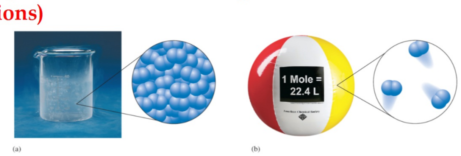
Monday November 3, 2014

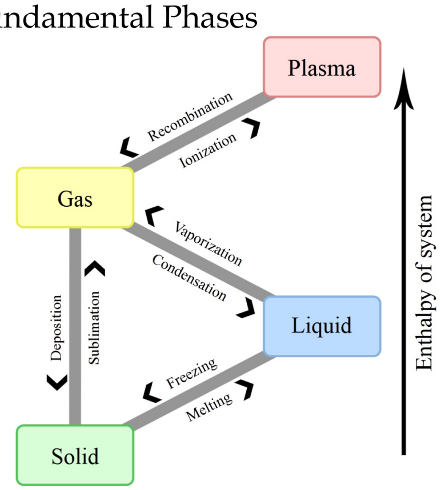
Objective: The student will be able to describe the relationship between intermolecular forces and vapor pressure.

Kinetic-Molecular Theory

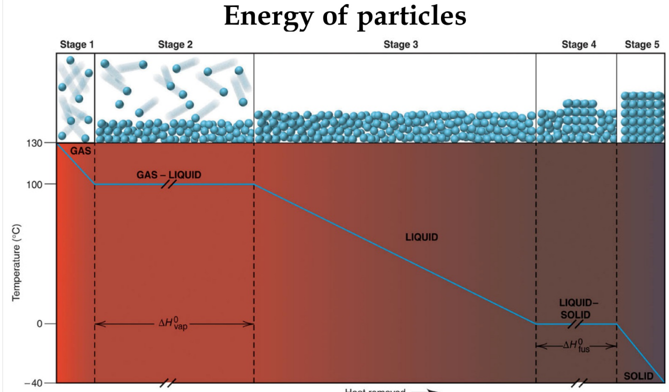
1. All gas molecules are considered to be "point" masses. (Mass)
2. The average kinetic energy of any gas is a function of its absolute temperature. (Energy)
3. Gas particles move in a rapid, random, straight-line motion. (Motion)
4. The volume of the gas molecules are negligible compared to the volume in which they are contained. (Volume)
5. Attractive and repulsive forces between gas molecules are negligible. (Collisions)



The Four Fundamental Phases

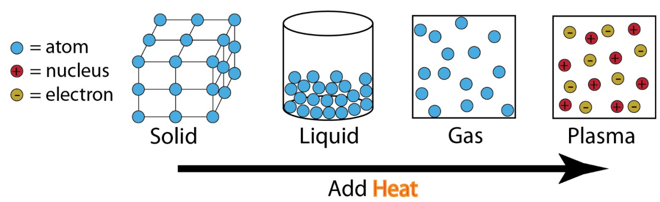


Energy of particles



Essential Question: What is happening on the molecular level? (Phase changes, IMFs)

States of Matter



Properties of Solids, Liquids & Gases

- All particles are in constant motion, have a density

Solids	Liquids	Gases
○ Particles very close together ○ Highest density ○ Lowest kinetic energy ○ Least amount of motion ○ Definite shape & volume ○ Not very affected by environmental conditions (i.e. physical changes)	○ Particles loosely held together ○ Moderate density ○ Moderate kinetic energy ○ Some motion ○ Conforms to shape of container, definite volume ○ Fixed volume ○ Expand & vaporize when heated ○ Fluid (less than gases)	○ Particles very far apart ○ Least dense ○ Most kinetic energy ○ High amount of motion ○ No definite shape or volume ○ No organization ○ Fluid

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Phase Diagrams

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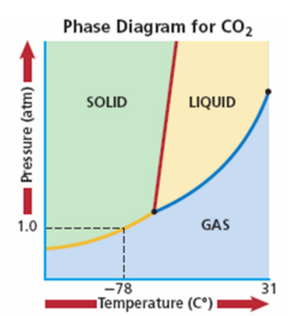
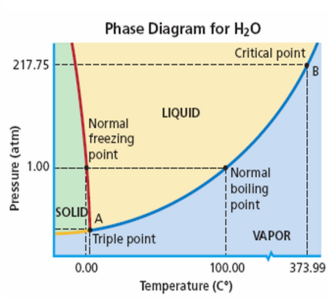
Comparison of Phase Diagrams





