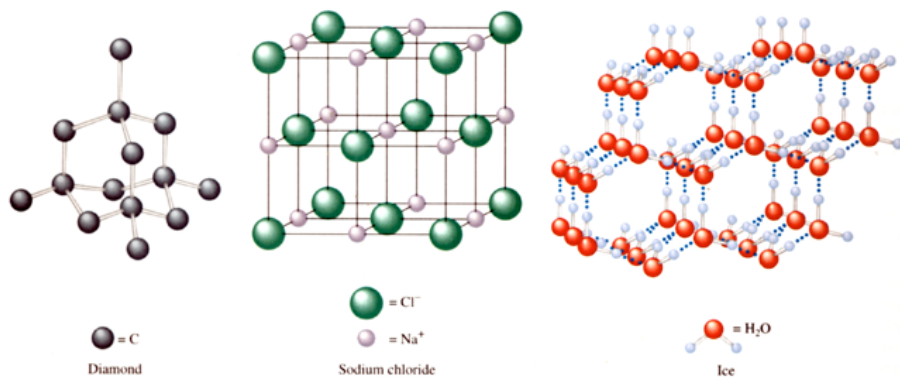


Students will be able to: Describe the difference between different types of solids. Identify different types of alloys and rationalize their properties. Explain how different types of intermolecular forces are formed and their relative strengths.

## Types of Solids

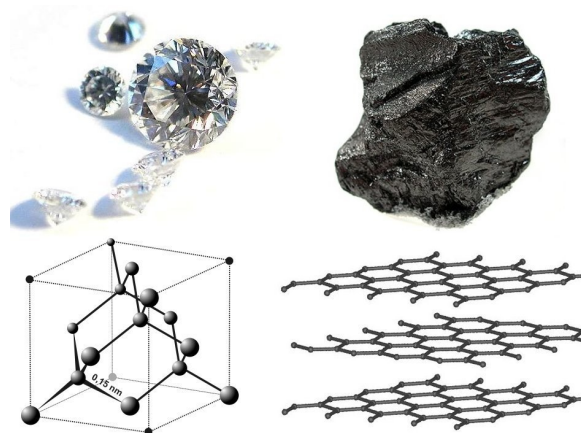
Solids are nearly always arranged in a regular pattern and are generally much easier to describe and model. In this class we will be categorizing solid structures based on what type of particle makes up the regular arrangement.



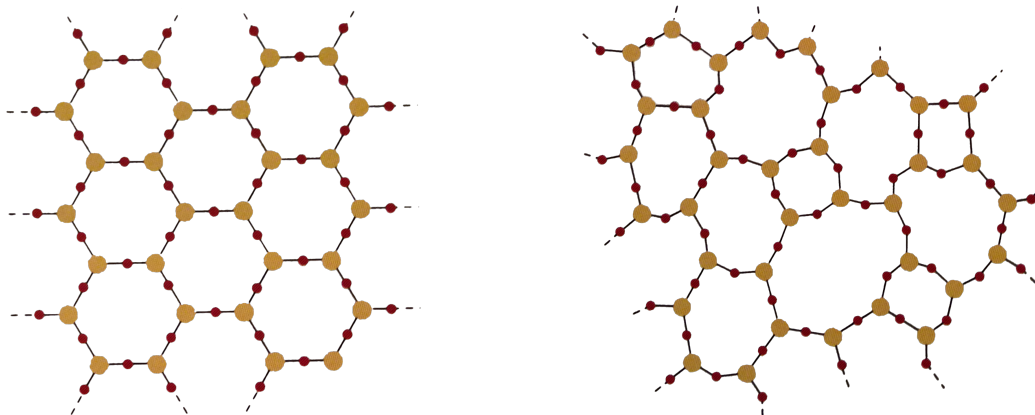
### Network Solids

In covalent network solids the solid is held together with a rigid grid of two or three dimensional covalent bonds. Common examples are diamonds and graphite, both of which are allotropes of carbon.

In diamonds the covalent bonds are arranged in a three dimensional structure, while in graphite they are two dimensional.



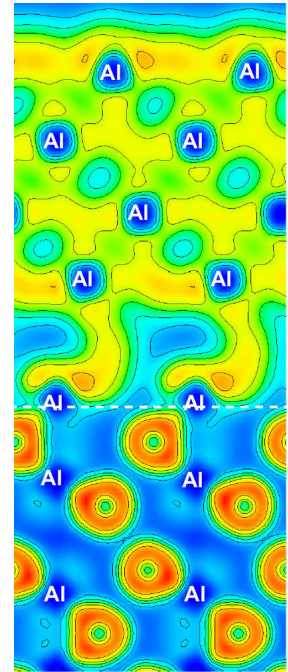
Another common network solid is silicon dioxide, better known as quartz. Quartz has many different types of internal structures the two most common are: quartz crystals which have a regular arrangement of atoms and quartz glass which has an amorphous structure. The irregular arrangement of atoms in the quartz glass give it a very broad melting point.



# Metals

Metals are held together by delocalized covalent bonds, the electrons are shared among many atoms creating what is called a “sea of electrons”. These delocalized electrons can travel through the material giving metals generally high conductivities and malleabilities.

