5A_End-of-Semester Paper Suggestions

Guidelines

Presentation

I mention this first because preparation of a paper or a manuscript begins with the figures. The pptx file should therefore be the precursor to your written manuscript. The ppt should have four to five slides

#1: title, author, date, place, and context

#2: The problem statement introduced by a figure, of your own making or from the literature or the web

#3: The approach to analysis

#4: Key results

#5: Summary of key points

The format of the slides should be simple. Black and white is best with some highlighting in color for emphasis

Do not have more than 20 words on one slide

Use a clean blank page without any icons.

Paper

•Abstract: written at the end with less that 100, preferably 50 words. Brevity is the key. Read your own writing and see how you can shorten the paragraph. On this page also give the title, the date and your name on the top.

•Introduction: Like the second slide in ppt above

•Analysis: Describe your approach to the problem, and give equations that are relevant to the topic (from note, the web, or elsewhere)

•Application of the analysis to the problem at hand with key results

•Closure: About half a page on where you started where you arrived

The total would be less than five pages, double spaced, including figure(s)

Google Scholar

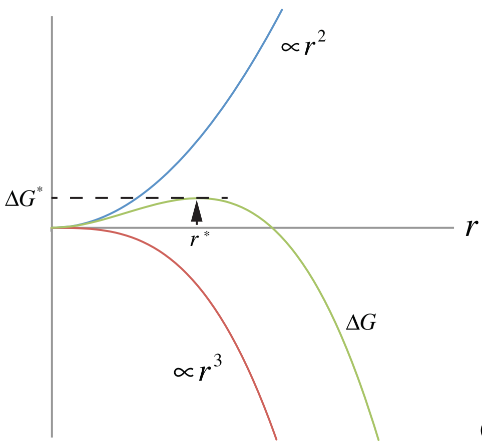
Use key words to search for papers in Google Scholar. Pick one or two articles that strike you as being interesting and build your paper on them: https://scholar.google.com/

Suggested Topics

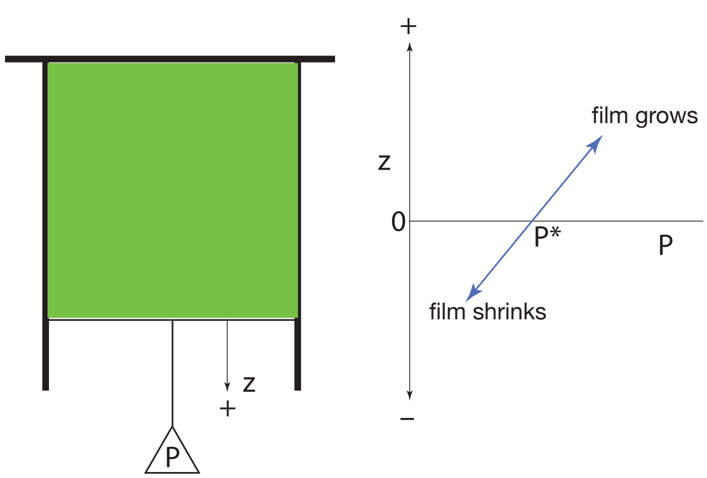
You can pick any topic you wish. A strong interest is the best starting point for a strong manuscript. If you wish to discuss your chosen topic with me, please ask me. Of course you can also join the office hours Sundays 1 - 3 PM

As stated above for Slide #2 of your presentation, a figure taken from course notes, home work, or from literature, or the web can become the fulcrum of your paper and presentation. The figure should be one that seeks to tell a story: what is is about, and why?

Some examples drawn from the notes and HW are given below. You must not choose from them; they are merely examples.

