Háskóli Íslands
Raunvísindadeild
Eðlisfræði

Haust 2014

Eðlisfræði þéttefnis I

Dæmablað 2

Skilafrestur 9. September 2014 kl. 15:00

1. **Bravais lattices** (10)

   In each of the following cases indicate whether the structure is a Bravais lattice. If it is, give three primitive vectors; if it is not, describe it as a Bravais lattice with as small as possible a basis:

   (a) Base-centered cubic: simple cubic with additional lattice points at the center of the horizontal faces of the cubic cell.

   (b) Side centered cubic: simple cubic with additional lattice points at the center of the vertical faces of the cubic cell.

   (c) Edge-centered cubic: simple cubic with additional lattice points at the midpoint of the lines joining the nearest neighbors of the cubic cell, i.e. at the midpoint of the edges of the cubic cell.

2. **Diamond structure** (10)

   (a) The convectional unit cell for a diamond structure is the same as for a face-centered cubic lattice. How many atoms are in this conventional unit cell? What is the volume of the primitive cell?

   (b) Calculate the packing fraction for close-packed diamond structure. Compare this to FCC.

3. **Lattices and primitive vectors** (10)

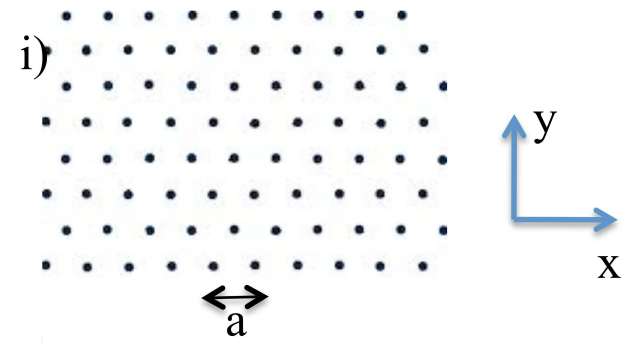
For each of the following lattices:

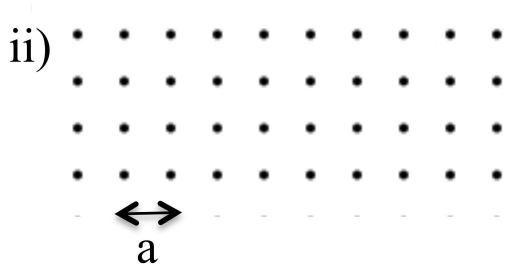
(a) Give two primitive vectors and draw them.

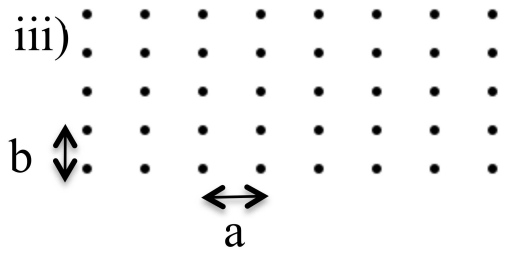
(b) Draw a primitive cell

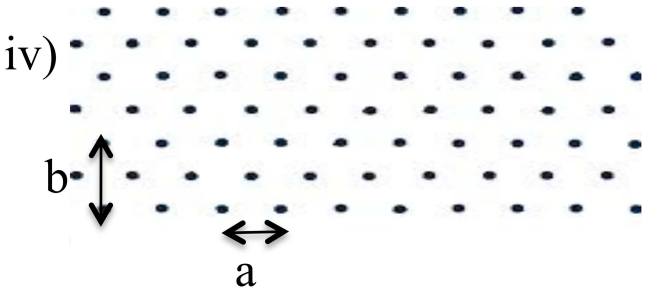
(c) List all the point group symmetries of the lattice

(d) Indicate the Bravais lattice type cell









4. **HCP structure** (10)

   (a) Show that the c/a ratio for an ideal hexagonal close-packed structure is $(8/3)^{1/2} = 1.633$. (c is the distance between hexagonally packed planes; a is the distance b/w nearest neighbors in- plane.) If c/a is significantly larger than this value, the crystal structure may be thought of as composed of planes of closely packed atoms, the planes being loosely stacked.

   (b) Calculate the packing fraction for the ideal close-packed HCP structure.

5. **Packing ratio** (10)

   The packing ratio is defined as the fraction of the total volume of the cell that is filled by atoms. Determine the maximum values of this ratio for equal spheres located at the points of simple-cubic, body-centered-cubic, and face-centered-cubic crystals.