

Matthew Z

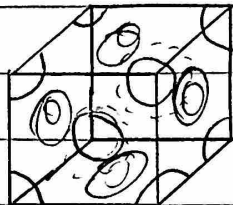
12-16-2020

ENR 235

VC

Final Exam

1 FCC:



$$FCC_{(100)}: a_{area} = a^2 = [(2\sqrt{2})R]^2 = 8R^2$$

$$PD_{FCC(100)} = \frac{2 \text{ atoms}}{8R^2} = 0.25 \text{ atoms}/R^2$$

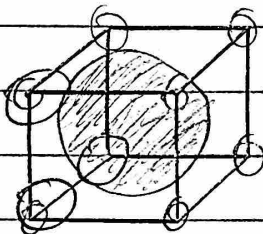
$$FCC_{(110)}: a_{area} = a^2 = 2\sqrt{2}R = 9\sqrt{2}R^2$$

$$PD_{FCC(110)} = \frac{2 \text{ atoms}}{8\sqrt{2}R^2} = 0.17 \text{ atoms}/R^2$$

$$FCC_{(111)}: a = (3 \times \frac{1}{6} + 3 \times \frac{1}{2})$$

$$PD_{FCC(111)} = \frac{(3 \times \frac{1}{6} + 3 \times \frac{1}{2}) \pi R^2}{2\sqrt{3}} = 0.9 \text{ atoms}/R^2$$

BCC:



$$BCC_{(100)}: a = 3 \text{ atoms}$$

$$PD_{BCC(100)} = \frac{3}{16R^2} = 0.19 \text{ atoms}/R^2$$

$$BCC_{(110)}: a = 3 \text{ atoms}$$

$$PD_{BCC(110)} = \frac{3}{9R^2\sqrt{2}} = 0.27 \text{ atoms}/R^2$$

$$BCC_{(111)}: a = \frac{1}{2} \text{ atoms}$$

$$PD_{BCC(111)} = \frac{\frac{1}{2} \pi R^2}{\frac{\sqrt{3}}{4} (\sqrt{2}R)^2} = 0.34 \text{ atoms}/R^2$$

2 Given: $F = 4 \text{ kN}$, $d_0 = 10 \text{ mm}$, $\nu = 0.34$, $E = 97 \text{ GPa} = 97,000 \text{ MPa}$

$$F = 4000 \text{ N}, d_0 = 0.4 \text{ in}, \Delta d = ?$$

$$F = \sigma \left(\frac{d_0}{2}\right)^2 \pi \Rightarrow 4000 \text{ N} = \sigma \left(\frac{0.01 \text{ m}}{2}\right)^2 \pi$$

$$\sigma = 50.9 \times 10^6 \text{ N/m}^2 \approx 50.9 \text{ MPa}$$

$$\sigma = \epsilon_z E \Rightarrow 50.9 \text{ MPa} = \epsilon_z (97000 \text{ MPa})$$

$$\epsilon_z = 5.2 \times 10^{-4}$$

$$\epsilon_z = -\frac{\epsilon_x}{\nu} = 5.2 \times 10^{-4} = -\frac{\epsilon_x}{0.34}$$

$$\epsilon_x = -1.7 \times 10^{-4}$$

$$\Delta d = -1.7 \times 10^{-3} \text{ mm}$$

3. a) Given: $P = 500 \text{ Kg}$, $D = 10 \text{ mm}$, 300 HB , $d = ?$

$$HB = \frac{2P}{\pi D [D - \sqrt{D^2 - d^2}]}$$

$$300 = \frac{2(500)}{\pi(10)[(10) - \sqrt{(10)^2 - d^2}]}$$

$$30000\pi \sqrt{10 - d^2} = 1000$$

$$\sqrt{10 - d^2} = \frac{1}{30\pi}$$

$$10 - d^2 = \frac{1}{900\pi^2}$$

$$d = \frac{\sqrt{1 + 9000\pi^2}}{30\pi} = \boxed{3.16}$$

b) 21

4. Table salt: Salt is made of sodium and chloride that is ionically bonded.

Natural Gas: Covalent bond because of gases are hydrogen

Calcium Phosphate: ionic bond because calcium and phosphate are both ions.

Steel: Metallic bond because the electrons are held by one or more atoms.

Bonding between two water molecules: Hydrogen Bonds because they form between hydrogen and oxygen atoms in water.

Bonding within a water molecule: Covalent bonds because they hold together the hydrogen and oxygen atoms.