Lecture 21

Thursday, May 22, 2008
8:22 PM

Ref:

1. G. Dieter, **Mechanical Metallurgy, 3rd Edition**, *McGraw-Hill*, 1986.
2. Reed-Hill, Abbaschian, **Physical Metallurgy Principles, 3rd Edition**, *PWS Publishing Company*, 1994.
3. R. J. Sanford, **Principles of Fracture Mechanics**, *Prentice Hall*, 2003.
4. T L Anderson, **Fracture Mechanics Fundamentals and Applications, 3rd Edition**, *Taylor & Francis*, 2005.

Course Notes:

1. We are going to hand your 2nd midterm back today -- after class.
2. Here is the breakdown (on first slide)
3. Based on the grade distribution, I'm giving you all 10 points. So therefore, take the score on the back of your exam and add 10 points to it, and that is the total percentage score that you will receive

4. I have been approached by several students looking for a possible extra credit assignment, and I'm going to give you one chance to improve your grade, if you are not happy with your current score. Here are the details:

   - The extra credit assignment will be worth 10% of your total grade (or will be equivalent to all of the homework combined). Enough to bump you from a D to a C, or a C to a B.
   - The extra credit will be given for making a 15 minute presentation
   - You will select a material's science topic of interest to you and submit your idea for approval by me.
   - You will independently research your topic and present a mini-lecture for 15 minutes with PowerPoint slides
   - I will grade the presentations based on the quality of the presentation and the accuracy and completeness with which you have covered the topic.
   - You will be awarded points, with the maximum equal to the 10% mentioned.
   - You will also hand me a hard copy of the PowerPoint at the beginning of your presentation.
   - The 15 minute presentations will all be on a Saturday June 7th starting at 10 am.
   - It is all voluntary – nobody has to sign up.
   - However, if a student signs up…then they must attend or I will doc them 5 points. (I don't want to waste a Saturday and I only want serious participation).
   - The participants will have to sit through everyone's presentation.
   - I will be asking questions.
   - If you are interested, you must send me an email by Wednesday May 28th, in which you declare that you will be attending and submitting your topic for approval

   These details will be posted on the website so that you can ponder it over the weekend. This is a good opportunity, and I hope you take advantage of it.

Review:

- Last time we began our discussion of Fracture and Failure
- We talked about the historical significance of Fracture Mechanics and Failure Analysis
- We then reviewed the point that materials can only respond in one of 3 ways when a stress is applied, they can: elastically deform, plastically deform, or they can fracture
- We discussed the Ludwik theory and the fracture vs. the flow curve
- We then dove into the details of cracking discussing the two types of fracture encountered in most structural materials: ductile fracture and brittle fracture
- We talked about how ductile fracture is created by microvoid formation and coalescence at locations of reduced plasticity in the crystalline matrix -- like at second phase particles. -- Remember we used the analogy of tearing chocolate chip cookie dough
- We saw the dimpled structure of a ductile crack in SEM images included in the class
- We talked about the formation of a necked region and a cup and cone configuration during at tensile test of a predominantly ductile metal
- We then switched our discussion and began talking about Brittle fracture mechanisms
- We talked about transgranular or intragranular cleavage, in which specific cleavage planes within a crystal enable easy separation of a crystal -- remember we used the analogy of a axe cutting wood.
- We looked at the cleavage fracture morphology both under a optical microscope and in an SEM
- We then talked about stress state and how a notch can create a triaxial stress state based on material constraint
- We briefly looked at intergranular fracture -- and discussed how usually it is related to some form of material degradation or environmental action in which the grain boundaries become a preferential crack path.
- We briefly introduced the art of fractography and how a fracture surface morphology can be read like a map to determine where a crack originated, and the state of stress under which it propagated.

Rest of Lecture is available in PowerPoint Presentation Paired with Lecture 21