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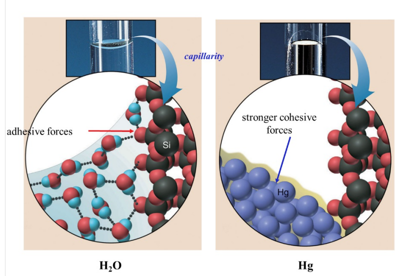
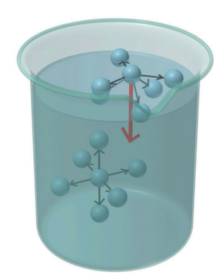
Properties of Liquids

viscosity, surface tension, capillary action

Viscosity is the resistance to flow.



capillary action



surface tension

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Vapor Pressure

Concept, V.P. vs IMF, factors, dynam. equilibrium

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How is cooking affected by T and P?

pressure cooker, microwave, bumping and Boiling chips (nucleation)

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Clausius - clapeyron equation

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{T_2 - T_1}{T_2 \times T_1}\right)$$

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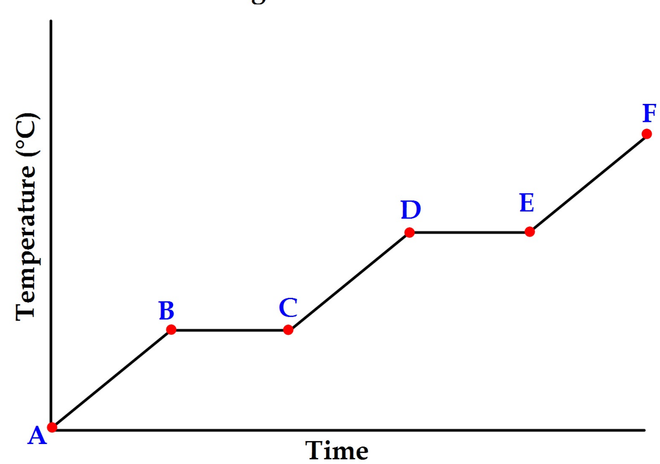
Change of State Problems



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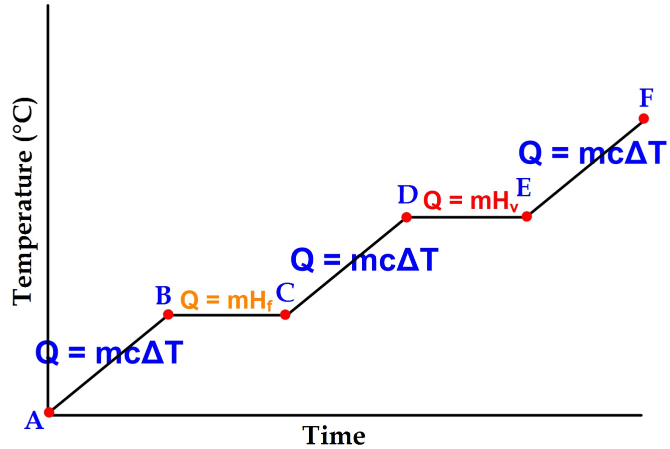
Equations and Variables

$Q = mC\Delta T$	$Q = mH_f$	$Q = mH_v$
Q = heat energy (J) m = mass (g) C = specific heat or heat capacity (J/g·°C) ΔT = change in T (°C)	H_f = heat of fusion (J/g)	H_v = Heat of vaporization

Heat Calculations



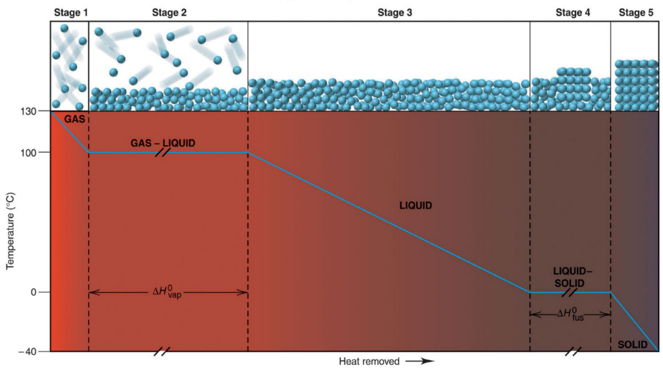
Example #1

How many kilojoules are needed to convert 80.0 grams of cold water at 0°C to hot water at 95.0°C?

Example #2

How many kilocalories are needed to convert 77.5 grams of ice at -8.0°C to water at 95°C?

