

Solids

Properties and Types of Solids

<u>Type of Solid</u>	<u>Particles</u>	<u>Attractive Force</u>	<u>Properties</u>	<u>Examples</u>
ionic	positive ions and negative ions	electrostatic	solid–poor conductor liquid–good conductor high melting point	NaCl KNO ₃
molecular	molecules	wan der Walls or dipole	poor conductor low melting point	H ₂ O N ₂ HCl C ₁₂ H ₂₂ O ₁₁
covalent or network	atoms	covalent bonds	poor conductor very high melting point	C SiO ₂
metallic	positive ions and free electrons	metallic bond	good conductor high melting point (not rigidly bonded so can change shape of solid without breaking)	Ag Cu Fe Hg

Type of Solid Melting Point (°C)

ionic	NaCl 801, FeO 1370
molecular	Cl ₂ -100, H ₂ O 0, benzene C ₆ H ₆ 5.5, C ₁₈ H ₃₈ 28
covalent or network	SiO ₂ 2950, C diamond >3550
metallic	Cu 1083, Fe 1535

Some definitions

isomorphous – same crystal structure

polymorphous – same substance but different crystalline structure (allotropes)

C diamond, graphite, buckyball (soccer shaped molecule of carbon C₆₀)
P red, white, black forms

amorphous – no well developed crystal structure (glass has amorphous structure)

Structure of Solids

Ionic Compounds

Structure and Properties determined by:

- Charges on ions
- Relative size of ions
- Polarization of ions

Sizes

Radius ratio = r^+/r^-

Determines packing

r^+/r^-	Type	Coordination Number
.15	Linear	2
.15-.22	Trigonal planar	3
.22-.41	Tetrahedral	4
.41-.73	Octahedral	6
.73 >	Cubic	8

Larger positive ion more negative ions can be in contact with

Ability of charge cloud to be distorted is polarizability

Negative ions are more easily polarized

Small positive ions cause distortion of negative clouds

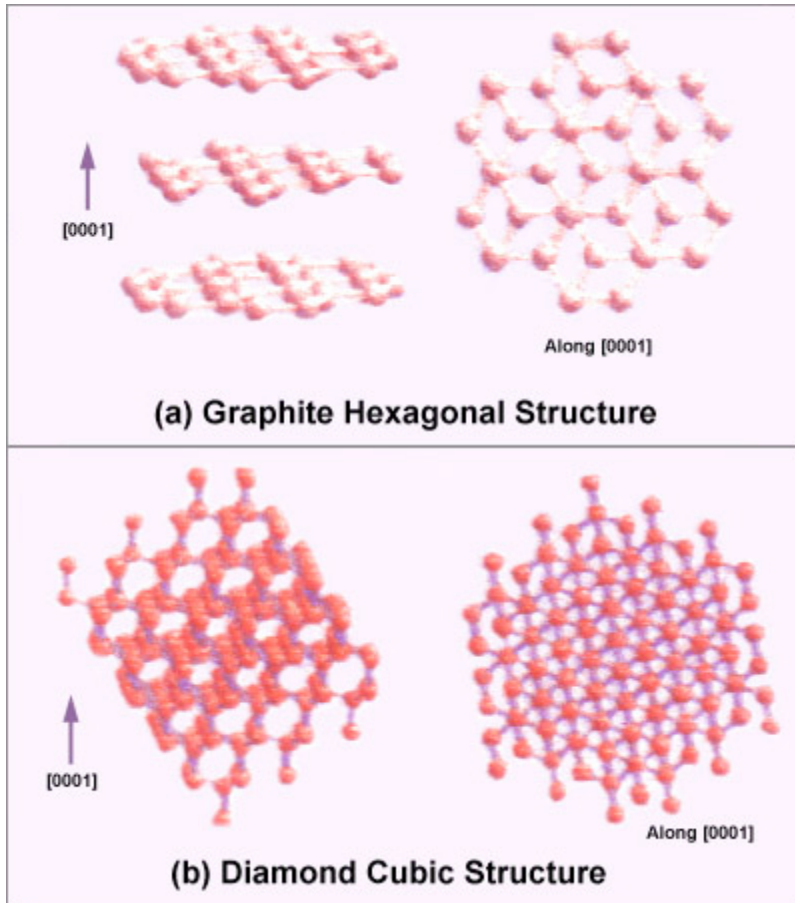
Examples of Ionic Crystal Structure (Dept. Models)

1:1 ratio positive and negative ions but different structure

Compound	Coordinate Number	Structure
ZnS	4	Tetrahedral
NaCl	6	Octahedral
CsCl	8	Cubic

Graphite is hexagonal (close packed)

Diamond is tetrahedral



(http://www.canadianrockhound.ca/2002/01/cr0206101_diamonds.html)

Crystal Structure of Metals

	Coordinate Number	% of Empty Space	12 CN layers line up
Body centered cubic	8	32%	
Cubic closest packed (face centered)	12	26%	a-b-c-a-b-c
Hexagonal closest packed	12	26%	a-b-a-b

Most metals are distributed among these three types

Fairly high density of metals