COLLEGE OF ENGINEERING & TECHNOLOGY

Campus : Smart Village Campus

Department : Electronics and Communications

Course : Solid State Electronics

Course Code: EC210

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Sheet (1) – Crystal Structure

1. The atomic weight of silver = **108 g/mol**, and its lattice parameter a = **4.077 ^{0}A**. Find the **density of silver** if it has a F.C.C structure.

2. Copper has a F.C.C structure and its atomic radius is **1.278 ^{0}A**. Calculate **its density**, given that the atomic weight of Copper is **63.54 g/mol**.

3. Aluminum (Al) has a density of about **2699 Kg/m^3**. Its atomic weight is **26.97 g/mol**.

- **a.** **How many atoms** contained in **1 m^3** of the solid approximately.
- **b.** Calculate **the volume of the unit cube** for this F.C.C metal.
- **c.** Calculate **the atomic radius** of Al.
- **d.** Calculate **the mass of a single atom** of Al.

4. Iron is a B.C.C. below **910^{0}C** and is a F.C.C. above **910 ^{0}C**, the fractional change in density accompanying the transition from the B.C.C. phase to the F.C.C. phase is **1.0%**. Calculate **the ratio of the atomic radius** in the two phases.

5. NaCl crystals have a density of **2.18 g/ cm^3**. Calculate **the distance between two nearest adjacent atoms**. Given that the atomic weight of Na = **23 g/mol**, the atomic weight of Cl = **35.5 g/mol**, and Avogadro`s Number = **6.02×10^{23}** atoms per mol.

6. If the density of NaCl is **2.163 g/cm^3**, and its molecular weight is **58.45 g/mol**. Find **the spacing between the cubic lattice faces of the NaCl**. Given that Avogadro`s Number is **6.02×10^{23}** atoms per mol.

7. **a. Draw the unit cells of Si and GaAs** (Shade the Ga and As atoms differently).

b. What is **the distance** between nearest atoms of Si.

8. Calculate **the densities of Ge and GaP** where the lattice constants are **5.66^{0}A** and **5.45^{0}A**, respectively, the atomic weight of Ge is **72.59 g/mol**, Ga is **69.72 g/mol**, and P is **30.97 g/mol**.

9.

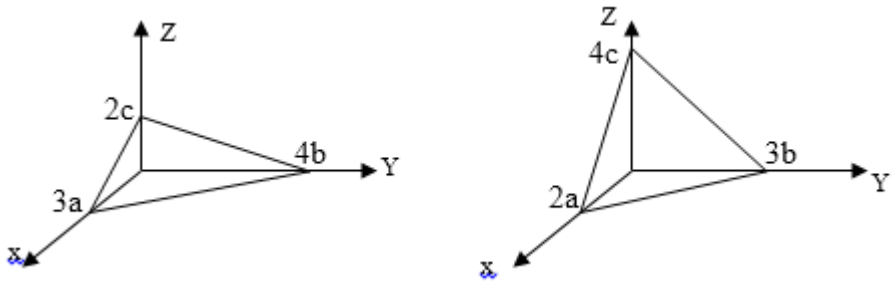
- **a.** Show that the maximum fraction of unit cell volume, which can be filled by hard spheres in the SC,BCC, FCC, and diamond lattices are **0.52, 0.68, 0.74**, and **0.34**, respectively.
- **b.** Show that for the atomic packing factor of the Face Centered Cubic (FCC), Body Centered Cubic (BCC), Simple Cubic (SC) and Diamond lattices are approximately in the ratio of **1.4 :1.3:1: 0.65**.

10. Obtain **the Miller indices** of a plane which intercepts x, y, and z axes at **a, b/2, and 3c,** respectively in a simple cubic unit cell.

11. Sketch the **(112) and (101) planes** in a simple cubic cell.

12. Draw the **(110) and (121)** planes and the **[110] and [121]** directions in a simple cubic crystal.

13. Label the planes shown below:



14. Lead is a F.C.C structure with an atomic radius **r = 1.746 ^{0}A**. Find the spacing of:

- **a. (200) planes.**
- **b. (212) planes.**
- **c. (111) planes.**

15. If Nickel has a F.C.C structure and its atomic radius r = **1.243×10^{-10} m**. Find d_{201}, d_{200}, d_{112}.

16. In a unit cell of simple cubic structure, find the angle between the normal to pair of planes whose Miller indices are:

- **a.** (100) and (121).
- **b.** (121) and (111).