

Take a look at the unit Unit 3 module name.

Atomic arrangement in crystalline

matter types of what my name is.

Kimberly, Fiona Afonso.

In this particular module,

we will outline the various type of bonding

that exists between crystalline substances.

We will highlight what is

coordination number, atomic radii,

and mineral stability and also we

will study the concept of atomic

arrangement in crystalline matter.

By the end of this module,

we will summarize the various kind of bonding

that exists in a crystalline substance.

We shall know the concept of atomic radii,

radius ratio and coordination principle

as well as understand the atomic

arrangement in crystalline matter.

So basically, the basic unit of

all crystal structure is an

atom in a crystalline substance.

The constituent atoms are not only tightly packed on a repetitive pattern, but they also want together by forces of varying strengths depending on the type of bond that exists between the two atoms, the kind of bond that occur will depend on the electronic configuration, which makes other crystalline structure.

These forces that bind together the atoms of crystalline solids are electrical in nature.

They are tight and intensity are largely responsible for the physical and chemical properties of minerals.

For example, properties like hardness, cleavage, electrical and thermal conductivity are directly related to binding forces.

In general, stronger the bond, harder the crystal higher its melting point.

The structural pattern,

for example in Pericles and sodium chloride,

that is halite is similar,

yet very close,

has a higher melting point compared

to halide.

Also, great amount of heat energy is

required to separate the atoms in Pericles,

indicating it has a stronger electrical

bond compared to highlight.

These electrical forces are chemical

bonds and can be described as either ionic,

covalent, metallic,

Wonderwall and hydrogen bond.

The aim of these bonds is for each atom

to end up with a noble gas configuration

and the outer shell of electrons.

So let us take a look at ionic bonds.

Atoms can attain a stable configuration

like that of inert gases.

By losing or gaining electrons.

I haven't bond is the one in which

one or more electrons is transferred

from a cation to an anion.

Here the outermost electrons

are removed from one atom.

That is the donor and result in

electron orbital of another atom.

That is the electron acceptor in

the electron donor reside on the

left side of the periodic table,

while the acceptors are on the right.

These donors produce cations while the

acceptors are referred to as Anions.

Here is a classic example.

Well ionic bond that is seen in

sodium chloride or rock salt.

You will see that sodium basically loses

one of its electron and chlorine gains it,

thus, making it sodium ion,

which is a cation and a chlorine ion,

which is an anion giving rise

to sodium chloride molecule.

Here the bonds are held together by

electrostatic forces due to equal

and opposite charge.

Hence the compound formed in this way,

that is by transfer of electrons,

are said to be Electro

Vaillant or ionic compounds.

Minerals with ionic bonds are

mechanically strong and hard

and have a high melting point.

They conduct electricity by ion movement.

Large number of medals are ionic compounds.

Covalent bond here the electrons remember

can also be shared between 2 combining

atoms and thus the shared electrons

can contribute towards stable atoms.

So covalent bond is the one in which

electron is shared between adjacent atoms.

These bonds are quite stable as the

sharing allows a stable electronic

configuration for both the elements to occur.

Covalent bond,

mainly existing gases such as oxygen,

nitrogen, hydrogen and chlorine.

These types of bonds are common in organic

compounds and very rare in minerals.

Water is an example of how a single

covalent bond is formed between

two hydrogen atoms and the bond is

formed by the sharing of a pair of electrons.

The best example of a mineral that

exhibits covalent bonding is Diamond

Diamond is made up of carbon atoms,

each carbon atom has atomic number

6 and each of these carbon atoms is

covalently bonded to four other carbon atoms.

They are all held together by strong covalent

bonds in a 3D network,

if this continues in 3D it also makes

diamond one of the hardest minerals.

Here is an image of a carbon atom

showing it is covalently bonded

to four other carbon atoms.

Metallic bonding is exhibited by metals.

These occur when valence electrons

are released by the metal atom.

These electrons move around

the array of cations,

binding them together and the structure.

This electron mobility gives

metals good electrical,

thermal and conductor

ductility properties to the metals.

These metallic bond and minerals

are opaque to incident light.

The metallic bond occurs also in

sulfide minerals that do not have

sufficient electrons to fill its eight

orbitals in the outermost shell.

These electrons that is there give sulfide

its metallic luster as light bounces

off from the sea of valence electrons.

Example of vendors that have metallic

bonds are native metals like copper,

lead, gold,

silver and sometimes a few

sulfides in our sides.

Here is an example of

basically, a metallic bonding,

and you can see the free electrons

that is floating.

There is a large attraction of the

positive metal ions for the negative

delocalized valence electrons.

These forces help to help

the crystal together.

When the while bonds are weak,

short range electrostatic attractive

forces between an uncharged molecules

arising from the interaction of permanent

or transient electric dipole interactions.

That is many molecules although

electrically neutral could have some time.

A small-time average concentration of

electrons on one side of the molecule,

thus, creating a distortion in

the charge distribution.

This creates a positive and negative.

End with a molecule.

This type of bond help in understanding

bonding between the electrically

neutral sheets and phyllosilicates.

Also,

mentors could occur as a

combination of two or

more bonds. Thereby,

the crystal will therefore shape

properties of different bonding,

and this will result in

an isotropic properties.

For example, mental graphite.

You have two bots,

one is a strong covalent bond

in the plains of the sheet,

whereas you have an excellent cleavage

that reflects the weak van der Waals bonding

that helps in joining the sheets together.

