
- Testing pump systems





Any questions?