PHASE CHEMISTRY

Chapter 12

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	Solids	Liquids	Gases	
	electronic	Electronic	electronic	Inter
U	vibrational	Vibrational	vibrational	
	(Def shape/volume)	Rotational	rotational	
		(No def shape, def volume)	translational	Intra
			(No def shape/volume)	

-But it all depends on the bonds *between* atoms and molecules.

Types of Chemical Bonds

Weak --/\/---Strong

London Di-pole Hydrogen Ionic Covalent Metallic

-strong bond = strong intramolecular force (high melting point)

-intramolecular force means vibration and rotation

Van Der Waal's Forces	True Chemical Bond
Field of electricity	Sharing of electrons
Proportional to molecular weight	
Weak	Strong
$F \propto 1/d^7$	$F \propto 1/d^2$
low boiling point	High boiling point
responsible for phase changes	

Kinetic Molecular Theory

	Solids	Liquids	Gases
Spacing	very small	a lot less, small	random, high
Particle Vol.	High	high	Negligible
Shape	def. Shape	no def. Shape	non, no def shape
Compressability	very low	very low	very high
Density	very high	high	Very very low
Inter. Forces	in well, attraction Outweighs collision	in well, attraction outweighs collision	out of well, collision outweighs attraction
Diffusion	very very low	high (still rotating)	very very high (fast)
Solids			

-solids arrange themselves in two distinct forms depending on the *rate of cooling* and intermolecular forces

Amorphous

-do not have a regular defined/natural shape. Glass is a classic example, although “amorphous” solids are sometimes called “super -cooled liquids.”

Crystalline

-have a regular nature/defined shape. This extends down to the arrangement of individual *particles* in the molecule

Unit Cell

-this is the smallest portion of a crystalline lattice that shows the entire 3 dimentional structure of the overall crystal.

-these occur at sites of nucleation

Face centered:

Body centered:

Simple cube:

Crystalline Structure of Solids (pg 369)

Name	# of axes of symmetry	# of axes of similar length	# of axes of dif. length	# of axes separated by 90 degrees	other separation angles
Isometric (cubic)	3	3	0	3	0
Tetragonal	3	2	1	3	0
Hexagonal (close packed)	4	3	1	1	60
Rhombohedral (hexagonal)	4	3	1	0	60
Orthorhombic	3	0	3	3	0
Monoclinic	3	0	3	2	90 to one other axis
Triclinic	3	0	3	3	any

Heat of Fusion

-the enthalpy change that is associated with the formation of a crystal lattice

-the more complex the crystal lattice, or higher the intermolecular forces, the higher the heat of fusion

$$\Delta H_{fus} = \text{-kJ/mol}$$

-recrystallization processes are exothermic! The lattice is more stable. This is also exotropic.
-Energy required the break the formed lattice, and a measure of the strength of that lattice is ΔH_{fus}
    -It offsets the change in temperature that should occur.

Liquids
-Phase of matter that has no definite shape but has a definite volume
Density
-Specific gravity is a method of determining mass without use of balances, and typically uses water as the reference material.
-water is a VERY dense liquid (density does vary with temperature, ~277 (4 C) is the max), aside from the BEC.

Surface Tension
-Intermolecular forces react with the walls of the container and each other.
    Capillary Action: movement of a liquid through the action of surface tension (trying to form a meniscus). The narrower the tube, the higher the liquid will travel.

Specific Gravity (relative density)

$M_1 = M_2$
$p_1 v_1 = p_2 v_2$
$p_1 v_1 = p_{H2O} v_{H2O}$
OR
$M_1 = p_{H2O} v_{H2O}$

-uses the density of water, which changes with temperature
.99705 g/cm3 at RTP

Vapor Pressure
temperature ∝ vapor pressure (always at equilibrium)
decrease vapor pressure, add a salt

state: temperature and pressure
phase: solid, liquid, gas
Phase Diagrams (12.3)