That is, understand what is

the concept of ionic radius?

Consider the ionic radii.

The size of this ion is given by

the radii measured in angstrom

units for some physical reason,

there is a limit to which two ions can

approach each other in such a position,

we take half the distance

between their centres.

This is called as your ionic radius.

The size of the atom and the crystal

structure depends on the number of

electronic shells surrounding the nucleus,

the type of bond,

and the size and number

of atoms surrounding it.

A large majority of compounds

are ionic compounds,

Diadochi as an ability of an atom of a different element to occupy a similar position in a crystal structure.

Thus, it is a replacement of one ion by another in a crystal lattice.

For example,

when Zn replaces magnesium in the isomorphous series of olivine.

So, what is radius ratio?

The strongest forces exist between ions that are the nearest neighbors.

Each ion tends to surround itself with ions of opposite charge is the number of nearest ions that can surround the central ion.

Ions depend on the relative sizes of the coordinated ions.

That is the coordination number with the ions,

the relative sizes of the ions is generally expressed as radius ratio,

which.

Is the radius of the kation to the

radius of the anion on the radii of

ions are measured in angstrom units.

Here is an example of a sodium chloride

where you have sodium and chlorine.

Sorry sodium and chlorine.

That gives us the radius ratio of 0.5.

There is also if you have two or

more cations that are coordinating

with the same anions you need to find

radius ratios for each separately.

For example,

if you have spinel, you will take

Mg as well as you take Al

to give you them the separate

radius ratios for each.

What does coordination principle,

when oppositely charged ions,

unite to form a crystal structure

in which the binding forces

are dominantly electrostatic?

Each ion will tend to gather to itself

or coordinate with as many ions of

opposite sign that its size permits.

The number of north ions surrounding

the cation is the coordination number of

the KATION with respect to the North ion.

For example,

if you have sodium chloride crystal.

You'll have the cation which is sodium

with surround itself through to six

of its chlorine neighbors there for

the coordination number in this case is 6.

In fluoride you have calcium,

which will surround itself by floating ions,

and there will be 8 of such fluorine ions,

so, the coordination number is 8.

This is determined by the relative sizes,

so, if the radii of      get unknown,

we will be able to

calculate the radius ratio.

Once we get a radius ratio.

This will help us understand

what is the coordination number.

It is found that there is a close relation

between the predicted coordination

number and those seen in nature,

confirming the assumption that ions does

behave like spheres of a definite radius.

Greater the distance between

the radius of two atoms,

the lower is the coordination number.

Assuming the ions are rigid spheres,

the following limiting values of radius

ratios for particular coordination have

been calculated in this particular table.

You will find that you have radius

ratios of a particular range that will

correspond to certain coordination number,

and that will in turn tell us

how the arrangement of the ions

are with respect to the cations.

Let us stick for example,  
in the radius ratio range of zero point  
42.73. The coordination number  
is 6 and this will be occupying  
the corners of octahedron as seen  
in sodium chloride crystals.

So here are two examples for  
you to understand the radius  
ratio and coordination number.

Minerals formed to lower the internal  
energy of the mass of the system.

This is a company door accomplished  
by building 3-dimensional repeating  
arrangement of atoms using chemical  
bonds of the shortest length possible.

So let us understand the close  
packing structure in three dimension.

The ionic solids ions I often larger  
than cat ions and therefore these  
anions touch the smaller cations  
then fit in the holes between ions.

Think of it as packing Co,  
packing softballs and golf balls  
in the most efficient way.

For now,  
practical purpose atoms and ions can be  
considered as hard spheres within a crystal.

These spheres are arranged  
in such a way that they fit  
together as close as possible.

The manner in which different atom fit  
together will depend on your relative size.

Is the simplest case would be to  
consider filling of space with  
atoms which has the same shape size  
and therefore, the radius ratio.

In this case will be one.

So let us take for consideration  
some marbles of uniform size and let  
us try to keep them as close as to  
one another so you will notice that  
one of such marble will surround

by a minimum of six others,  
so that of flat hexagonal pattern is  
obtained. This is seen in two dimension.

This will give a hexagonal layout of  
closed packing like you see in this  
particular image you have the red  
ball or a red marble that is surrounded  
by six other marbles around it.

Now the second layer of marbles.

Could there be placed in the  
indentations left by the first layer?

There is a space trapped between this  
layer that is not filled by solid marbles.

Here we get two types of holes.

That is the interstitial sites.

One is the octahedral hole,  
which has six nearest  
marble surrounding it and the  
other at the tetrahedral pole,  
which has four nearest neighbors  
as seen in this diagram.

There are two sets of positions in  
which the third layer could now fit.

Marbles, the third layer,  
are placed in the voids overlying  
the marbles of the bottom layer.

In such a case,  
we get hexagonal close packing here.

Basically we repeat the layers as a baby  
and it continues so forth in three dimension.

So basically you have the third  
layer and the first layer that are  
arranged in a similar fashion.

This is seen in the metals of Platinum group.

The other way is basically placing  
the marbles in the third layer in  
a different orientation of position  
with that of the first layer.

This will result in cubic closest packing  
as seen in native minerals like copper,  
gold and silver.

Here the stack will repeat as ABC,

ABC,

ABC.

Hence we conclude that in a closest packing

of similar spheres,

each must be surrounded by exactly

12 of others of same size.

Desire references thank you.