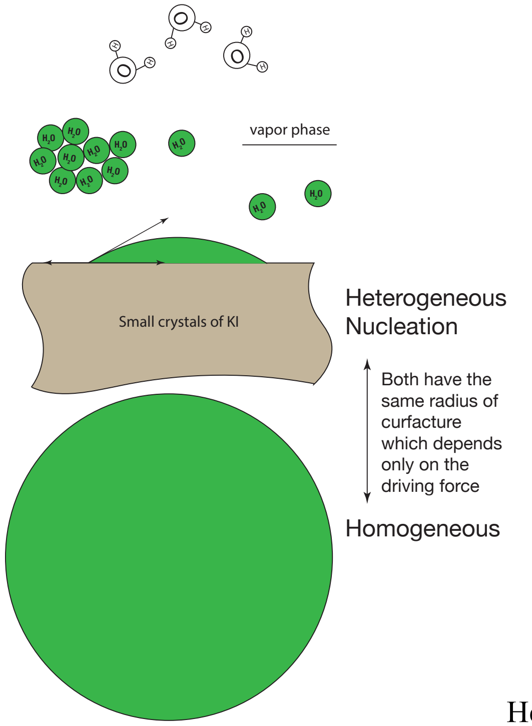


Origin of the energy barrier to nucleation.

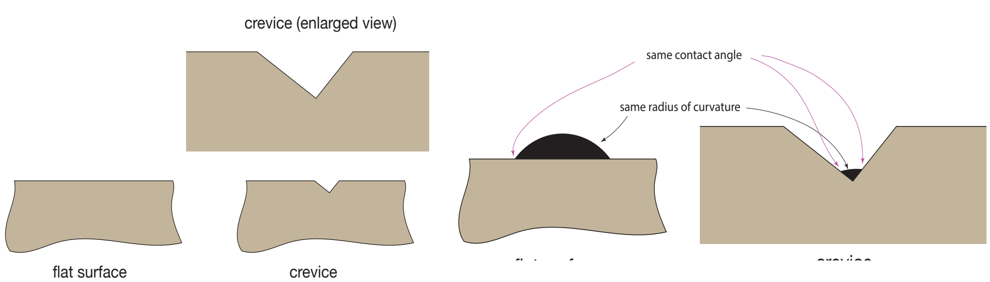


At P* there is mechanical equilibrium between surface tension and the applied load

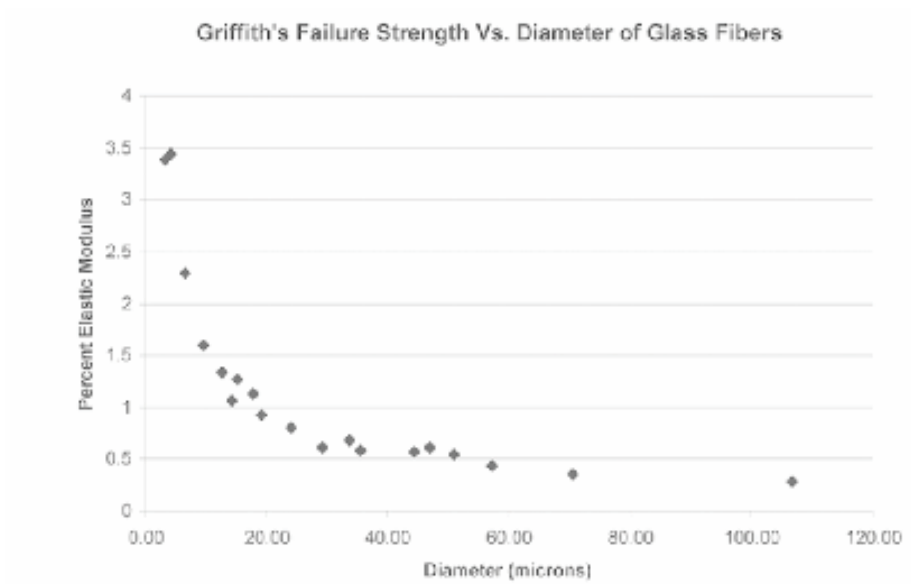
Surface tension and how it is measured for liquids.



Heterogeneous nucleation, the significance of the contact angle and the number of atoms contained within the volume of a critical nucleus.



why is nucleation easier in crevices?



fracture of glass fibers depends on their diameter, usually increasing exponentially if the fiber diameter is smaller than about 1 μm.

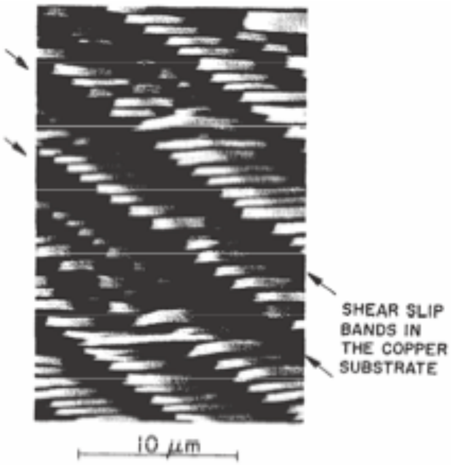


Fig. 3. The shear slip bands in the copper appear as relief in the silica film. However, the crack spacing is not influenced by the orientation and the localization of the slip bands. $\epsilon = 25\%$.