Energy of particles



Essential Question: What is happening on the molecular level? (Phase changes, IMFs)

Tuesday Nov. 19, 2013

TOPICS: Properties of Solids

Warm - Up:
Name or provide the chemical formulas for the following complexes:

(1) $[Rh(en)_2(NO)_2](C_2O_4)_2$ 2

(2) cesium hexacyanoferrate(II)

(3) tetraaquadibromotungsten(VI) dinitroargentate(I)

Answers to Warm -Up

bis(ethylenediamine)dinitrosylrhodium(IV) oxalate

$Cs_4[Fe(CN)_6]$

$[W(H_2O)_4Br_2][Ag(NO_2)_2]_4$

Review of Yesterday's Topic

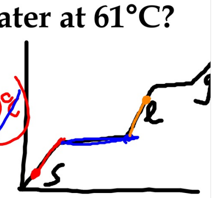
$H_f = -H_{freeze}$ $\Delta = f - i$

How many ~~kilojoules~~ kilocalories are needed to convert 14.4 grams of ice at -80.0°C to water at 61°C?

$q_1 = mC\Delta T$
$= 14.4g(2.05 J/g°C)(0.0°C + 80°C)$
$= 2361.6J$

$q_2 = mH_f$
$= 14.4g(334 J/g)$
$= 4809.6J$

$q_3 = mC\Delta T$
$= 14.4g(4.18 J/g°C)(6$
$= 3671.7J$



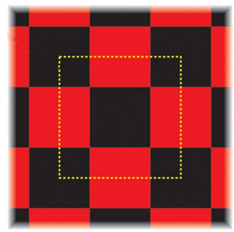
Types of solids

Solid Type	Form of Unit particles	Forces between particles	Properties	Examples
Atomic (very limited category!)	atoms	London dispersion forces (van der Waals)	soft, low MP, poor thermal & electrical conductors	Noble gases
Molecular	molecules	London dispersion forces, (van der Waals) dipole-dipole, hydrogen, dipole - induced dipole	soft, low to moderate MP, poor thermal & electrical conduction	methane, water, CO_2, sugar
Covalent (network)	atoms or molecules	covalent	very hard, very high MP, often poor thermal & electrical conduction	diamond, graphite, quartz (SiO_2)
Ionic	cations/anions	ionic	hard and brittle, high MP, poor thermal & electrical conduction in the solid state,but great conductor in themolten (liquid) state	typical salts like NaCl, $Ca(NO_3)_2$
Metallic	atoms (metals)	metallic	soft to very hard, low to very high MP, excellent thermal & electrical conductor, malleable, ductile	all metallic elements - like W, Cu, Fe

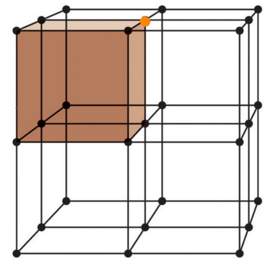
In what category does glass fall?

Crystal Lattice

unit cell: the smallest portion that gives the crystal structure if it is repeated in all directions



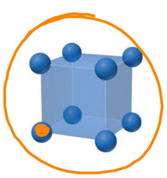
portion of a 2-D lattice



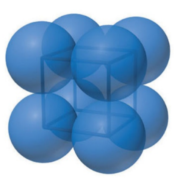
portion of a 3-D lattice

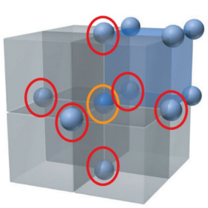
coordination number: the number of nearest neighbors to a particle

