Homework #1

Crystal Structure of Solids – *100 points*

DUE @ Beginning of Class: Thursday, September 7

1) Consider the surface of a Si wafer that has a (100) plane: (12 points)

a. Sketch the placement of Si atoms on the surface of the wafer.
b. Determine the number of atoms per cm^2 at the surface of the wafer.
c. Repeat part a., this time taking the surface of the Si wafer to be (110).
d. Repeat part b., this time taking the surface of the Si wafer to be (110).

2) Assuming a cubic crystal system with lattice constant a_0, make a sketch of the following planes being sure to label your axis and intersections: (16 points)

a. (001) b. (111) c. (123) d. $(\bar{1}10)$
e. (010) f. $(\bar{1}\bar{1}\bar{1})$ g. (221) h. $(0\bar{1}0)$

3) Assuming a cubic crystal system, use an appropriately directed arrow to identify each of the following directions: (16 points)

a. [010] b. [101] c. $[00\bar{1}]$ d. [111]
e. [001] f. [110] g. $[0\bar{1}0]$ h. [123]

4) E-Book, problem 1.5 (15 points)

5) E-Book, problem 1.16 – show your steps clearly! (14 points)

6) E-Book, problem 1.20 (15 points)

7) E-Book, problem 1.24 (12 points)

1) Consider the surface of a Si wafer that has a (100) plane: (12 points)

a. Sketch the placement of Si atoms on the surface of the wafer.

b. Determine the number of atoms per cm^2 at the surface of the wafer.

c. Repeat part a., this time taking the surface of the Si wafer to be (110).

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4) E-Book, problem 1.5 (15 points)

1.5 The lattice constant of GaAs is $a = 5.65$ Å. Calculate (a) the distance between the centers of the nearest Ga and As atoms, and (b) the distance between the centers of the nearest As atoms.

5) E-Book, problem 1.16 – show your steps clearly! (14 points)

1.16 For a simple cubic lattice, determine the Miller indices for the planes shown in Figure P1.16.

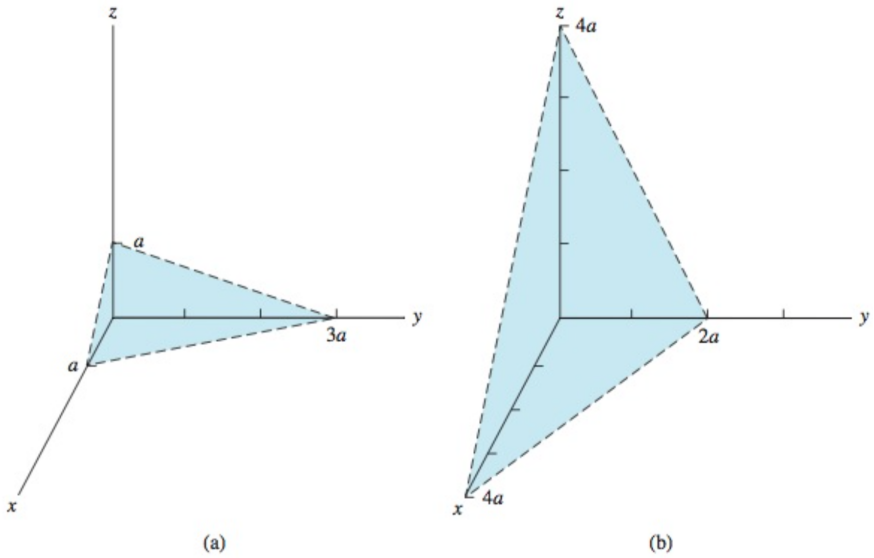

Figure P1.16 | Figure for Problem 1.16.

6) E-Book, problem 1.20 (15 points)

1.20 Determine the surface density of atoms for silicon on the (*a*) (100) plane, (*b*) (110) plane, and (*c*) (111) plane.

7) E-Book, problem 1.24 (12 points)

1.24 (*a*) If 5×10^{17} phosphorus atoms per cm^3 are add to silicon as a substitutional impurity, determine the percentage of silicon atoms per unit volume that are displaced in the single crystal lattice. (*b*) Repeat part (a) for 2×10^{15} boron atoms per cm^3 added to silicon.