1. Calculate the volume density of Si atoms (number of atoms/cm3), given that the lattice constant of Si is 5.43 Å. Calculate the areal density of atoms (number/cm2) on the (100) plane.

   Si has FCC structure.

   Number of atoms inside the unit cell = 1+ 6*1/2 = 4

   Volume of unit cell = a^3 = (5.43*10^-8)^3 = 1.6 * 10^(-22) cm3

   Volume Density = Number of atoms inside the unit cell/ Volume of unit cell

   = 8/(1.6 * 10^(-22)) = 5 * 10 ^22 atoms/cm^3

   Determine the area of the (100) plane

   The area of the (100) plane corresponds to a square with sides equal to the lattice constant a.

   Area = a^2 = (5.43*10^(-8))^2 = 2.95 * 10^(-15) cm^2

   Calculate the number of atoms on the (100) plane

   In the FCC structure, the (100) plane contains 2 atoms per unit cell surface.

   Areal Density = Number of atoms on the (100) plane / Area of the (100) plane = 2/2.95 * 10^(-15) cm^2 = 6.78 * 10^(14) atoms /cm^2

2. Calculate the volume density of Ge atoms (number of atoms per cm^3), given that the lattice constant of Ge is 5.66 Å. Additionally, calculate the areal density of atoms (number per cm^2) on the (110) plane.

   Ge has FCC structure. The number of atoms per unit cell is 8.

   Calculate the volume of the unit cell : =

   Calculate the volume density : =

   Determine the area of the (110) plane

   For the (110) plane, the area is determined by the product of the lattice constant a and the diagonal length in the plane, which is

   = = =

   Calculate the number of atoms on the (110) plane

   The (110) plane in a diamond cubic structure contains 4 atoms per unit cell surface.

   Calculate the areal density

3. Calculate the volume density of GaAs atoms (number of atoms per cm^3), given that the lattice constant of GaAs is 5.65 Å. Additionally, calculate the areal density of atoms (number per cm^2) on the (111) plane.

   GaAs has FCC structure. The number of atoms per unit cell is 8.

   Calculate the volume of the unit cell : =

   Calculate the volume density : =

   Determine the area of the (111) plane

   For the (111) plane, the area is determined by the product of the lattice constant a and the diagonal length in the plane, which is

   = =

   Calculate the number of atoms on the (111) plane

   The (111) plane in a zinc blende structure contains 2 atoms per unit cell surface.

   Calculate the areal density

4. A body-centered cubic lattice has a lattice constant of 4.83 Å. A plane cutting the lattice has intercepts of 9.66 Å, 19.32 Å, and 14.49 Å along the three cartesian coordinates. What are the Miller indices of the pane?

   Identify the intercepts of the plane with the x, y, and z axes. The given intercepts are 9.66 Å, 19.32 Å, and 14.49 Å.

   Express the intercepts in terms of the lattice constant , a = 4.83 Å

   9.66/4.83 = 2 , 19.32/4.83 = 4, 14.49/4.83 = 3

   Take the reciprocals of these fractional intercepts:

   1/2 1/4 1/3

   Clear the fractions by finding a common multiple, typically the least common multiple (LCM) of the denominators:

   The LCM of 2, 4, and 3 is 12

   Multiplying each reciprocal by 12: h= 6, k = 3, l = 4

   Miller indices = (6,3,4)

5. The lattice constant of a single crystal is 4.73 Å. Calculate the surface density (#/cm2) of atoms on the (i) (100), (ii) (110). Assume a simple cubic structure.

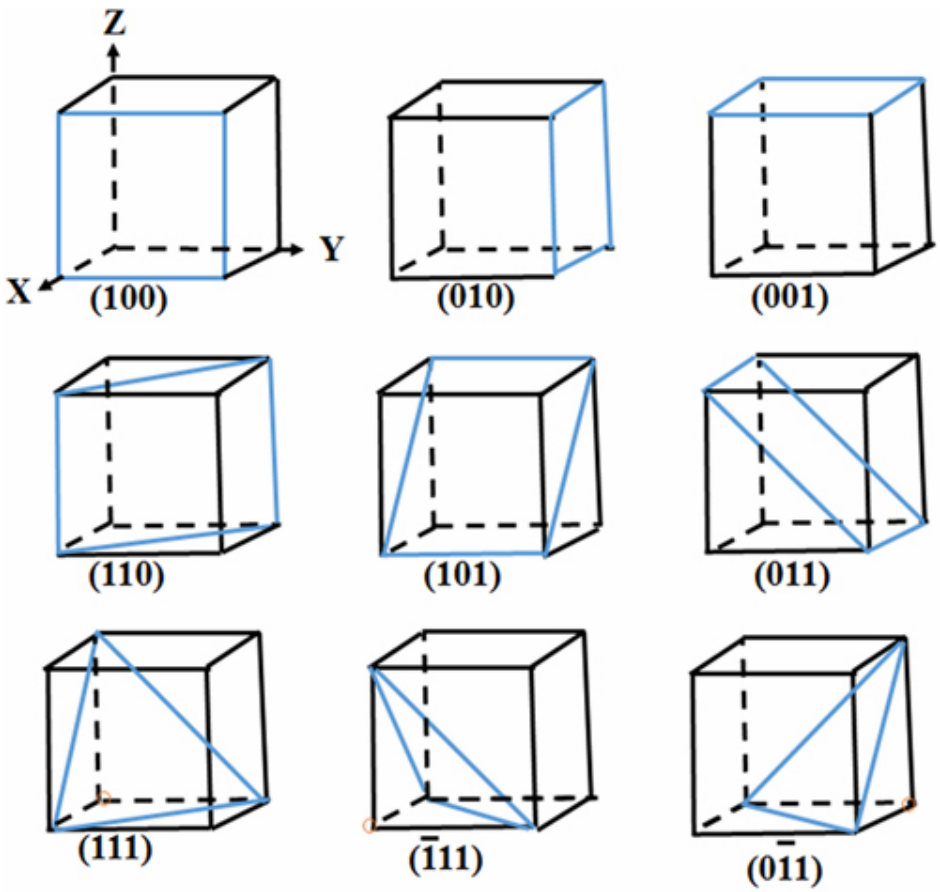
   a = 4.73A˚ =

   (i) The surface density on the (100) plane is the number of atoms per unit area on this plane.

Area of the (100) Plane :

Number of Atoms on the (100) Plane : The (100) plane contains 1 atom per unit cell surface

Surface Density on the (100) Plane :



(ii) Area of the (110) Plane :

Number of Atoms on the (110) Plane : The (100) plane contains 2 atom per unit cell surface

Surface Density on the (110) Plane :