

## Solid State Physics- SSP

### Crystal Structure (T-Sheet 1) M.A.Shah

1. Find the maximum radius of interstitial sphere that can just fit into the void at  $(1/2, 1/2, 1/2)$  between the body centered atoms of bcc structure.
2. Lead is fcc and its atomic radius is 0.175nm. What is its volume, its face and body diagonal in a unit cell.
3. Zinc has hcp structure and the height of the unit cell is 0.494nm. The nearest neighbor distance is 0.27nm. The atomic weight of zinc is 65.37. Calculate the volume of unit cell and density of zinc.
4. How many atoms per  $\text{mm}^2$  surface area are there in (1 0 0) plane, (1 1 0) and (1 1 1) plane for lead which has fcc structure. The radius of atom is 0.174nm.
5. show that for a simple cubic lattice  $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$
6. Show that the spacing  $d_{111}$  is approximately 1.2 times the spacing  $d_{200}$  in lead which has fcc structure. The radius of lead atom is 0.1743nm.
7. The  $\langle 101 \rangle$  family of directions includes what individual directions (a) in a cubic crystal (b) in a tetragonal crystal.
8. How many atoms per  $\text{mm}^2$  are there on the (100) planes of lead (fcc).
9. Find Miller indices of a set of parallel planes which makes intercepts in the ratio 3a: 4b on the X-axis and Y -axis and parallel to the Z-axis, a,b,c being primitive vectors of lattice.
10. A plane includes points 0,0,0:  $1/2, 1/4, 0$  and  $1/2, 0, 1/2$ . What are its miller indices?
11. What directions is the line of intersections of the (111) and  $(1 \bar{1} 1)$  planes.
12. The fraction of vacancy sites in a metal is  $1 \times 10^{-10}$  at  $500^\circ\text{C}$ . What will be the fraction of vacancy sites at  $1000^\circ\text{C}$ ?
13. Mg has hcp structure. The radius of magnesium atom is 0.1605nm. Calculate the volume of unit cell in Magnesium.
14. The unit cell of chromium is cubic and the density is 7.19  $\text{Mg}/\text{m}^3$ . Determine the dimension of chromium unit cell.
15. Copper has an fcc metal structure with an atomic radius of 0.1278nm. Cal its density. Cal the vol of the unit cell of LiF, which has the same fcc structure as does NaCl.
16. Assume spherical atoms. What is the c/a ratio of hcp metal.
17. Sketch a no cubic unit cell. Show that the location of points that have the following coefficients. 0,0,0    0,0,1/2     $1/2, 1/2, 1/2$      $1/2, 1/2, 0$     1,1,0    1,1,1    1,1,2
18. Calculate the glancing angle on the plane (110) of a cube of rock salt ( $a = 0.281$ ) nm corresponding to second order diffraction maximum for the x rays of wavelength 0.071nm.
19. X -rays of unknown wavelength are diffracted  $43.40^\circ$  by a copper fcc, whose lattice constants a is 0.3615nm. Separate determinations indicate that this diffraction line for copper is of the first order  $n = 1$  line for  $d_{111}$ .  
(a) what is wavelength (b) the same x-rays are used to analyze tungsten (bcc) . what is angle  $2\theta$ , for the second order  $n = 2$  diffraction lines of the  $d_{010}$  spacing.
20. Prove the statement that in determining the lattice parameters, the greater is the diffraction angle greater is the accuracy.