4.D2 This problem asks that we determine the concentration (in weight percent) of Cu that must be added to Pt so as to yield a unit cell edge length of 0.390 nm. To begin, it is necessary to employ Equation 3.5, and solve for the unit cell volume, V_C, as

$$V_C = \frac{nA_{\text{ave}}}{\rho_{\text{ave}} N_{\text{A}}}$$

where A_{ave} and ρ_{ave} are the atomic weight and density, respectively, of the Pt-Cu alloy. Inasmuch as both of these materials have the FCC crystal structure, which has cubic symmetry, V_C is just the cube of the unit cell length, a. That is

$$V_C = a^3 = (0.390 \text{ nm})^3$$

$$(3.90 \times 10^{-8} \text{ cm})^3 = 5.932 \times 10^{-23} \text{ cm}^3$$

It is now necessary to construct expressions for A_{ave} and ρ_{ave} in terms of the concentration of vanadium, C_{Cu}, using Equations 4.11a and 4.10a. For A_{ave} we have

$$A_{\text{ave}} = \frac{100}{\dfrac{C_{\text{Cu}}}{A_{\text{Cu}}} + \dfrac{(100 - C_{\text{Cu}})}{A_{\text{Pt}}}}$$

$$= \frac{100}{\dfrac{C_{\text{Cu}}}{63.55 \text{ g/mol}} + \dfrac{(100 - C_{\text{Cu}})}{195.08 \text{ g/mol}}}$$

whereas for ρ_{ave}

$$\rho_{\text{ave}} = \frac{100}{\dfrac{C_{\text{Cu}}}{\rho_{\text{Cu}}} + \dfrac{(100 - C_{\text{Cu}})}{\rho_{\text{Pt}}}}$$

$$= \frac{100}{\dfrac{C_{\text{Cu}}}{8.94 \text{ g/cm}^3} + \dfrac{(100 - C_{\text{Cu}})}{21.45 \text{ g/cm}^3}}$$