Material Science
Homework 2
Due Tuesday Oct 23, 2018

1. (a) Would you expect Frenkel defects for anions to exist in ionic ceramics in relatively large concentrations? Why or why not? (Problem 6.4)
   (b) Cite the relative Burgers vector–dislocation line orientations for edge, screw, and mixed dislocations. (Problem 6.34)
   (c) Which grain boundary energy is larger, the small-angle one or the high-angle one? Why is this so?

2. Calculate the activation energy for vacancy formation in aluminum, given that the equilibrium number of vacancies at 500°C is 7.57×10^{23} m^{-3}. The atomic weight and density (at 500°C) for aluminum are, respectively, 26.98 g/mol and 2.62 g/cm^3. (Problem 6.3)

3. Some hypothetical alloy is composed of 12.5 wt% of metal A and 87.5 wt% of metal B. If the densities of metals A and B are 4.27 and 6.35 g/cm^3, respectively, and their respective atomic weights are 61.4 and 125.7 g/mol, determine whether the crystal structure for this alloy is simple cubic, FCC, or BCC. Assume a unit cell edge length of 0.395 nm. (Problem 6.26)

4. Silver and palladium both have the FCC crystal structure, and Pd forms a substitutional solid solution for all concentrations at room temperature. Compute the unit cell edge length for a 75 wt% Ag–25 wt% Pd alloy. The room-temperature density of silver and palladium are 10.49 g/cm^3 and 12.02 g/cm^3, respectively. Atomic weight of silver and palladium are 107.9 g/mol and 106.4 g/mol, respectively. Atomic radius of palladium is 0.138 nm. (Problem 6.33)

5. For both FCC and BCC crystal structures, there are two different types of interstitial sites. In each case, one site is larger than the other, and is normally occupied by impurity atoms. For FCC, this larger one is located at the center of each edge of the unit cell; it is termed an octahedral interstitial site. On the other hand, with BCC the larger site type is found at $0\,\frac{1}{2}\,\frac{1}{4}$ positions—that is, lying on {100} faces, and situated midway between two unit cell edges on this face and one-quarter of the distance between the other two unit cell edges; it is termed a tetrahedral interstitial site. For both FCC and BCC crystal structures, compute the radius ***r*** of an impurity atom that will just fit into one of these sites in terms of the atomic radius ***R*** of the host atom. (Problem 6.10)