ELEC 321/4-H	INTRODUCTION TO SEMICONDUCTOR MATERIALS AND DEVICES	Winter 2018
Homework due on January 23rd 2018 No late homework will be accepted		

Homework #1

1. The crystal structure of sodium chloride (NaCl) is a simple cubic with the Na and Cl atoms alternating positions. Each Na atom is then surrounded by six Cl atoms and likewise each Cl atom is surrounded by six Na atoms. (a) Sketch the atoms in a (100) plane. (b) Assume the atoms are hard spheres with nearest neighbors touching. The effective radius of Na is 1.0 Å and the effective radius of Cl is 1.8 Å. Determine the lattice constant. (c) Calculate the volume density of Na and Cl atoms. (d) Calculate the mass density of NaCl.

2. (a) A material is composed of two types of atoms. Atom A has an effective radius of 2.2 Å and atom B has an effective radius of 1.8 Å. The lattice is a BCC with atoms A at the corners and atom B in the center. Determine the lattice constant and the volume densities of A atoms and B atoms. (b) Repeat part (a) with atoms B at the corners and atom A in the center. (c) What comparison can be made of the materials in parts (a) and (b)?

3. Consider the material described in Problem 2 in parts (a) and (b). For each case calculate the surface density of A atoms and B atoms in the (110) plane. What comparison can be made of the two materials?

4. For a simple cubic lattice, determine the Miller indices for the plane shown by the dotted lines in Fig. 1.

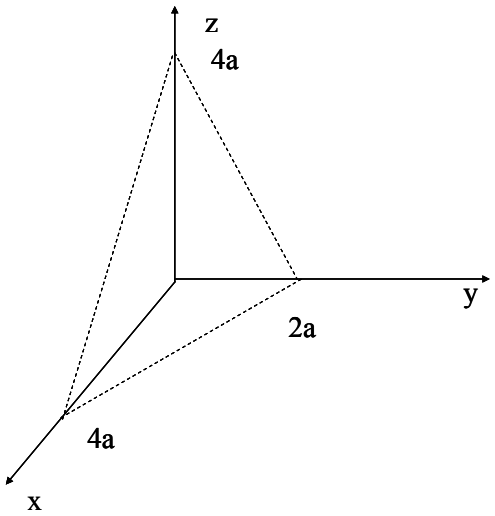

Fig.1

5. Consider a face-centered cubic lattice. Assume the atoms are hard spheres with the surfaces of the nearest neighbors touching. Assume the radius of the atom is 2.5 Å. (a) Calculate the volume density of atoms in the crystal. (b) Calculate the distance between nearest (110) planes. (c) Calculate the surface density of atoms on the (110) plane.