

Metals

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Metals....

Metals are naturally occurring elements.
They are more than 70 in number among the elements found till now.

i) Combined and free state of metals (occurrence of metals)

Metals are generally found in combined state, very rarely they found in free state.

Combined state of metals

Metals are generally occur in nature in the combination with other elements. The chief ores of metals are oxides, sulphides, halides & carbonates

K }
Na } occur as halide
Ca }
Mg }
Al } occur as oxide
Zn }
Fe } occur as sulphide
Ni }

fig-electrochemical series and occurrence of metals

Native and free state-

A few metals like Au, Ag, Pt, Hg etc are found in nature in elemental form, and are called in native & free form. Only 13 elements form are in free state, they are as follows.

Group (viii)

Fe Co Ni

Ru Rb Pd

Os Ir Pt

Group (IB)

Cu

Ag

Au

Group (IIB)

Hg

Table-List of metals, occur in free state.

Some elements are found in combined as well as free state for eg copper.

ii) Distinction between metal and non metal

Physical Properties

Metals

a) Metal are generally found in solid state at ordinary temperature.

Exception - Hg , is a liquid.

b) Metal possesses metallic lustre

c) Metals have high density, so they are hard but Na , K , Ca , Li are soft and light.

Non metals

a) Non-metals generally exists in all the three states of matter.

b) Non-metals are not lustrous.
Exception- Graphite & Iodine have lustre

c) Non metals have low density.

Distinction between metal and non metal

Physical Properties, contd...

Metals

- d) They are good conductors of heat & electricity.
- e) Metals are usually malleable and ductile.
- f) They have usually high melting and Boiling points.

Non- Metals

- a) They are poor conductors of heat & electricity. exception. Graphite, is good conductor of electricity.
- b) Non-metals are usually brittle.
- c) They have low melting and boiling points.
Exception - Diamond, has high melting & boiling Point.

Distinction between metal and non metal

Physical Properties, contd...

Metals

- g) Atoms of metals have fewer number of electrons in valence shell.
- h) The e-s in metals are loosely held, hence they can be easily removed.
So metals form cations, and during passage of electricity they are deposited on cathode and metals are said to be electropositive.

Non-Metals

- g) Atoms of non-metals have more than 3 e-s in valence shell except H₂.
- h) They form anions & they are discharged at anode and they are said to be electronegative. So, non metals have electronegative character.

Chemical Properties

Metals

- a) Metals form basic oxides.
 $\text{Na} + \text{O}_2 \rightarrow \text{Na}_2\text{O}$
Exception - ZnO & Al_2O_3 are amphoteric and oxides of Mn & Cr are acidic.
- b) Metals either do not form hydride, and even if forms, they are not stable.
- c) Chlorides of metals are stable.
- d) Metals easily lose electrons, hence act as reducing agent.

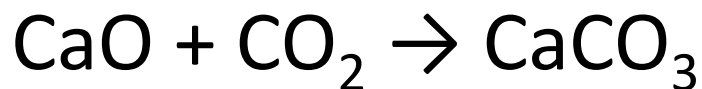
Non metals

- a) Non-metal forms acidic oxides
 $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- b) Hydrides of non-metals are quite stable.
- c) Chlorides of non-metals are unstable and chlorides of carbon are organic compounds.
- d) Non-metals have tendency to accept, so act as oxidizing agent.

(iii) Chemistry of metallic carbonates:-

Preparation:-

- (i) Metallic carbonates like Na_2CO_3 , K_2CO_3 and CaCO_3 may be obtained **by passing CO_2 gas** to their hydroxide or oxides.



Preparation of metallic carbonates, contd...

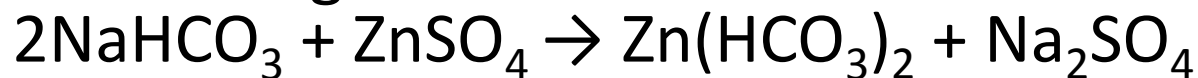
ii) **By double decomposition (preparation insoluble carbonates)→**

Insoluble metal carbonates can be prepared by treating their soluble salts with Na or NH_4CO_3 solution.



(iii) By function with sodium carbonates →

Similarly, normal carbonates of Ag, Ca, Sr can be prepared. In certain instances, on addition of sodium carbonates, basic carbonates are produced. For example soluble salts of zinc, copper and Mg when treated with Na_2CO_3 Solution, give basic carbonates. To obtain their carbonates the soluble salts are treated with sodium bicarbonate, and the resulting mixture is heated to get carbonate.



Properties of metallic carbonates..

Action of water→

Except carbonates of alkali metals, all other carbonates are insoluble in water .



Action of heat→

Except sodium and potassium carbonates, all other carbonates decompose on heating to give oxides & carbon dioxide.



Chemistry of metallic carbonates, contd...

Action of acid-

Carbonates dissolve in acid with effervescence giving CO₂ gas and corresponding salts.