Types of Unit Cells



Simple Cubic

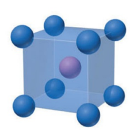




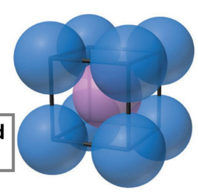
coordination number = 6

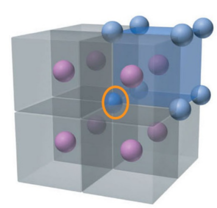
1/8 atom at 8 corners

Atoms/unit cell = 1/8 * 8 = 1

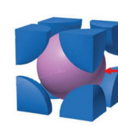


Body-centered Cubic





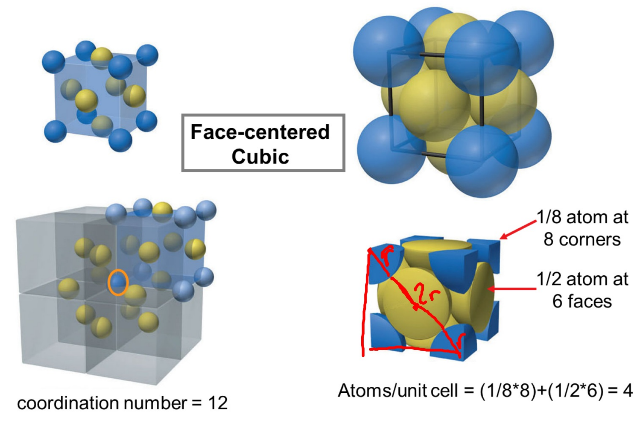
coordination number = 8



1/8 atom at 8 corners

1 atom at center

Atoms/unit cell = (1/8*8) + 1 = 2



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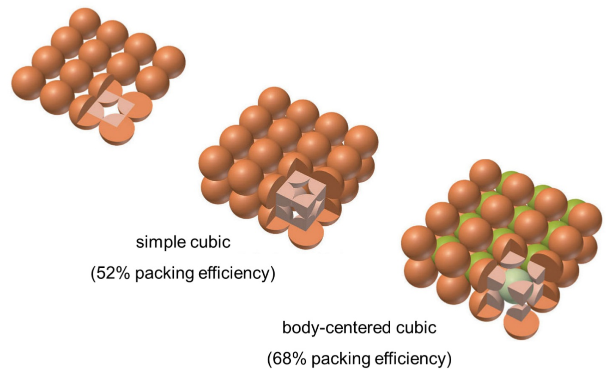
Packing efficiency



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Example Problem

Barium is the largest nonreadioactive alkaline earth metal. It has a body-centered unit cell and a density of 3.62 g/cm^3. What is the atomic radius of barium? (V_{sphere}= 4/3πr^3)

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When lithium metal crystallizes it exhibits a body-centered cubic structure with an edge length of 3.509Å and a density of 0.534 g/cm^3. Calculate Avogadro's number based on this information.

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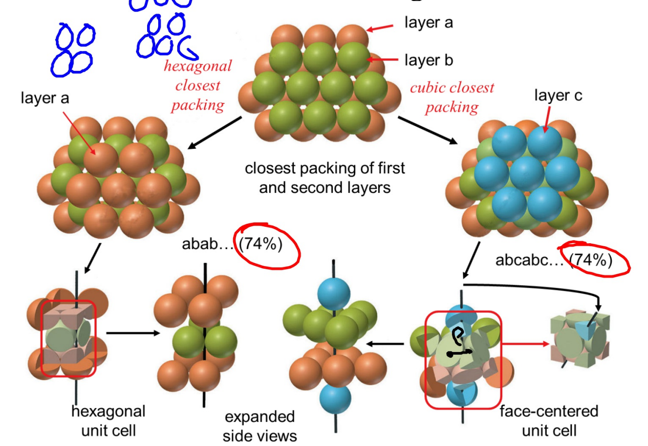
Practice Problem

Iron crystallizes in a body-centered cubic structure. The volume of one Fe atom is 8.38x10^{-24} cm^3, and the density of Fe is 7.874 g/cm^3. Calculate an approximate number for Avogadro's number.

Closest-Packing

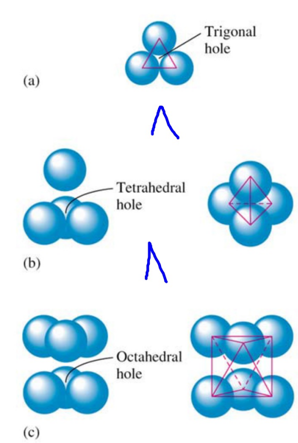


Example Problem

Copper adopts cubic closest packing, and the edge length of the unit cell is 361.5 pm. What is the atomic radius of copper? What is the density of this 35.5 gram substance?

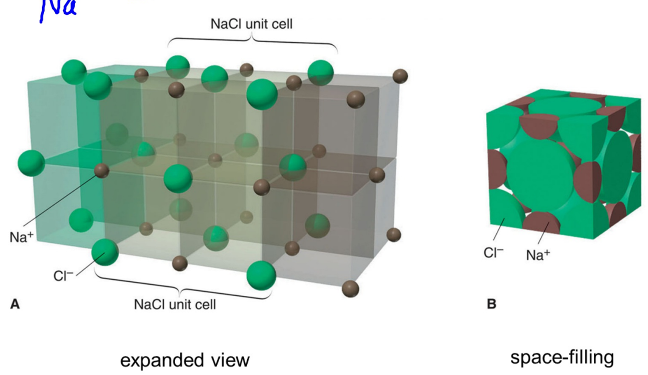
Types of Spacings

How do they rank when compared to same diameter?



