**Introduction to Crystallography**

**Midterm Examination, October 15, 2008**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Student ID.: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. The zonal equation is written as hu+kv+lw = 0. It shows a relationship between directions defined as [uvw] which lie in the plane defined as (hkl). Please derive this zonal equation step by step. (10 points)
2. In the reciprocal lattice space, the reciprocal vector, defined as , is known to be perpendicular to the (hkl) plane and its magnitude is . Show it. (20 points)
3. The primitive translation vectors of the FCC lattice is given as,

 

Find out the primitive translation vectors of the reciprocal lattice and show that it has a BCC type lattice structure in the reciprocal space. (20 points)

1. Si is known to have a diamond crystal structure which is defined to have an FCC type arrangement with the same element located in half of the tetrahedral sites in this FCC arrangement. (20 points)
2. What is the size ratio of the general (not particularly in the diamond structure) tetrahedral site compared to the host atom?
3. Draw a unit cell of the diamond crystal structure and identify the location of each atom.
4. Thus identify that the diamond crystal structure is composed of two different sets of FCC arrangements.
5. Draw the [110] projection of the diamond crystal structure and identify the stacking sequence.
6. What is the atomic packing factor of diamond crystal structure?
7. Please follow the instructions. (10 points)
8. Draw a close packed plane and identify the unit cell. These atoms are assigned to be located in A positions.
9. Then draw another close packed plane on top of this in B positions. (It is recommended to keep half of the A-plane un-stacked so you have room for step (c).)
10. Then move half of these B position atoms to C positions. Now you will see that half of the atoms are located in B position and the other half of these atoms are located in C position. There is a line defect in the borderline in between B position atoms and C position atoms. This is one of the most famous dislocations known as the Shockley partial dislocation. The displacement from B to C position is known as the burgers vector of this dislocation. Find out this displacement vector. (Namely, the direction vector from B to C position.)
11. Draw the general poles of the following symmetry in a stereographic projection and identify the multiplicity. (20 points)
12. 
13. 3m
14. 6mm
15. 622
16. 432