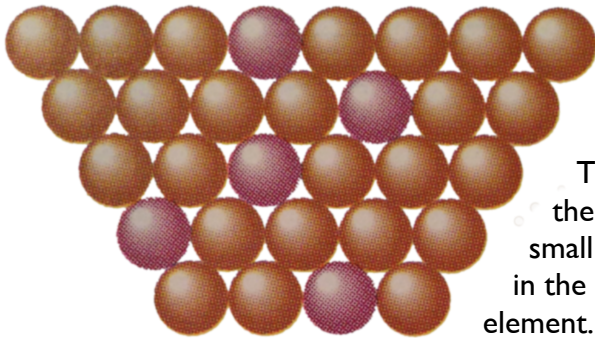
Introducing nonmetal atoms into the crystal structure will disrupt the delocalization of the electrons and create ceramics. The much more directional covalent bonds in the ceramics dramatically reduce the conductivity and malleability of the material.



## Alloys

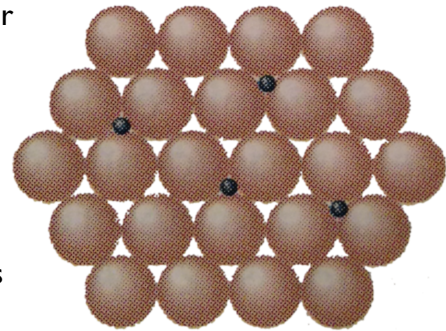
Alloys are mixtures of metals that generally come in two different types.

Substitutional alloys are formed when the atoms being mixed are similar in size. These alloys tend to have physical properties that are between the two elements being mixed. For instance the density of brass is between that of copper and zinc the two metals that make up the alloy.



The other main type of alloy is an interstitial alloy. In this type the elements involved have very different sizes. This leads the small atoms to fit in-between the gaps in the crystal structure of the larger element. One of the most common examples of this is carbon steel which

has carbon atoms fitting into the interstitial gaps in the iron crystal.



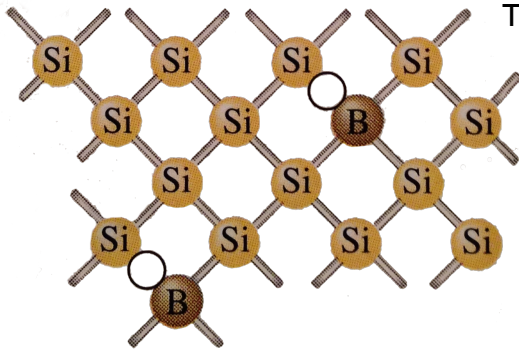
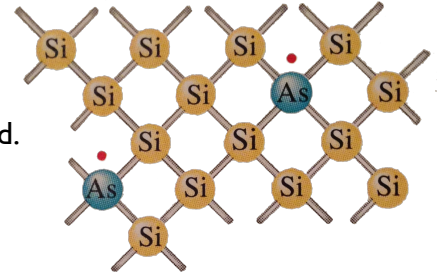
Interstitial alloys tend to have densities that are higher than either element alone and generally are generally harder and less malleable as the small atoms distort the crystal structure of the larger crystals.

Ex:

## Semiconductors

Semiconductors are materials that are less conductive than most metals but more conductive than insulators such as glass. In general semiconductors have internal structures similar to network solids but with electrons that are more mobile. The amount of conductivity can be selectively increased adding impurities in to the semiconductors crystal lattice.

There are two different types of impurities that are commonly added. By adding an element with more electrons than the matrix element we can increase the conductivity by the addition of additional negatively charged electrons that are free to move around. This is called a N-type semiconductor. A common example is the doping of a silicon crystal with arsenic atoms.



The second type of semiconductor is created by doping the matrix with an element that has fewer electrons. The missing electrons create a positively charged hole that nearby electrons can move into, thus increasing the conductivity of the material. A common example is the addition of boron into a silicon crystal to form a P-type semiconductor.

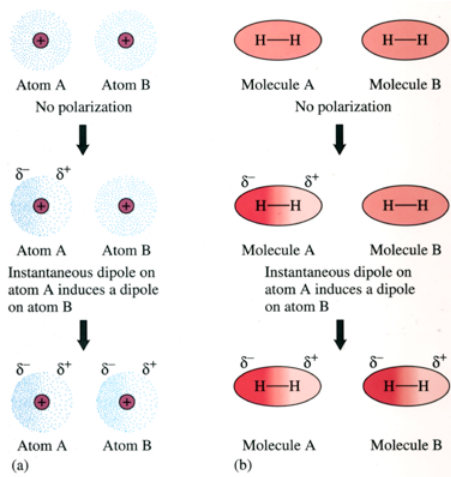
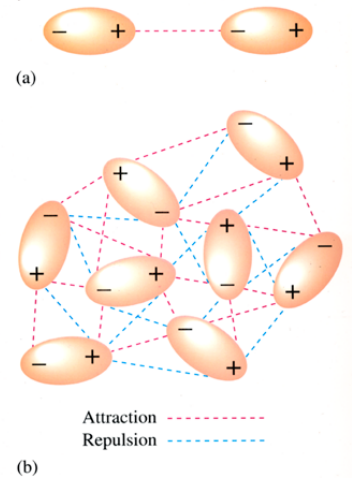
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## Intermolecular Forces

In KMT one of the postulates that we discussed was the assumption that there were no attractive forces between molecules. We went on to show that this was untrue. To understand condensed states of matter (solids and liquids) we need to have a much greater understanding of the the different types of intermolecular forces.

There are two main types of intermolecular forces:

Dipole-dipole interactions occur between molecules that are polar. Dipole-dipole interactions occur because of the attraction between the positive and negative charges on different molecules. Hydrogen bonding is an especially strong form of dipole-dipole interaction. Molecules that have hydrogen bonded to nitrogen, oxygen or fluorine can exhibit hydrogen bonding.



London dispersion forces are temporary dipole interaction that exist in all substances. They are the most important forces in non-polar molecules and are generally much weaker than dipole-dipole forces.