HW 3

4.1 The equilibrium fraction of lattice sites that are vacant in silver (Ag) at 700°C is 2 x 10^-6. Calculate the number of vacancies (per meter cubed) at 700°C. Assume a density of 10.35 g/cm^3 for Ag.

4.7 Which of the following systems (i.e., pair of metals) would you expect to exhibit complete solid solubility? Explain your answers.

(a) Cr-V

(b) Mg-Zn

(c) Al-Zr

(d) Ag-Au

(e) Pb-Pt

4.14 What is the composition, in atom percent, of an alloy that consists of 5.5 wt% Pb and 94.5 wt% Sn?

4.30 Consider an iron-carbon alloy that contains 0.2 wt% C, in which all the carbon atoms reside in tetrahedral interstitial sites. Compute the fraction of these sites that are occupied by carbon atoms.

4.40 For a BCC single crystal, would you expect the surface energy for a (100) plane to be greater or less than that for a (110) plane? Why?

5.3 (a) Compare interstitial and vacancy atomic mechanisms for diffusion.

(b) Cite two reasons why interstitial diffusion is normally more rapid than vacancy diffusion.

5.19 For a steel alloy it has been determined that a carburizing heat treatment of 15 h duration will raise the carbon concentration to 0.35 wt% at a point 2.0 mm from the surface. Estimate the time necessary to achieve the same concentration at a 6.0-mm position for an identical steel and at the same carburizing temperature.

5.20 Cite the values of the diffusion coefficients for the interdiffusion of carbon in both α-iron (BCC) and γ-iron (FCC) at 900°C. Which is larger? Explain why this is the case.

5.26 The activation energy for the diffusion of copper in silver is 193,000 J/mol. Calculate the diffusion coefficient at 1200 K (927°C), given that D at 1000 K (727°C) is 1.0 × 10–14 m^2/s.

5.41 An FCC iron–carbon alloy initially containing 0.10 wt% C is carburized at an elevated temperature and in an atmosphere in which the surface carbon concentration is maintained at 1.10 wt%. If after 48 h the concentration of carbon is 0.30 wt% at a position 3.5 mm below the surface, determine the temperature at which the treatment was carried out