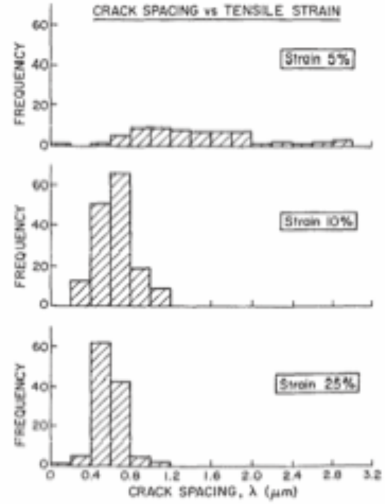
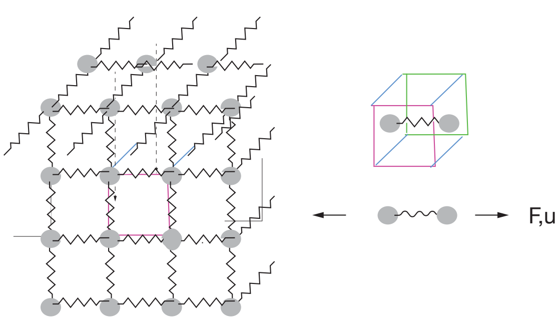
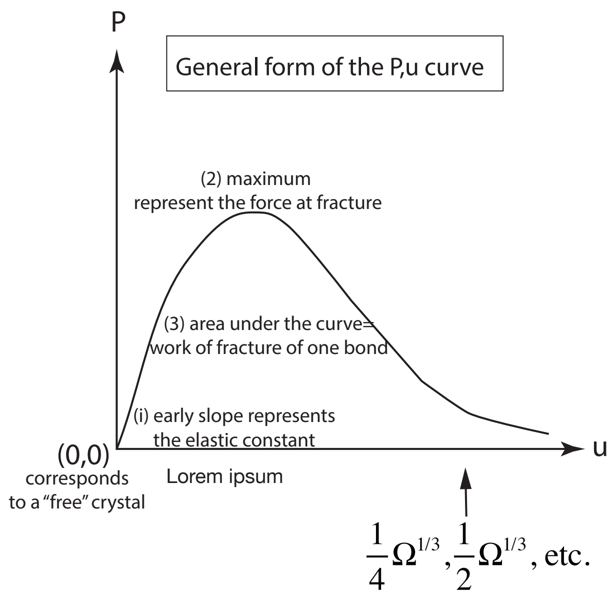


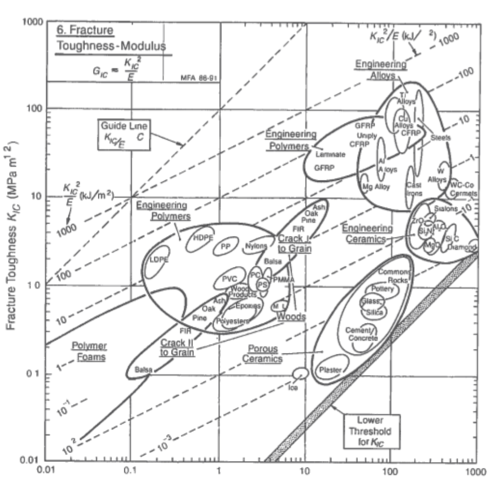
Fig. 4. The distribution of crack spacing, λ, obtained at applied tensile strain of 5, 10 and 25%.

Fracture in thin films of a brittle material (like a ceramic) on a ductile substrate when it is stretched to deform plastically. See: Agrawal DC, Raj R. Measurement of the ultimate shear strength of a metal-ceramic interface. Acta Metallurgica. 1989 Apr 1;37(4):1265-70.



