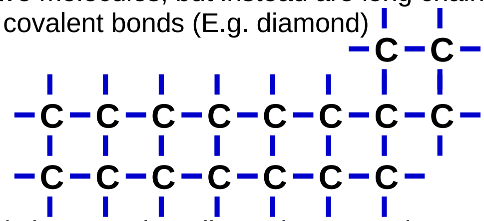
Ionic, H-bonding, Dipole, or London?

Details	Bond	Molecule	IMF
ΔEN = 0 - 0.5	nonpolar	nonpolar	London
ΔEN = 0.5 - 1.7	polar	polar	dipole-dipole*
ΔEN = 1.7 - 3.2	ionic	Ionic	ionic*
H + N,O,F	polar	polar	H-bonding*
Symmetrical molecule (any ΔEN)	--	nonpolar	London

*Since all compounds have London forces. London forces are also present. However, their affect is minor and overshadowed by the stronger forces present. Note: the term “polar” is used interchangeable with “polar covalent”. Likewise, “nonpolar” and “nonpolar covalent” mean the same thing.

Network solids (covalent crystals)

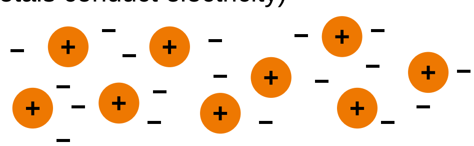
- There are some compounds that do not have molecules, but instead are long chains of covalent bonds (E.g. diamond)



- This happens in 3 dimensions, creating a crystal
- Because there are only covalent bonds, network solids are extraordinarily strong

Metallic crystals

- Metals normally occur as solids (high melting points).
- Thus, there must be strong bonds between the atoms of metals causing them to bond
- Bonding in metals and alloys is different from in other compounds: positive nuclei exist in a sea of electrons (this explains why metals conduct electricity)



Crystal types

- There are 6 types of intermolecular forces
- These forces are associated with certain crystal types. By comparing solids we have a common frame of reference.
- The crystal types and their basic units are
  1) Network (covalently bonded atoms)
  2) ionic (electrostatic attraction of ions),
  3) metallic (positive nuclei in electron sea),
  4) Molecular (electrostatic attraction of dipoles in molecules)
     a) Polar (dipole-dipole and H-bonding)
     b) Non-polar (London forces)

Properties of crystals

- Boiling and melting occur when the forces between molecules are overcome and a change of state occurs
- The higher the force of attraction between molecules (IMF) the higher the melting/-boiling point (see previous slide for order)
- Only metallic crystals conduct electricity in solid state (they also conduct in liquid state)
- Ionic crystals will conduct electricity in molten state or dissolved because ions are free to move to positive and negative poles

Solubility of crystal types

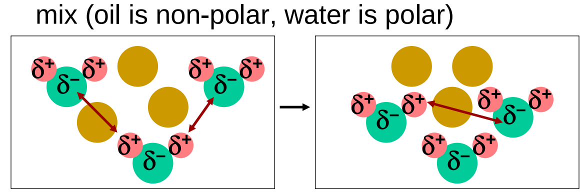
- Solute = what is dissolving (e.g. salt)
- Solvent = what it is dissolving in (e.g. water)
- Strong attractions between the basic units of covalent crystals cause them to be insoluble.
- Metallic crystals are likewise insoluble
- The solubility of other crystals depends on solute and solvent characteristics
- We will see that polar/ionic solutes dissolve in polar/ionic solvents and non-polar solutes dissolve in non-polar solvents
- This is known as the like-dissolves-like rule

Attraction and randomness

- The reason why some substances mix and others do not has to do with …
  1) Intermolecular forces
  2) the tendency for randomness due to random molecular motion
- Reference: 499 (starting from “A tendency toward randomness”) to 502 (ending right before “How Soaps and Detergents work”)

Mixing oil and water

- Lets take a look at why oil and water don’t mix (oil is non-polar, water is polar)



The dipoles of water attract, pushing the oil (with no partial charge) out of the way: attractions win out over the tendency toward randomness