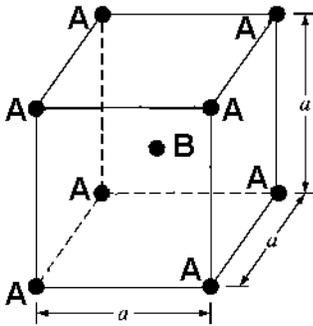


**1.13** (a) Consider the materials described in Problem 1.12(a) and 1.12(b). For each case, calculate the surface density of A atoms and B atoms in the (100) plane. What comparison can be made of the two materials? (b) Repeat part (a) for the (110) plane.

**1.12** (a) A material is composed of two types of atoms. Atom A has an effective radius of 2.2 Å and atom B has an effective radius of 1.8 Å. The lattice is a bcc with atoms A at the corners and atom B in the center. Determine the lattice constant and the volume densities of A atoms and B atoms. (b) Repeat part (a) with atoms B at the corners and atom A in the center. (c) What comparison can be made of the materials in parts (a) and (b)?

a)

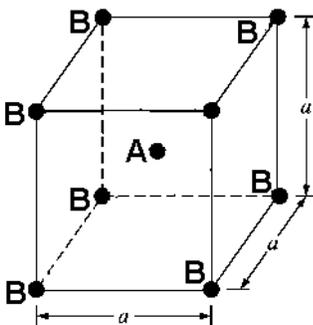


For the bcc lattice w/ atom B in the center, the (1 0 0) plane (i.e., the front face) has 4 corners (1/4 A atom/corner) = 1 A atom.

From 1.12a,  $a = 4.6188 \text{ \AA}$ . The surface density is then

$$asd_A = 1 \text{ atom} / a^2 = 1 / (4.6188 \times 10^{-10} \text{ m})^2 = 4.6875 \times 10^{18} \text{ atoms/m}^2$$

$$\Rightarrow \underline{asd_A = 4.6875 \times 10^{14} \text{ atoms/cm}^2}$$



For the bcc lattice w/ atom A in the center, the (1 0 0) plane (i.e., the front face) has 4 corners (1/4 B atom/corner) = 1 B atom.

From 1.12b,  $a = 4.6188 \text{ \AA}$ . The surface density is then

$$asd_B = 1 \text{ atom} / a^2 = 1 / (4.6188 \times 10^{-10} \text{ m})^2 = 4.6875 \times 10^{18} \text{ atoms/m}^2$$

$$\Rightarrow \underline{asd_B = 4.6875 \times 10^{14} \text{ atoms/cm}^2}$$

b) For the bcc lattice w/ atom B in the center, the (1 1 0) plane (i.e., front left edge to back right edge plane) has

4 corners (1/4 A atom/corner) + 1 B atom in middle = 1 A + 1 B atom.

From 1.12a,  $a = 4.6188 \text{ \AA}$ . The surface density is then

$$asd_A = asd_B = 1 \text{ atom} / [a\sqrt{2}a] = 1 / [\sqrt{2} (4.6188 \times 10^{-10} \text{ m})^2] = 3.3146 \times 10^{18} \text{ atoms/m}^2$$

$$\Rightarrow \underline{asd_A = asd_B = 3.3146 \times 10^{14} \text{ atoms/cm}^2}$$

For the bcc lattice w/ atom A in the center, the (1 1 0) plane (i.e., front left edge to back right edge plane) has 4 corners (1/4 B atom/corner) + 1 A atom = 1 A + 1 B atom.

From 1.12b,  $a = 4.6188 \text{ \AA}$ . The surface density is then

$$asd_A = asd_B = 1 \text{ atom} / [a\sqrt{2}a] = 1 / [\sqrt{2} (4.6188 \times 10^{-10} \text{ m})^2] = 3.3146 \times 10^{18} \text{ atoms/m}^2$$

$$\Rightarrow \underline{asd_A = asd_B = 3.3146 \times 10^{14} \text{ atoms/cm}^2}$$

c) The materials in parts a and b are the same!