

ENGR 240 Science of Materials

Homework 11

15 points. Due Wednesday, March 21, 2001

- [2 points] Sketch a BCC unit cell and a FCC unit cell. Within each unit cell, sketch one example of a slip system and specify the plane and direction in your drawings.
- [2 points] Why are materials with the HCP crystal structure usually more brittle than BCC or FCC metals? How do you think the ductility of BCT (body centered tetragonal) crystals would compare with BCC and FCC crystals? Explain your answer.
- [3 points] A plate of annealed (unworked) copper with an initial cross-sectional area of $A_0 = 500 \text{ mm}^2$ is cold rolled to a cross-sectional area of 400 mm^2 and then to a cross-sectional area of 200 mm^2 .
 - Calculate the percent cold work for each of the two rolling steps (based on the initial thickness).
 - Based on Figure 7.19 in Callister, estimate the tensile strength after each of the two rolling steps.
 - Compare the tensile strengths of the rolled copper to the strength of annealed copper by calculating the percent increase in the strength due to the two cold rolling steps.
- [2 points] Callister Problem 7.19 – grain boundary strengthening.
- [2 points] Use a graphing program such as Excel to plot yield strength (in MPa) versus grain size (in μm) for jewelry bronze with grain sizes of 1 to $100 \mu\text{m}$. For strength given in MPa and grain size in μm , the constants σ_0 and k for jewelry bronze are 200 MPa and 300, respectively. Jewelry bronze has a composition of 87.5% Cu and 12.5% Zn (in case you were wondering).
- [2 points] Is it possible to strengthen lead by cold rolling at room temperature? Explain your answer.
- [1 point] How does increasing percent cold work affect the recrystallization temperature?
- [1 point] Would the recrystallization temperature for pure Cu be higher or lower than the recrystallization temperature for a Cu-Zn brass alloy?