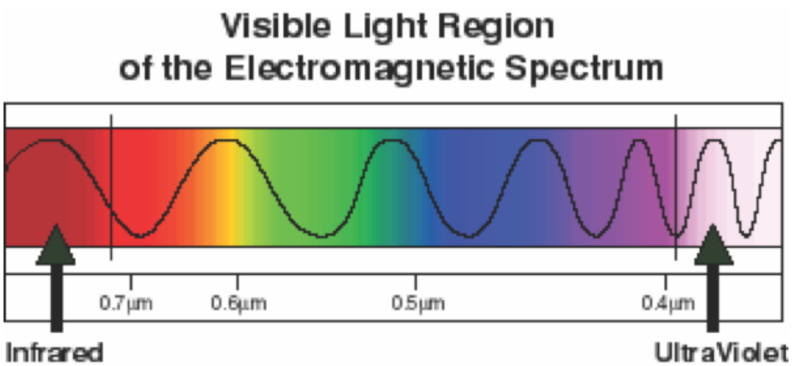


show how the Youngs modulus can be related to the ideal fracture strength, estimated to be 15% of the Youngs Modulus.



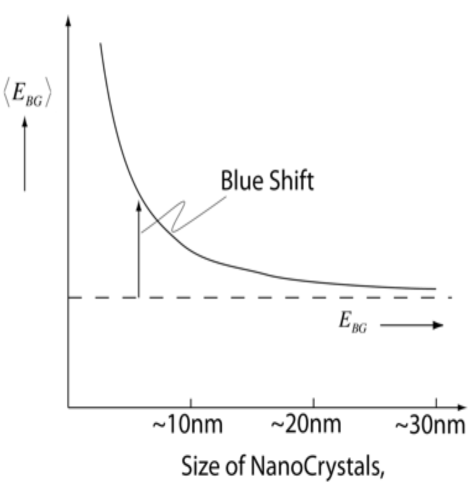
Why does the fracture toughess of materials increase with the Youngs Modulus?

$E = h\nu = h\frac{c}{\lambda}$ discuss the fundamental significance and the many applications of the Planck's Constant.

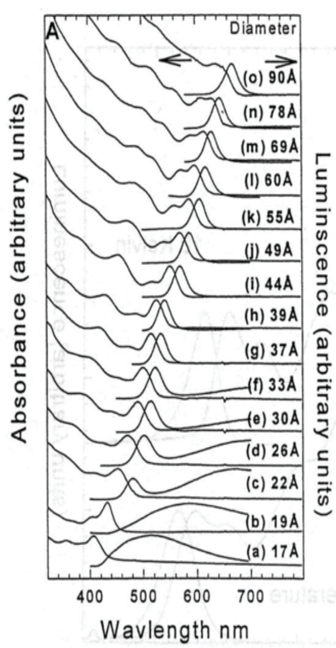


the origin of color: its relationship to the atomic orbitals and,

Why emulsions of small particles of semiconductors have color and why the color is related to the band gap.

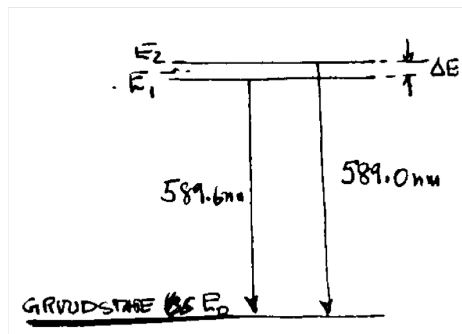


CdSe



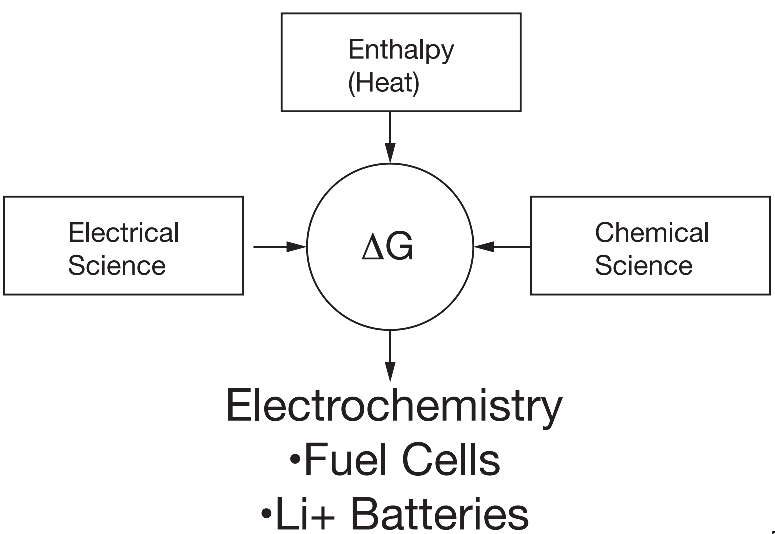
The Blue Shift in CdSe with nanocrystal size.

