Material Science
Homework 4
Due Tuesday Nov. 27, 2018

1. One slip system for the HCP crystal structure is {0001} <11$\bar{2}$0>. In a manner similar to Figure 9.6b, sketch a {0001}-type plane for the HCP structure and, using arrows, indicate three different <11$\bar{2}$0> slip directions within this plane.

2. Sometimes $\cos\varphi\cos\lambda$ in Equation 9.2 is termed the Schmid factor. Give schematic drawings and prove Schmid factor.

3. A single crystal of a metal that has the FCC crystal structure is oriented such that a tensile stress is applied parallel to the [110] direction. If the critical resolved shear stress for this material is 1.75 MPa, calculate the magnitude(s) of applied stress(es) necessary to cause slip to occur on the (111) plane in each of the [$\bar{1}$10], [10$\bar{1}$] and [0$\bar{1}$1] directions.

4. (1) From the plot of yield strength versus (grain diameter)$^{-1/2}$ for a 70 Cu–30 Zn cartridge brass, Figure 9.15, determine values for the constants σ_0 and k_y in Equation 9.7.
   (2) Now predict the yield strength of this alloy when the average grain diameter is 1.0×10^{-3} mm.

5. In the manner of Figures 9.17b and 9.18b, indicate the location in the vicinity of an edge dislocation at which an interstitial impurity atom would be expected to be situated. Now briefly explain in terms of lattice strains why it would be situated at this position

6. Briefly explain why small-angle grain boundaries are not as effective in interfering with the slip process as are high-angle grain boundaries.

7. List four strengthening mechanisms discussed in this class.

8. (a)What are the driving force for (1)recrystallization and (2)grain growth?
   (b)Briefly cite the differences between recovery and recrystallization processes.