Chemistry Study Materials for Class 11
(NCERT Based Notes of Chapter 10)
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The s – Block Elements

GROUP II ELEMENTS
[ALKALINE EARTH METALS]

General Characteristics

1. General electronic configuration: [Noble gas] ns^2
2. Ionization enthalpy: have low ionisation enthalpy and decreases down the group. First ionization enthalpies of alkaline earth metals are higher than those of alkali metals.
3. Hydration enthalpy: Hydration enthalpy of alkaline earth metal ions decreases with increase in ionic size.

   $Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

4. **Flame colouration**

Alkaline earth metals give characteristic colour to the flame. In flame the electrons are excited to higher energy levels and when they return to the ground state, energy is emitted in the form of visible light. So calcium gives brick red, Strontium gives crimson red and Barium gives apple green colour to the flame.

The electrons in Be and Mg are very strongly bound to the nucleus. So they do not get excited by the flame. Hence these elements do not give flame colouration.

Chemical Properties

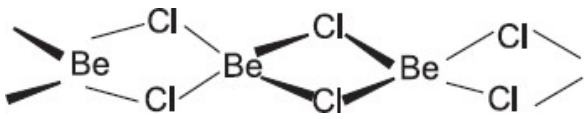
1. Reaction with air and water

   Be and Mg are inert to O_2 and H_2O because of the formation of oxide film on their surface. However powdered Be burns brilliantly in air to give BeO and Be_3N_2. Other elements form monoxide with air.

2. Reaction with halogen

$M + X_2 \rightarrow MX_2$

$BeCl_2$ is prepared by passing chlorine gas to a mixture of BeO and Carbon at 600 – 800K. $BeO + C + Cl_2 \rightarrow BeCl_2 + CO$



It has a chain structure in the solid state.

In the vapour phase, it forms chloro-bridged dimmer.

3. Reaction with hydrogen $M + H_2 \rightarrow MH_2$

BeH_2 can be prepared by the reaction of $BeCl_2$ with lithium aluminium hydride ($LiAlH_4$).

$2BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$

4. Reaction with acids: $M + 2HCl \rightarrow MCl_2 + H_2$

5. Reducing nature: Like alkali metals, group II elements are strong reducing agents. But the reducing power is less than that of alkali metals.

6. Solution in liquid ammonia: They dissolve in liquid ammonia to form deep blue black solution due to the formation of ammoniated electrons.

$M + (x + y)NH_3 \rightarrow [M(NH_3)_x]^{2+} + 2[e(NH_3)_y]^-$

<u>Anomalous Properties of Beryllium</u>

Beryllium shows some anomalous behaviour as compared to magnesium and other members of the group. Some of the properties are:

1. Be has high ionization enthalpy and small size. It forms compounds which are highly covalent and get easily hydrolised.
2. It does not show co-ordination number more than 4 as its valence shell contains only 4 orbitals. The remaining members of the group can have a co-ordination number of 6 by making use of vacant d- orbitals.
3. The oxide and hydroxide of Be are amphoteric in nature.
4. $BeCl_2$ exists as dimer even in vapour phase and is soluble in organic solvents.

Diagonal relationship between Beryllium and Aluminium

1. Like Al, Beryllium is not readily attacked by acids because of the presence of an oxide film on the surface of the metal.
2. $Be(OH)_2$ dissolves in excess of alkali to give beryllate ion, just as $Al(OH)_3$ gives aluminate ion.
3. The chlorides of both the elements have bridged structure in vapour phase. Both the chlorides are soluble in organic solvents and are strong Lewis acids. They are used as Friedel – Crafts catalysts.
4. Be^{2+} and Al^{3+} ions have strong tendency to form complexes BeF_4^{2-} and AlF_6^{3-}.

Uses of Alkali metals

1. Beryllium is used in the manufacture of alloys. Copper-beryllium alloys are used in the preparation of high strength springs. Metallic beryllium is used for making windows of X-ray tubes.
2. Magnesium-aluminium alloys are used in air-craft construction. Magnesium (powder and ribbon) is used in flash powders and bulbs, bombs and signals. A suspension of magnesium hydroxide in water (called milk of magnesia) is used as antacid in medicine. Magnesium carbonate is used in toothpaste.
3. Calcium is used in the extraction of metals from oxides which are difficult to reduce with carbon. Calcium and barium metals are used to remove air from vacuum tubes.
4. Radium salts are used in radiotherapy, for example, in the treatment of cancer

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