Example 3.1: Sodium vapor lamp emits a “doublet” in the yellow region, one at $\lambda =$ 589.0 nm, and the other at 589.6 nm. Calculate the difference in the energy between the ground state and the two excited states for the electron in the Na atom.



Let us first calculate $E_1 - E_o$:

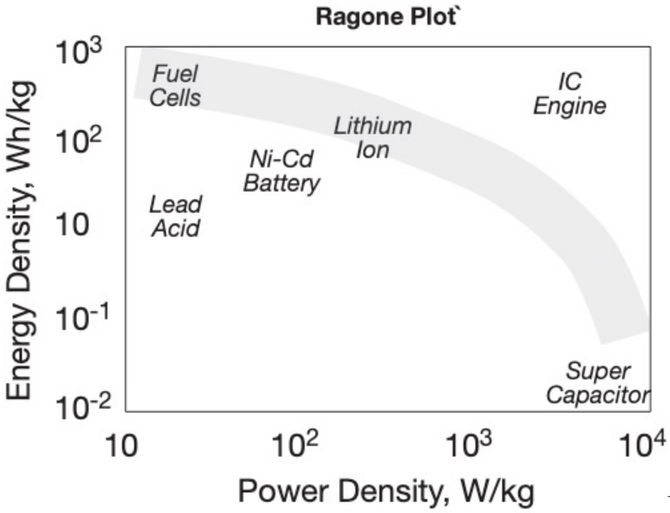
Emission of yellow lines from sodium vapor lamp.



The confluence of electrical, chemical and thermal energy.

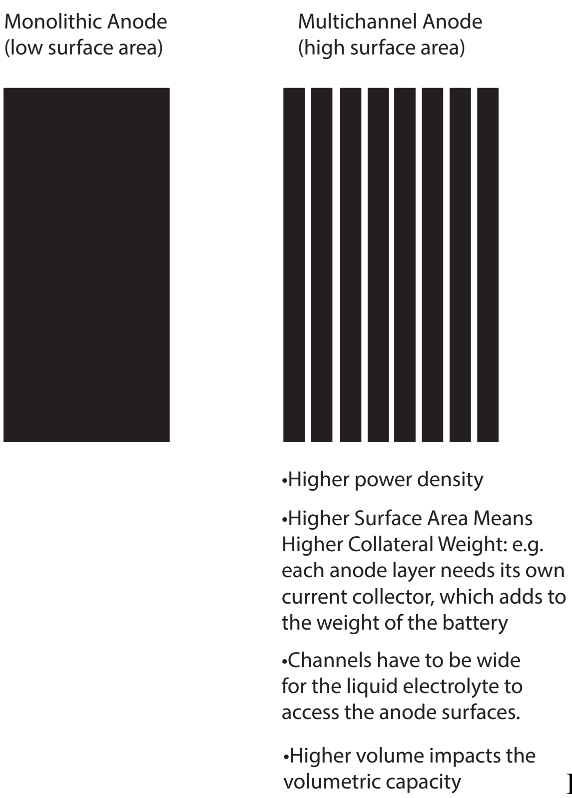
And its application to Li+ ion batteries (the Nernst Potential)

