Chemical Engineering 378

Science of Materials Engineering

Lecture 23

Exam II Review

Spiritual Thought

"Through the lens of pure love, we see immortal beings of infinite potential and worth and beloved sons and daughters of Almighty God.

Once we see through that lens, we cannot discount, disregard, or discriminate against anyone."

-Dieter F. Uchtdorf

Open Ended Problem 1

Apparently, Shard Plate is a steel with 0.76% carbon content. When it was originally created by the Spren, they used Stormlight to keep it ductile. However, once Stormlight runs out, the shard plate shatters with any hit. Explain how this steel is made, and why its properties are the way they are.

Open Ended Problem 2

When Thanos is beating on Captain America's shield, it actually splits in two pieces! Assuming that the vibranium shield has several microcracks with crack lengths of 1, 4, and 10 μm, a modulus of elasticity of 300 GPA, and a surface energy of 2.5 J/m^2. Which of these cracks will propagate first, and with how much force does Thanos need to strike the shield to crack it?

Answers: 10 μm cracks will propagate first because they have the lowest critical stress.

σ_c = 218.5MPa, A = 1cm^2, thus F = 21,850 N !!

Game

- Draw a peritectoid
- What are 2 ways to harden a material?
- Draw a eutectoid
- What is recrystallization?
- Draw a eutectic
- What is strain hardening?
- What is σ_m?
- What is σ_c?

Game

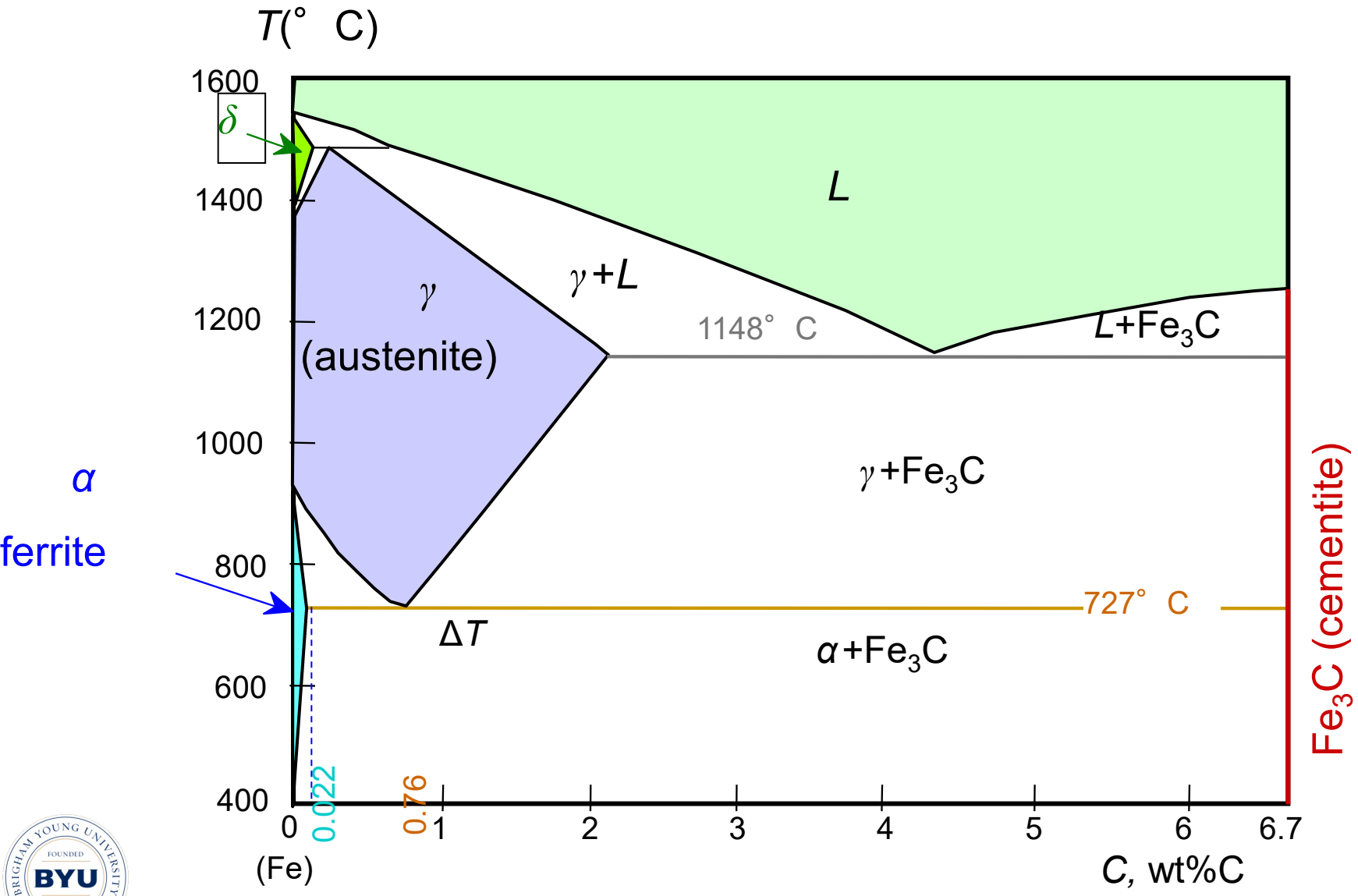
- What is the brittle to ductile transition temp?
- What are the features of brittle fracture?
- What are the feature of ductile fracture?
- What is creep?
- What is fatigue?
- What is strain hardening?
- What are 2 ways to improve fatigue life?
- List in order of ductility (low to high):