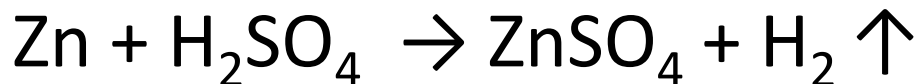


(iv) CHEMISTRY OF METALLIC SULPHATES

General methods of preparation -

(i) By the action of metals with sulphuric acid:-

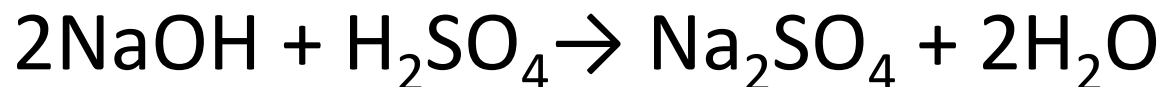
The sulphates formed by this method is filtered and the filtrate is heated to its crystallization point.



CHEMISTRY OF METALLIC SULPHATES, preparation, contd...

(ii) By treating the oxides, hydroxides carbonates and sulphides of metal with sulphuric acid.

The resulting solution is evaporated to crystallization .



CHEMISTRY OF METALLIC SULPHATES, preparation, contd...

(iii) By double decomposition (preparation of insoluble sulphates) -

Soluble salts is treated with excess of sulphuric acid and precipitate formed is separated by filtration



General properties of metallic sulphates, contd..

Action with water→

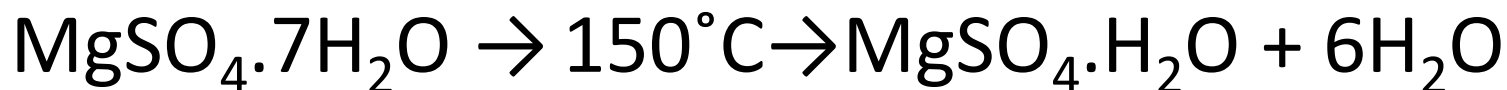
Except sulphates of Barium, strontium & lead other sulphates of metals are soluble in water, and they crystallize with a no. of H_2O molecules as the water of crystallization .

Sulphates of Ca & Ag are slightly soluble in water.

General properties of metallic sulphates, contd..

Action of Heat→

Water of crystallization present in metal sulphate may be lost at ordinary conditions or may be removed by heating to a different temperature. For example,



Magnesium Sulphate heptahydrate

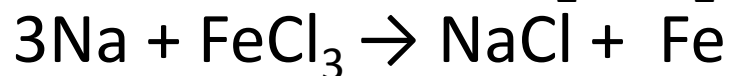
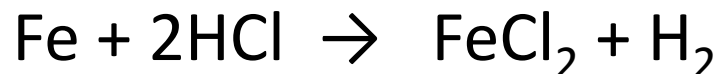
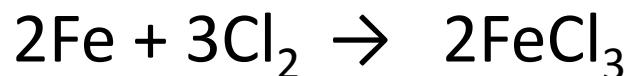


(v) Chemistry of Metallic Chloride

General methods of preparation

A) Preparation of Anhydrous Chlorides

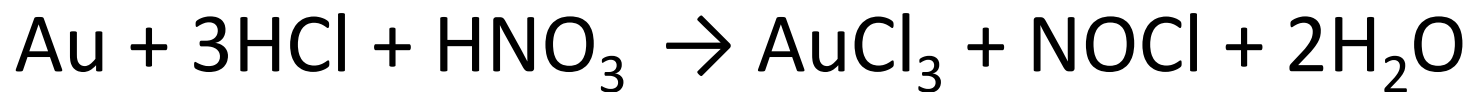
By heating metals with chlorine or dry hydrochloric acid or chlorides or chlorides of other metal.



B) Preparation of hydrated chlorides :

i] By treating metal with HCl, aqua regia, etc.

Soluble chlorides of metals can be prepared by this process the resulting solution is filtered and the filtrate is heated to crystallization point to get crystals of chlorides of the metals.



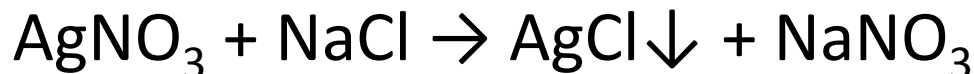
Preparation of hydrated chlorides, contd....

ii] By treating with oxides, hydroxides, carbonates or sulphides of metal with HCl



iii] By double decomposition (Preparation of insoluble chlorides)

This type of chlorides can be prepared by adding sodium chloride or HCl solution on nitrates of metal.



Chemistry of Metallic Chloride, contd...

General Properties

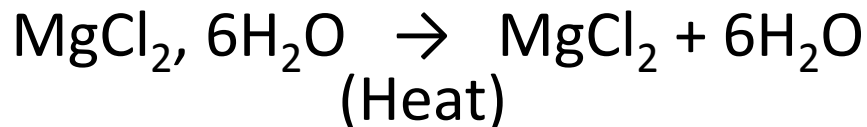
Action of water

Except AgCl , Hg_2Cl_2 and Cu_2Cl_2 , chlorides of metals are soluble in water. Lead chloride is sparingly soluble in cold water but soluble in hot water

Chemistry of Metallic Chloride, contd...

Action with heat

Most chlorides simply melt when strongly heated (for example. NaCl, KCl, etc.) and certain hydrated chlorides decompose when heated eg. $\text{MgCl}_2, 6\text{H}_2\text{O}$; $\text{CuCl}_2, 2\text{H}_2\text{O}$



Action with acid

When chlorides of metals are strongly heated with conc. H_2SO_4 , HCl gas is evolved.

