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ENGR145 HW2

3.9) Pd, FCC, density $= 12.0\,g/cm^3$, atomic weight $= 106.4\,g/mol$

$$\rho = \frac{nA}{V_C N_A} \qquad a = 2R\sqrt{2} \qquad V_c = (2R\sqrt{2})^3$$

$\rho = 12.0\,g/cm^3$
$n = 4$ for FCC
$A = 106.4\,g/mol$

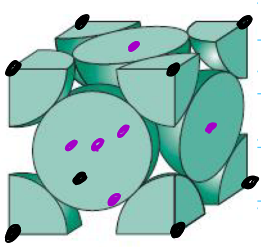
$$\rho = \frac{nA}{(2R\sqrt{2})^3 N_A} = \frac{nA}{8R^3(2)\sqrt{2}N_A} = \frac{nA}{16R^3\sqrt{2}N_A}$$

$$R^3 = \frac{nA}{16\rho\sqrt{2}N_A} = \frac{4(106.14)}{16(12)\sqrt{2}(6.02\times10^{23})} = 2.597\times10^{-24}$$

$$R = \sqrt[3]{2.597\times10^{-24}} = 1.375\times10^{-8}\,cm$$

$1\,cm = 1\times10^{7}\,nm$, $R = 0.1375\,nm$

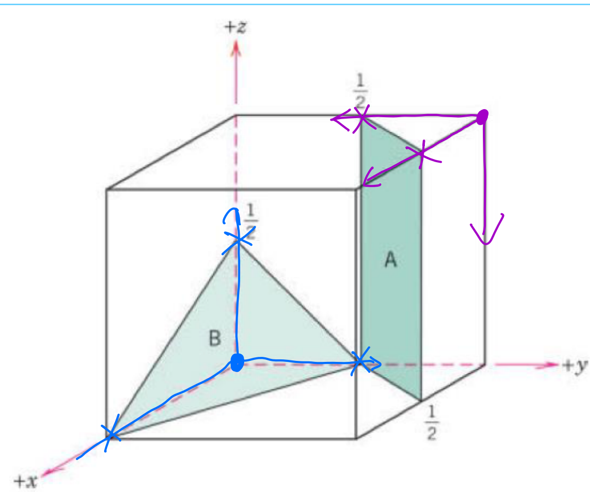
3.46)



Corner Atoms: 0 0 0, 1 0 0, 0 1 0, 1 1 0, 0 0 1, 1 0 1, 0 1 1, 1 1 1

Face Atoms: $\frac{1}{2}\,\frac{1}{2}\,0$, $\frac{1}{2}\,0\,\frac{1}{2}$, $\frac{1}{2}\,\frac{1}{2}\,1$, $\frac{1}{2}\,1\,\frac{1}{2}$, $1\,\frac{1}{2}\,\frac{1}{2}$, $0\,\frac{1}{2}\,\frac{1}{2}$

3.69)



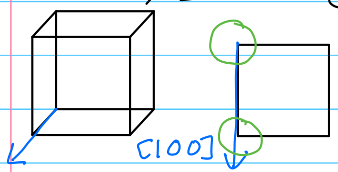

A: $(\frac{1}{2}\ \bar{\frac{1}{2}}\ \infty)$

$(2\ \bar{2}\ 0)$

B: $(1\ \frac{1}{2}\ \frac{1}{2})$

$(1\ 2\ 2)$

3.80 a) [1 0 0]




$a$

R R

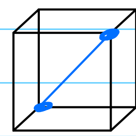
$2R = 1$ atom

$$LD = \frac{1 \text{ atom}}{a}$$

$$4R = \sqrt{2}a, \quad a = \frac{4R}{\sqrt{2}}$$

$$LD_{[100]} = \frac{1}{\frac{4R}{\sqrt{2}}} = \boxed{\frac{\sqrt{2}}{4R}}$$

[1 1 1]



$\sqrt{3}a$

R R

$2R = 1$ atom

$$LD = \frac{1 \text{ atom}}{\sqrt{3}a}$$

$$LD_{111} = \frac{1}{\frac{4\sqrt{3}R}{\sqrt{2}}} = \frac{\sqrt{2}}{4\sqrt{3}R}$$

$$= \frac{2}{4\sqrt{6}R} = \boxed{\frac{1}{2\sqrt{6}R}}$$

b) Atomic Radius of Cu: 0.128 nm

$$LD_{100} = \frac{\sqrt{2}}{4(.128)} = \boxed{2.762}$$

$$LD_{111} = \frac{1}{2\sqrt{6}(.128)} = \boxed{1.595}$$

For Copper, the linear density of the [100] direction is greater than the [111] direction.

3.95 a) $d = \frac{n\lambda}{2\sin\theta}$, $n = 1$ $\lambda = 0.0711$ nm, $\theta = 36.12°$, FCC

$$d_{311} = \frac{1(0.0711)}{2\sin(36.12°)} = \boxed{0.0603 \text{ nm}}$$

b) $$a = d_{211}\sqrt{h^2 + k^2 + l^2}$$

$$a = 0.0603 \text{ nm} \sqrt{3^2 + 1^2 + 1^2}$$

edge length $= 0.20$ nm $= a$, $a = 2R\sqrt{2}$

$$\frac{a}{2\sqrt{2}} = R \qquad R_{Rh} = \frac{0.20}{2\sqrt{2}} = \boxed{0.0707 \text{ nm}}$$

Thought question: In addition to x-rays, crystalline materials can be studied by electron diffraction. What does this say about the properties of an electron beam?

Crystalline structures have their atoms organized in repeating patterns, so when an electron beam passes through, it is diffracted. Due to the unique lattice structures of different crystalline materials, we can predict the material based on the diffraction pattern. This effect shows the important property of the beam, which is that it can be predictably diffracted by different crystalline structures.