  Atactic, isotactic, syndiotactic

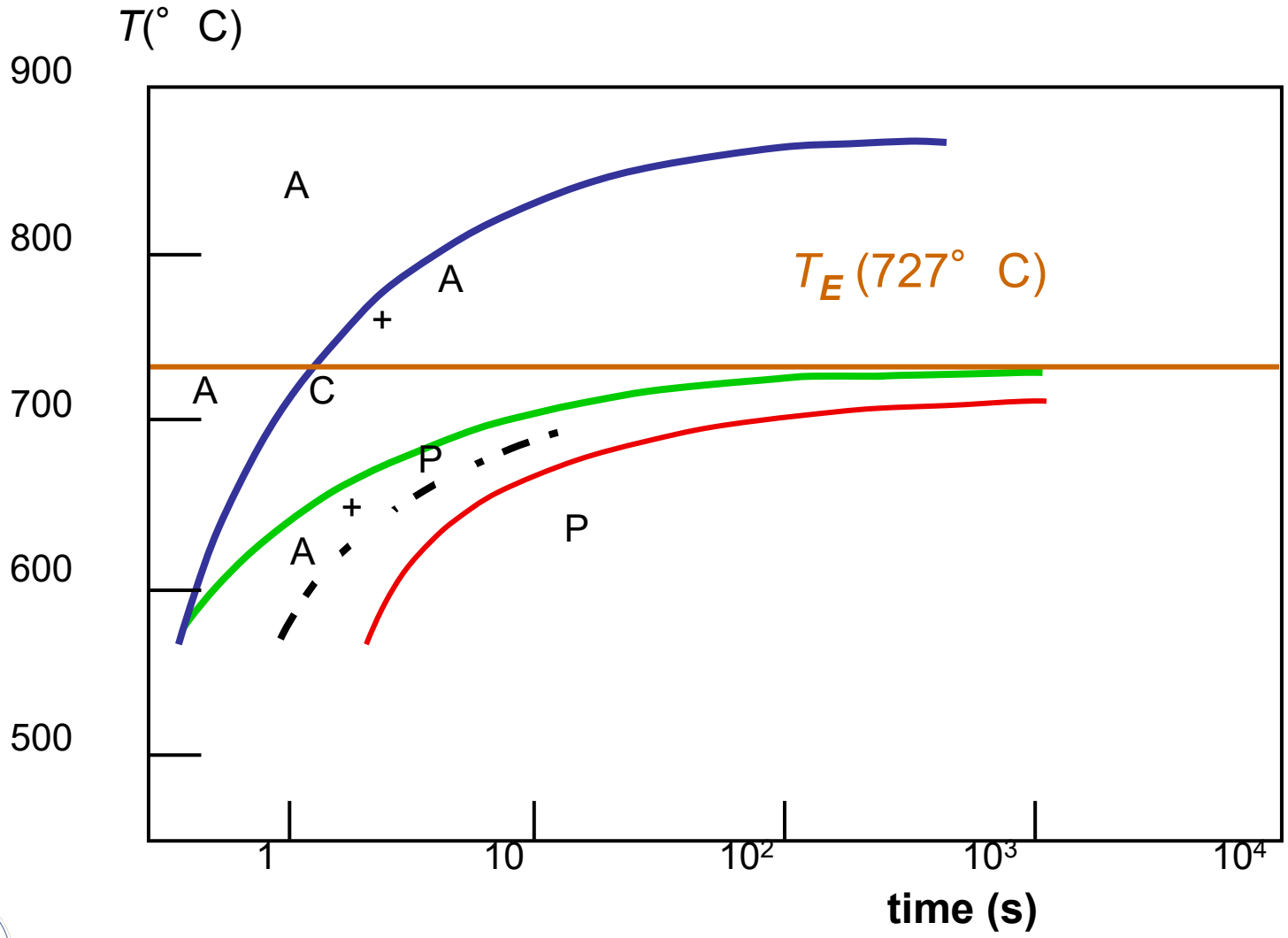
Game

- What is an elastomer?
- What is a polymer?
- Which of the following is most hard & brittle: crosslinked, branched, linear, network?
- T or F: the number and weight fractions of polymers is always the same.
- What is a thermoset?
- What is adhesion?
- What is cohesion?

Transformations & Undercooling



Proeutectoid Transformations



Transformation Diagram