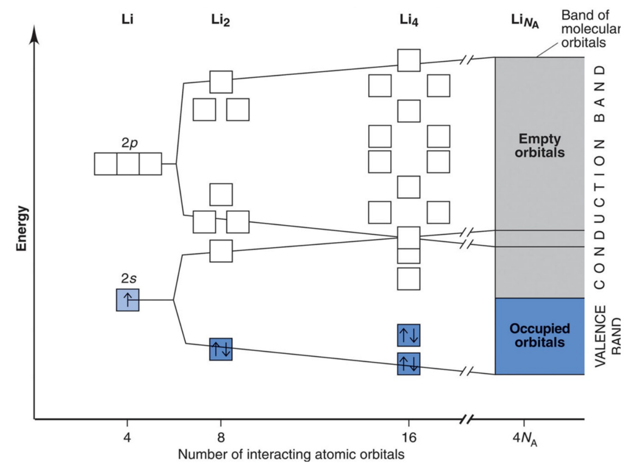
Structure of sodium chloride

Na^+ Cl^-

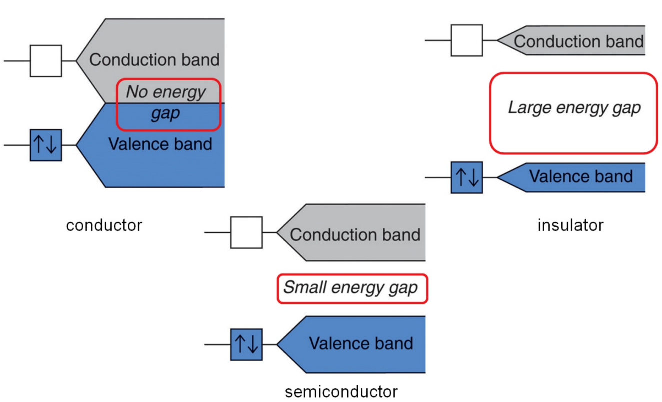


imagine 2 the ions in seperate face-centered cubic arrays

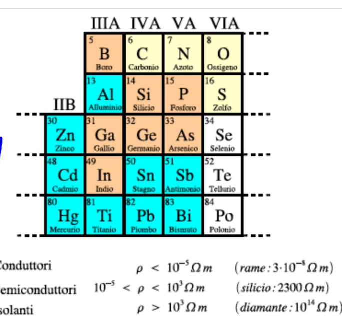
Molecular Orbital Band Theory



Molecular Orbital (Band) Theory and Conductivity



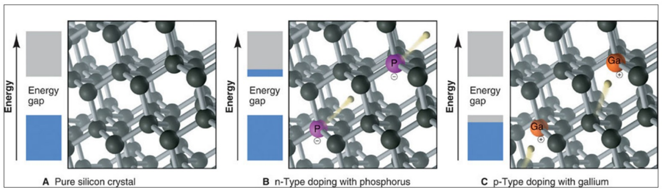
Semiconductors



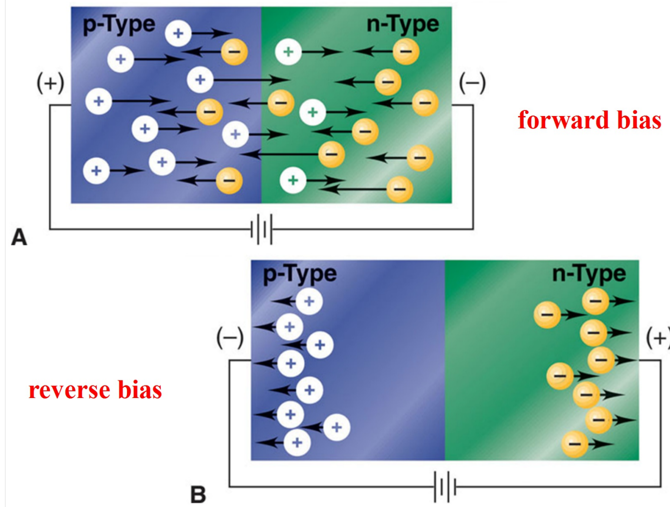
doping → intentional addition of impurities to modify characters (performance) of semiconductors

