Fundamentals of Electronics Devices

Unit-5 Lecture-5

Tunnel diode

- The simplest three-dimensional lattice is one in which the unit cell is a cubic volume, such as the three cells.
- The *simple cubic* structure (abbreviated sc) has an atom located at each corner of the unit cell.

 The body centered cubic (bcc) lattice has an additional atom at the center of the cube, and the face-centered cubic (fcc) unit cell has atoms at the eight corners and centered on the six faces.

- As the atoms are packed into the lattice in any of these arrangements, the distances between neighboring atoms will be determined by a balance between the forces that attract them together and other forces that hold them apart.
- We shall discuss the nature of these forces for particular solids.

- For now we can calculate the maximum fraction of the lattice volume that can be filled with atoms by approximating the atoms as hard spheres.
- The packing spheres in a face-centered cubic cell of side *a*, such that the nearest neighbors touch.

- The dimension *a* for a cubic unit cell is called the *lattice constant*.
- For the fcc lattice the nearest neighbor distance is one-half the diagonal of a face, or ½(a 2).
- Therefore, for the atom centered on the face to just touch the atoms at each corner of the face, the radius of the sphere must be one-half the nearest neighbor distance, or ¼(a 2).

Exercise

• Find the fraction of the fcc unit cell volume filled with hard spheres.

• Hint:

Each corner atom in a cubic cell is shared with seven neighboring cells; thus each unit cell contains 1/8 of a sphere at each of the eight corners for a total of one atom.