Michael Shur. Introduction to Electronic Devices
John Wiley, 1996

Correction to Solution Manual.

Updated 10-4-97

2-2-10. Assume that atoms in an fcc lattice can be modeled as hard touching balls and calculate the percentage of the crystal volume occupied by the atoms.

Solution:

The volume of the unit cell of an fcc lattice is $V_p = a^3$ (four atoms per unit cell). The distance between the nearest neighbors is equal to $a\sqrt{2}$. Hence the radius of each atom is $r = a/2^{3/2}$. The volume of each atom is $4\pi r^3/3 = \pi a^3/(12\sqrt{2})$. Hence the volume of all four atoms is $\pi a^3/(3\sqrt{2})$. The fraction of the volume of a unit cell occupied by these four atoms is $\left[\pi a^3/(3\sqrt{2})\right]/a^3 = \pi/(3\sqrt{2}) \approx 0.74$.

2-2-11. Which plane (100), (110) or (111) in diamond structure has the highest density of atoms?

Solution:

1) Diamond Structure:

	100	110	111
Area of the unit cell in the plane	a^2	$2^{1/2}a^2$	$3^{1/2}a^2/2$
Number of atoms the unit cell in the plane	2	4	2
Atoms per unit area (density	$2/a^2$	$2^{3/2}/a^2$	$4/(3^{1/2}a^2)$

1) FCC Structure:

	100	110	111
Area of the unit cell in the plane	a^2	$2^{1/2}a^2$	$3^{1/2}a^2/2$
Number of atoms the unit cell in the plane	2	2	2
Atoms per unit area (density	$2/a^2$	$2^{1/2}/a^2$	$4/(3^{1/2}a^2)$