MT 250 Metallurgical Concepts

Physical Metallurgy

Home Assignment 1 (Due 5.9.2003)

1. Enumerate, and sketch, all the two-dimensional lattices.

2. Show that a base-centered tetragonal lattice is equivalent to a simple tetragonal lattice. On similar lines, what is the equivalent of base-centred cubic lattice?

3. For special values of α, the angle between any two of the lattice basis vectors (**a, b, c**), the rhombohedral lattice becomes (i) simple cubic, (ii) body-centered cubic, and (iii) face-centered cubic. Find these angles.

4. Identify the rotation axes and mirror planes in each of the 7 crystal classes in three dimensions.

5. Sketch the atomic arrangement in the (100), (110) and (111) planes of simple cubic, *fcc,* and *bcc* crystals.

6. Which of the the following points (given by the position vectors) lie in the (111) lattice planes in a simple cubic lattice:
   a. 0,0,0
   b. 1/2, 0, 0
   c. 1/2, 0, 1/2
   d. 1/2, 1/2, 1/2

7. In a cubic crystal, sketch and identify the Miller indices of the plane passing through the points given by the position vectors:
   0,0,0
   0,1,1
   1,0,1

8. Which members of the $\langle 111 \rangle$ family of directions lie within the (110) plane?

9. Show that translational periodicity of a lattice is consistent with n-fold rotation symmetry only when n belongs to the set $\{1, 2, 3, 4, 6\}$.

10. In cubic crystals, show that the direction $[hkl]$ is normal to the family of planes (hkl).

11. Enumerate all the families of planes designated by $\{hkl\}$ in
    (a) a cubic crystal
    (a) a tetragonal crystal

12. Derive the formula for the interplanar spacing d_{hkl} between two consecutive planes in the family of planes (hkl) in a cubic crystal. In an aluminium crystal (which has an *fcc* structure with a lattice parameter of $a = 0.404$ nm), calculate the d spacing for (111), (200), (220), (311) and (222) planes.