Prob. 1.7

Draw <110> direction of diamond lattice.

This view is tilted slightly from (110) to show the alignment of atoms. The open channels are hexagonal along this direction.
Prob. 1.4

*Calculate densities of Si and GaAs.*

The atomic weights of Si, Ga, and As are 28.1, 69.7, and 74.9, respectively.

**Si:**

\[
\frac{8 \text{ atoms}}{a^3} = \frac{8}{(5.43 \times 10^{-8} \text{ cm})^3} = 5.0 \times 10^{31} \frac{\text{atom}}{\text{cm}^3}
\]

\[
\text{density} = \frac{5.0 \times 10^{31} \frac{\text{atom}}{\text{cm}^3} \times 28.1 \frac{\text{g}}{\text{atom}}}{6.02 \times 10^{23} \frac{\text{mol}}{\text{atom}}} = 2.33 \frac{\text{g}}{\text{cm}^3}
\]

**GaAs:**

\[
\frac{4 \text{ atoms}}{a^3} = \frac{4}{(5.65 \times 10^{-8} \text{ cm})^3} = 2.22 \times 10^{22} \frac{\text{atom}}{\text{cm}^3}
\]

Prob. 1.12

*Find packing fraction of fcc unit cell.*

- **nearest atom separation** = \( \frac{\sqrt{2}}{2} A = 3.54 \text{Å} \)
- **tetrahedral radius** = 1.77Å
- **volume of each atom** = 23.14Å³
- **number of atoms per cube** = \( 6 \times \frac{1}{8} + 8 \times \frac{1}{8} = 4 \text{ atoms} \)
- **packing fraction** = \( \frac{23.14Å³ \times 4}{(5Å)^3} = 0.74 = 74\% \)

Prob. 1.12

*Find atoms/cell and nearest neighbor distance for sc, bcc, and fcc lattices.*

**sc:**

- **atoms/cell** = \( 8 \times \frac{1}{8} = 1 \)
- **nearest neighbor distance** = \( a \)

**bcc:**

- **atoms/cell** = \( 8 \times \frac{1}{8} + 1 = 2 \)
- **nearest neighbor distance** = \( a \sqrt{3} \)

**fcc:**

- **atoms/cell** = \( 8 \times \frac{1}{8} + 6 \times \frac{1}{8} = 4 \)
- **nearest neighbor distance** = \( a \sqrt{2} \)