Lecture 15

Sunday, May 04, 2008
3:33 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.

Course Notes:

- Don't forget to turn in your short lab reports for Lab 3 due in your TA's mailbox on the 4th Floor of Roberts
- You do have homework this week -- due on Friday
- The second exam is the Monday after next

Review:

- Last time we finished our discussion of cold working by talking about how cold working is strain hardening
  - dislocation tangles associated with applied stress
- We talked about the effects of cold work on the mechanical properties of a material
  - An increase in tensile strength, an increase in yield strength, a decrease in ductility
- We also mentioned that there is a small decrease in density (few 10^{ths} of a percent), a significant decrease in electrical conductivity, a small increase in the coefficient of thermal expansion, and an increase in chemical reactivity -- which can manifest as increased susceptibility to corrosion
- We discussed temperature effects on the stress strain curve -- and introduced dislocation climb to explain why increases in temperature increase ductility
- We talked about the stored strain energy after cold working
- We then starting talking about annealing -- heat treating to remove the dislocation structure created during cold work
- We talked about how there is a measurable release of energy upon heating a cold worked microstructure
- We mentioned that there are 3 stages to annealing -- Recovery, Recrystallization, and Grain Growth
- We detailed recovery -- how it is the "restoration of the physical properties of a cold worked metal without any observable change in microstructure"
- How on an crystalline scale, dislocation annihilation and polygonization occur during recovery
- We then discussed recrystallization -- how it is the replacement of the cold worked structure by the nucleation and growth of a new set of strain free grains
- During recrystallization we nucleate and grow new strain free grains which decreases the dislocation density, eliminates the strain hardening, reduces the strength, and returns the ductility
- The driving force for recrystallization is the release of the stored strain energy
- We discussed how recrystallization works and where it occurs
- We talked about the recrystallization temperature and how there were six main variables which influence recrystallization behavior including: the amount of prior deformation, the annealing temperature, the annealing time, the initial grain size (before cold work), the alloy composition, and the amount of recovery or polygonization that occurred prior to the start of recrystallization
- Therefore -- the recrystallization temperature is not a fixed temperature like melting point
- It is practically defined as the temperature at which recrystallization of a highly cold worked alloy is completed within 1 hour

Rest of Lecture is available in PowerPoint Presentation Paired with Lecture 15