

4.17 This problem asks that we determine the unit cell edge length for a 80 wt% Ag-20 wt% Pd alloy. In order to solve this problem it is necessary to employ Equation 3.5; in this expression density and atomic weight will be averages for the alloy—that is

$$\rho_{\text{ave}} = \frac{nA_{\text{ave}}}{V_C N_A}$$

Inasmuch as the unit cell is cubic, then $V_C = a^3$, then

$$\rho_{\text{ave}} = \frac{nA_{\text{ave}}}{a^3 N_A}$$

And solving this equation for the unit cell edge length, leads to

$$a = \left(\frac{nA_{\text{ave}}}{\rho_{\text{ave}} N_A} \right)^{1/3}$$

Expressions for A_{ave} and ρ_{ave} are found in Equations 4.11a and 4.10a, respectively, which, when incorporated into the above expression yields

$$a = \left[\frac{n \left(\frac{100}{\frac{C_{\text{Ag}}}{A_{\text{Ag}}} + \frac{C_{\text{Pd}}}{A_{\text{Pd}}}} \right)}{\left(\frac{100}{\frac{C_{\text{Ag}}}{\rho_{\text{Ag}}} + \frac{C_{\text{Pd}}}{\rho_{\text{Pd}}}} \right) N_A} \right]^{1/3}$$

Since the crystal structure is FCC, the value of n in the above expression is 4 atoms per unit cell. The atomic weights for Ag and Pd are 107.9 and 106.4 g/mol, respectively (Figure 2.6), whereas the densities for the Ag and Pd are 10.49 g/cm³ (inside front cover) and 12.02 g/cm³. Substitution of these, as well as the concentration values stipulated in the problem statement, into the above equation gives