Types of Doping

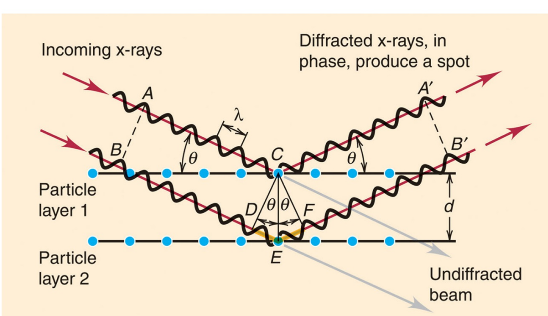
n - type: increases the number of valence electrons.
- **bridging energy gap and increasing conductivity**



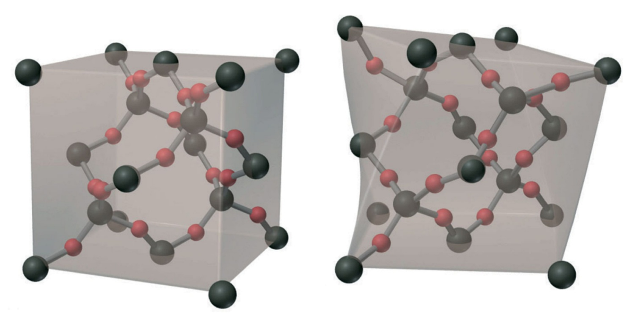
p - type: decreasing the number of valence electrons
- **orbitals in valence band are empty creating a positive hole, decreasing conductivity**



Bragg Equation

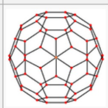
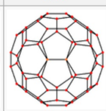
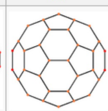
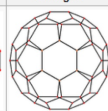
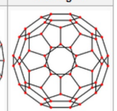


Silicon Dioxide



Allotropes and their Significances

Orthogonal projections

Centered by	Vertex	Edge 5–6	Edge 6-6	Face Hexagon	Face Pentagon
Image					
Projective symmetry	[2]	[2]	[2]	[6]	[10]

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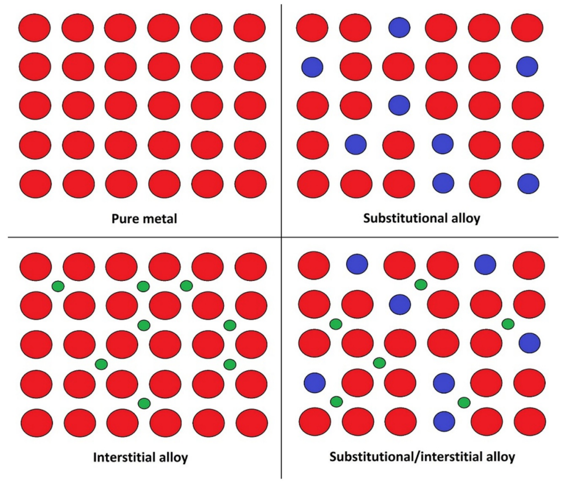

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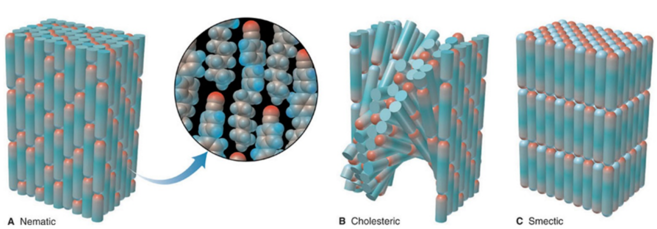
Liquid Crystals

Liquid crystals (LCs) are matter in a state that has properties between those of conventional liquid and those of solid crystal.



For instance, an LC may flow like a liquid, but its molecules may be oriented in a crystal-like way.

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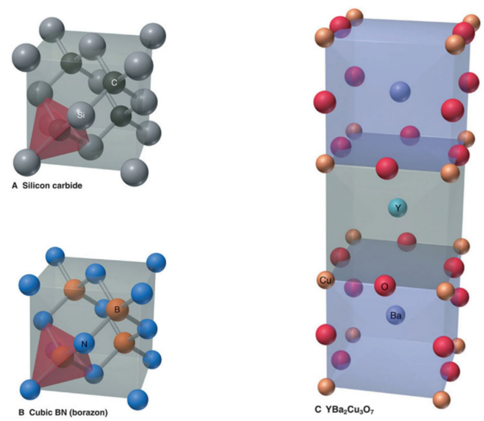
Ceramic Materials



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