

Atomic bonding

Ionic: Anions gain electrons, cations lose electrons

Covalent: electrons shared between two atoms

Metallic: electrons shared between many atoms

Van der Waals: temporary or permanent dipole

Interacts with other objects

Crystal structures

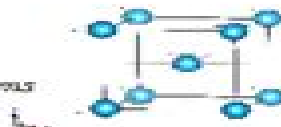
BODY CENTERED CUBIC

$$4R = \sqrt{a^2 + a^2 + a^2}$$

$$4R = a\sqrt{3}$$

1 center atom, 8 corner atoms

2 atoms per unit cell



FACE CENTERED CUBIC

$$4R = \sqrt{a^2 + a^2}$$

$$4R = a\sqrt{2}$$

6 face atoms, 8 corner atoms

4 atoms per unit cell



Volume of a cubic = a^3

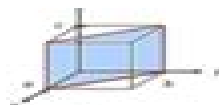
$$A = 10^{-10} \text{ m}$$

$$\text{Avogadro No} = 6.022 \times 10^{23} \left(\frac{\text{atoms}}{\text{mol}} \right)$$

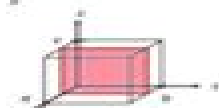
$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{\# \text{ of atoms} \times \text{atomic mass}}{\text{volume of unit cell} \times \text{Avogadro}}$$

Miller Indices

crystal	h	k	l
1. Intercepts	1	1	1
2. Reciprocals	1/1	1/1	1/1
3. Reduction	1	1	1
4. Miller indices	(111)		



crystal	h	k	l
1. Intercepts	1/2	1	1
2. Reciprocals	2/1/2	1/1	1/1
3. Reduction	2	1	2
4. Miller indices	(212)		



$$\text{Planar Density} = \frac{\text{atoms per face}}{\text{area of face}}$$

$$\text{Packing Factor} = \frac{\text{volume of atom} \times \text{number of atoms}}{\text{volume of the unit cell}}$$

Point Defects

$$n_v = n \cdot e^{-\frac{Q_v}{RT}}$$

$$n_v = \# \frac{\text{vacancies}}{\text{cm}^3}, n = \# \frac{\text{atoms}}{\text{cm}^3}$$

Q_v = energy for 1 mol of vacancies, T = Temp

$$R = \text{Gas constant} = 1.987 \frac{\text{cal}}{\text{mol} \cdot K} = 8.314 \frac{\text{joules}}{\text{mol} \cdot K}$$

Diffusion

$$D = D_0 \cdot e^{-\frac{Q}{RT}}$$

D_0 = constant based on material

Q_v = energy for 1 mol of vacancies, T = Temp

$$R = \text{Gas constant} = 1.987 \frac{\text{cal}}{\text{mol} \cdot K} = 8.314 \frac{\text{joules}}{\text{mol} \cdot K}$$

$$J = -D \cdot \frac{dc}{dx}, x = \text{thickness}, J = \text{Flux} \text{ - Fick's 1st law}$$

c = Compositions in atomic percent

Mechanical Properties

$$\text{Engineering stress (S)} = \frac{F}{A_0}$$

$$\text{Engineering Strain (e)} = \frac{\Delta l}{l}$$

$$\text{Young Modulus (E)} = \frac{S}{e}$$

F = Force, A_0 = Area

Δl = Change in length, l = Original length

$$K_c \text{ or } K_{Ic} = f \cdot \sqrt{\pi a}$$

σ = Exposed stress, a = flaw size

f = geometry factor for the specimen and flaw

K_{Ic} = fracture toughness

K_{Ic} = plain strain fracture toughness

$$\pm \sigma = 5.09 \cdot \frac{FL}{d^3}$$

F = Applied Load, L = Length of shaft

d = diameter of shaft

$$1 - K(V) = \exp \left[- \left(\frac{\sigma}{\sigma_0} \right)^m \right]$$

m = Weibull Modulus, σ_0 = Flexural Strength

F = Failure, σ_0 = Initial Flexural Strength

$$\text{Poissons Ratio (v)} = \frac{-\epsilon_{lateral}}{\epsilon_{longitudinal}}$$

$$\text{Modulus of resilience (E}_r) = \frac{1}{2} (\text{yield strength}) (\text{strain@yielding})$$

$$\text{Ductility \%Elongation} = \frac{l_f - l_0}{l_0} \cdot 100\%$$

$$\text{Ductility \%Reduction in area} = \frac{A_0 - A_f}{A_0} \cdot 100\%$$

$$\text{True Stress} = \frac{F}{A_f}$$

$$\text{True Strain} = \ln \left(\frac{l}{l_0} \right)$$

$$\sigma_t = K \epsilon_t^n$$

n = strain coefficient, K = Constant

ϵ_t = True strain, σ_t = True Stress

$$\sigma_m = 2\sigma_0 \left(\frac{a}{r_0} \right)^{\frac{1}{2}}$$

σ_m = Stress @ Crack tip, σ_0 = Applied stress

a = Crack Length, r_0 = radius of curvature

$$\sigma_c = \left(\frac{2E\gamma_s}{\pi c} \right)^{\frac{1}{2}}$$

σ_c = Critical Stress, E = elastic modulus

γ_s = specific surface energy

c = one half length of internal crack

Solidification and Nucleation

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web objective to apply stoichiometric principles to calculate the appropriate chemical equation for the reaction between iron metal and a solution of copper i sulfate introduction in the form of finely split powder copper metal is produced as a byproduct of the process as iron ions the ion meta dissolves

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web procedure 1 find the mass of a clean dry 100 ml beaker and record 2 measure out 8 00 grams of copper ii sulfate onto a piece of filter paper taking the filter paper s mass into account add these to the beaker 3 measure 50 0 ml of water in the cylinder and add it to the beaker 4

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web stoichiometric principles can be used to determine the chemical equation between iron powder and aqueous copper ii sulfate in the iron copper ii sulfate redox reaction the iron ions dissolve in the copper ii sulfate solution to produce copper ii ions

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web lab 4 stoichiometry the reaction of iron with copper ii sulfate revised 8 19 2009 1 introduction in this experiment we will use stoichiometric principles to deduce the appropriate equation for the reaction between metallic iron and a solution of copper ii sulfate this reaction produces

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web under the finalize of the experiment it was found that iron was the limiting reactant and iron ii sulfate was a product of the reaction between 7 0002g away cooper ii sulfate and 2 0101g iron metal which produced 2 3037g of copper product with a percent yield of 100 72 introduction

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web stoichiometry lab report the reaction of iron with copper ii sulfate period 5 in this experiment i observed the reaction of iron with copper ii sulfate i obtained the results to this experiment through adding heated CuSO_4 solution to the iron powder stirring the solution adding water then removing water adding acetone heating the acetone on low

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web stoichiometry the reaction of iron with copper ii sulfate purpose to enhance the understanding of stoichiometry a reaction between iron and copper ii sulfate solution will be conducted this will help you to differentiate limiting and excess

reactant in a chemical reaction

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web stoichiometry lab iron and copper sulfate sample data data and observations mass of copper ii sulfate pentahydrate 3 27
g of g mass of filter paper mass of filter paper and dry copper mass of dry copper 1 28 g