$$V = \frac{RT}{nF} \ell n \frac{a_{Li}^{A}}{a_{Li}^{C}}$$

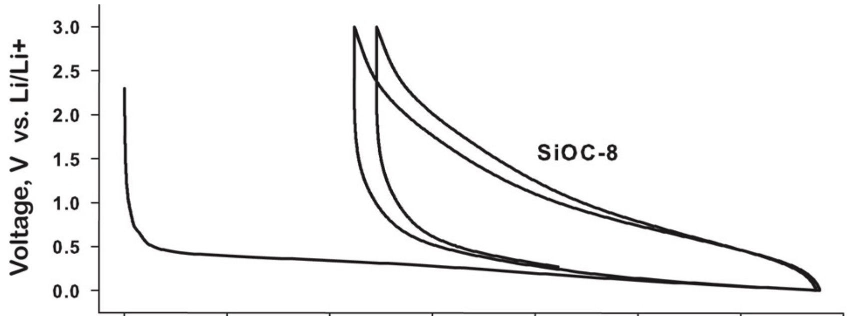


Energy and Power Density of Li ion batteries and a comparison with gasoline and the IC engine.

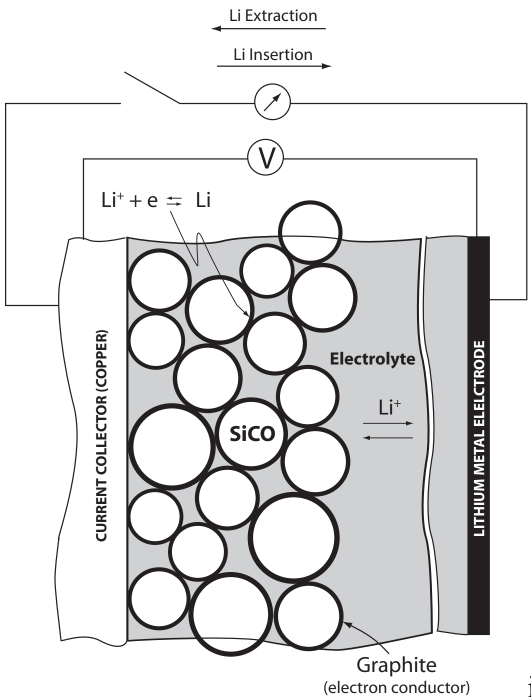
$$J = D_{Li} \frac{dC_{Li}}{dx}$$ The diffusion coefficient and its relevance to the Li+ battery.



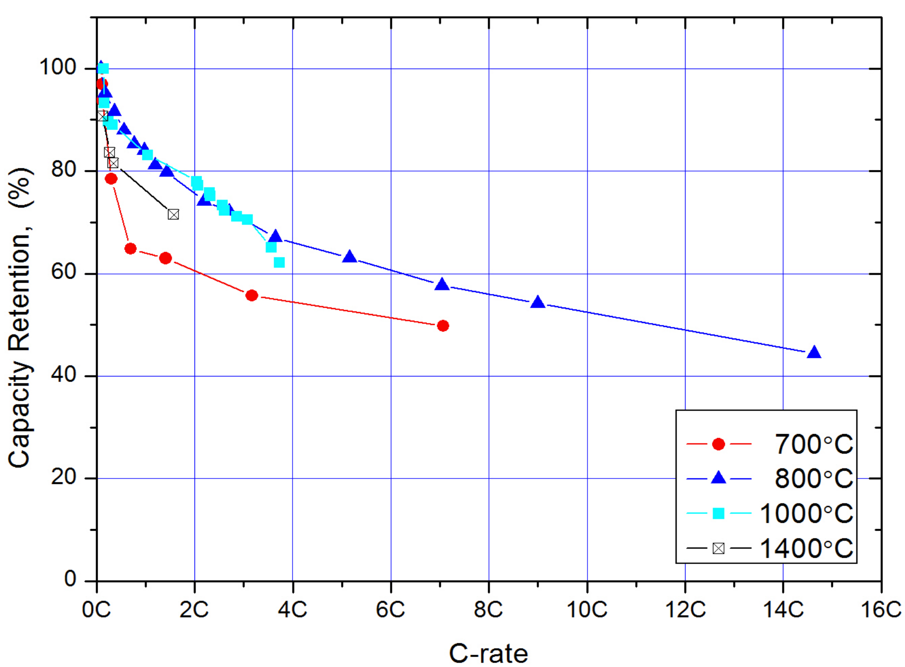
How the architecture of the anode can influence its power and energy density.



Fading: reduction of capacity with cycles.



influence of particle size on fading and C-rate



how the capacity can decline with C-rate (defined as the number of cycles per hour). In the figure above the curves represent different processing history of an anode material: but all show similar behavior.