Chemical Engineering 378

Science of Materials Engineering

Lecture 13

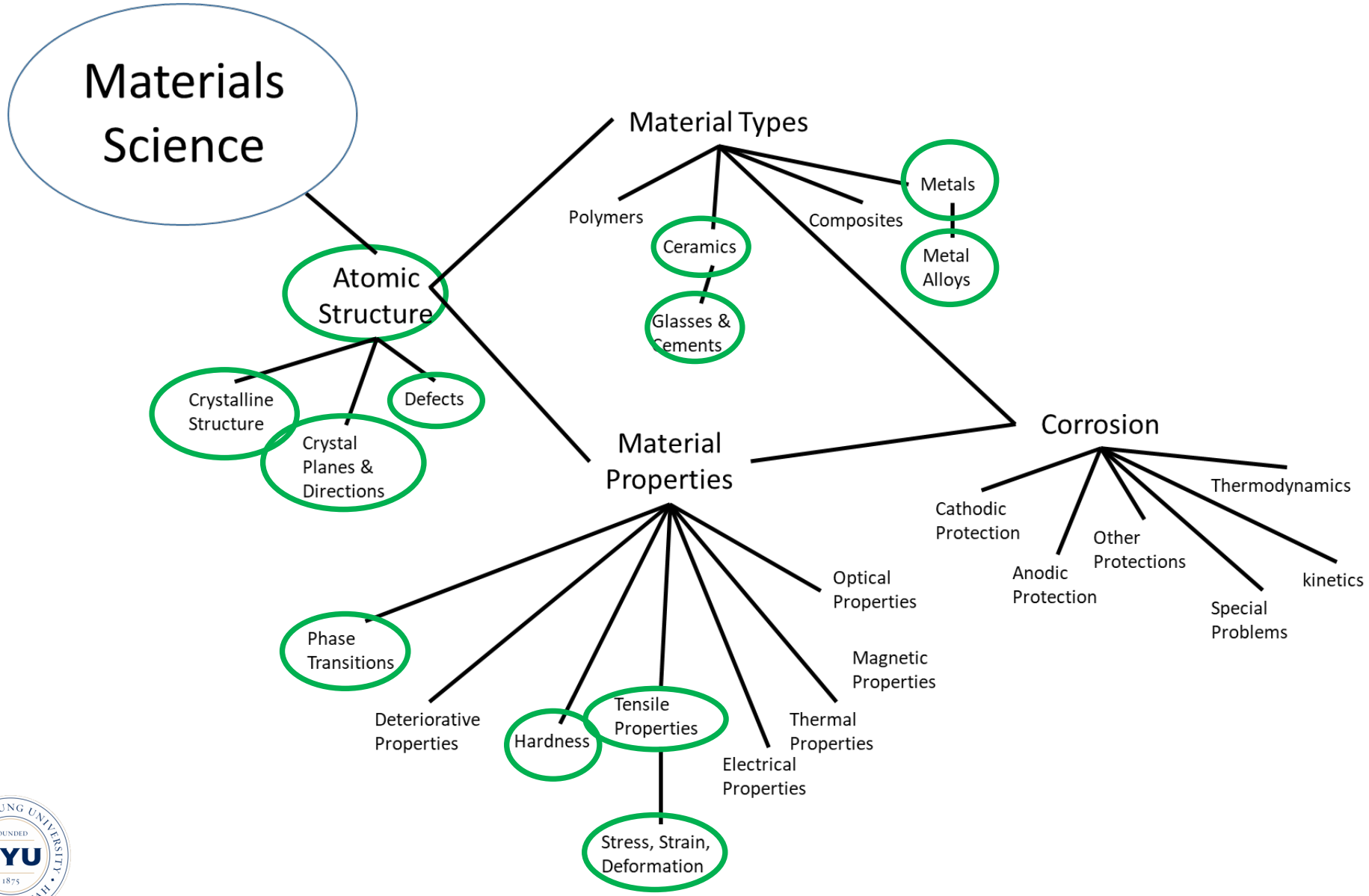
Exam 1 Review

Spiritual Thought

"Do we know what we have?"

-Gertrude Specht

Materials Roadmap



Whiteboard Artistic Competitions

- Draw a FCC unit Crystal
  - Draw a (1 2 1) on the FCC
- Draw a HCP unit Crystal
  - Draw [0 0 0 1] on the HCP
- Draw BCC unit crystal
  - Draw (1 0 2) on the FCC
- What is the linear atom density of chromium in the [111] direction
- What is the fraction of vacancies for a metal crystal with Qv = -0.5 eV/atom at a temperature of 1200° C? (k = 8.62E-5 eV/atom/K)

More Whiteboard Challenges

- What is the electron structure for Fluorine?
- What is the electron structure for Aluminum?
- How many valence electrons for Titanium?
- How many valence electrons for Carbon?
- Name 4 Types of primary bonding.
- What is an amorphous structure?
- Define Polycrystalline
- Define Polymorphic

Final Whiteboard Challenges

- Draw a stress-strain curve for a ductile and brittle metal on the same plot
- Draw an engineering stress-strain curve for a ductile metal, and then include as a dashed line the true stress-strain curve
- What is the resilience of a metal that linearly deforms to an elastic strain of 0.09 under a stress of 0.13 Gpa?
- What would the likely crystal structure for Lithium Bromide?

Example Problem 1

Kaladin Stormblessed has to walk a fine line in Kholinar; he needs enough Stormlight to grant healing, but not so much Stormlight that he could be discovered as a knight radiant. The challenge with Stormlight is that it diffuses through the skin where it can be seen as vapory wisps. Thus, if a concentration of .3 kg/m^3 is found on the outside of the skin, a discernable glow can be seen in daylight. Given the values of Stormlight listed below, and assuming his body volume is around 0.07 m^3, calculated how much Stormlight (in kg) Kaladin can take in before he is detected.

Skin Thickness	1 cm
Stormlight Diffusion Pre-exponential, D_o	1.3×10^{-4} m^2/s
Body Temperature	98.6 °F
Stormlight Activation Energy, Q_d	55 kJ/mol
Stormlight Flux through skin, J	2.2×10^{-8}

Example Problem 1 (cont)

Example Problem 2

- Batman is in a serious jam! Turns out Joker tied him up with steel bands, shut him in an insulated box, and placed a 1 m steel sword ($\alpha = 1.3 \times 10^{-5}$, $\rho = 805 g/cm^3$) so that it was just touching his belly. Batman does have access to his blow torch, which he can use to cut the bands on his hands and feet, but this would increase the temperature of the box by 100 ° C. Can Batman escape unscathed?