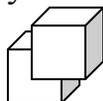


LECTURE 18. SOLIDS

- As you remove energy from a system, IMF attractions increase, and gases turn into liquids, which then lose more energy to become ordered solids.
- Not all solids are ordered (i.e. plastic), but under specific circumstances, crystalline solids form that have specific geometrics
- There are 7 primitive cells (one is a simple cubic comprised entirely of right angles and equal side lengths; the other six vary in angle measure and length)
- Unit cells can be merged by overlapping them to form more complex structures – crystals



Bonding in Solids

4 types of bonds, depending on location of molecules in periodic table:

Period	1A	2A	Metals										Nonmetals and Noble gases						8A																															
			3B	4B	5B	6B	7B	8B		1B	2B	3A	4A	5A	6A	7A																																		
1	H																		He																															
2	Li	Be											B	C	N	O	F	Ne																																
3	Na	Mg	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Al	Si	P	S	Cl	Ar																																
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																																
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																																
6	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																																
7	Fr	Ra		Unq	Unp	Unh	Uns	Uno	Une																																									
	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>6</td> <td>La</td> <td>Ce</td> <td>Pr</td> <td>Nd</td> <td>Pm</td> <td>Sm</td> <td>Eu</td> <td>Gd</td> <td>Tb</td> <td>Dy</td> <td>Ho</td> <td>Er</td> <td>Tm</td> <td>Yb</td> <td>Lu</td> </tr> <tr> <td>7</td> <td>Ac</td> <td>Th</td> <td>Pa</td> <td>U</td> <td>Np</td> <td>Pu</td> <td>Am</td> <td>Cm</td> <td>Bk</td> <td>Cf</td> <td>Es</td> <td>Fm</td> <td>Md</td> <td>No</td> <td>Lr</td> </tr> </table>																		6	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	7	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
6	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																																			
7	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																																			

TABLE 5.4 Typical Characteristics of Solids

Class	Examples	Characteristics
metallic	<i>s</i> - and <i>d</i> -block elements	malleable, ductile, lustrous, electrically and thermally conducting
ionic	NaCl, KNO ₃ , CuSO ₄ ·5H ₂ O	hard, rigid, brittle; high melting and boiling points; those soluble in water give conducting solutions
network	B, C, black P, BN, SiO ₂	hard, rigid, brittle; very high melting points; insoluble in water
molecular	BeCl ₂ , S ₈ , P ₄ , I ₂ , ice, glucose, naphthalene	relatively low melting and boiling points; brittle if pure

- 1) **Metallic Bond** -> Metal bonds with Metal; very strong (ex. Cr-V-Cr-V or Al-Al-Al-Al)
- 2) **Ionic Bond** -> Metal bonds with a Nonmetal; ≈ 200 kJ/mol (ex. Na-Cl-Na-Cl)
- 3) **Covalent Bond** -> Nonmetal bonds with a Nonmetal; ≈ 400 kJ/mol (ex. graphite C-C-C-C or glass Si-O-Si-O)
- 4) **IMF between molecules** -> Solids form from H-bonds, dipoles, dispersion (ex. H-O-H -----O-H); These are the weakest solids (1-20 kJ/mol)