Beryllium

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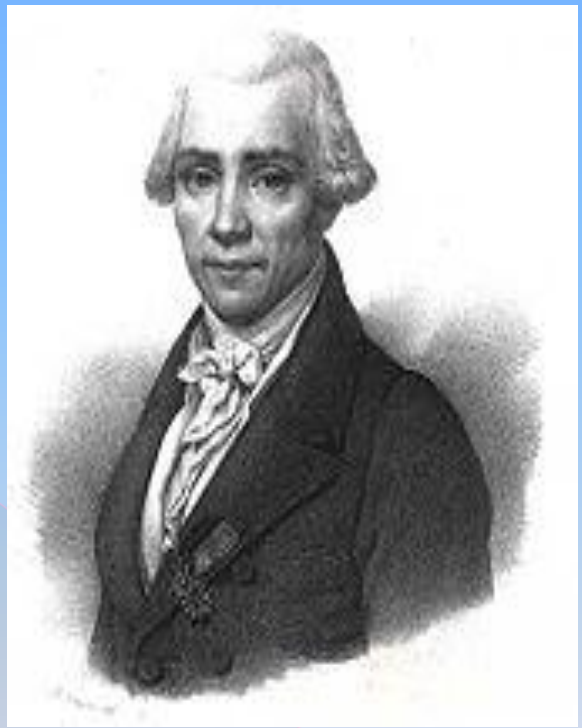
Lecture plan

1. General characteristic of beryllium
2. Occurrence
3. Preparation of beryllium
4. Physical properties of beryllium
5. Chemical properties of beryllium
6. Compounds
7. Application

Beryllium

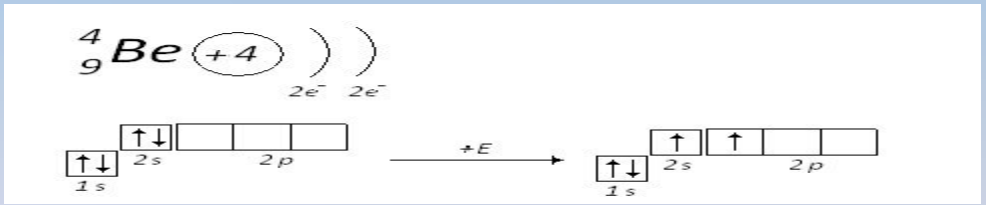
Beryllium was first discovered in 1794 by french chemists Nicholas Vauquelin.The name beryllium comes from the name of beryl mineral.



- Beryllium is located in the Periodic table in the second A group and the second period. Beryllium the first member of group 2A. Beryllium is a chemical element with symbol Be and atomic number 4.

It's electron configuration is

$+4\ Be\ 1s^2\ 2s^2$



Beryllium is a steel gray and hard metal that is brittle at room temperature and has a close-packed hexagonal crystal structure.

It melts at 1258ºC, boils at 2970ºC and has a density of 1,848 g/cm³.

It is has one stable isotop: 9Be

Occurrence

- The Sun has a concentration of 0.1 parts per billion of beryllium. Beryllium has a concentration of 2 to 6 parts per million in the Earth's crust. Beryllium is found in over 100 minerals,but most are uncommon to rare. The more common beryllium containing minerals include:
- bertrandite ($Be_4Si_2O_7(OH)_2$)
- beryl (Al_2 [$Be_3(Si_6O_{18})$]
- chrysoberyl (Al_2BeO_4)
- phenakite (Be_2SiO_4).

Minerals of Beryllium

Emerald

Red Beryl

Aquamarine

White beryl

Chrysoberyl

Morganite

Phenakit

Heliodorous

Preparation

- Friedrich Wöhler and Antoine Bussy independently isolated beryllium in 1828 by the chemical reaction of metallic potassium with beryllium chloride, as follows:

$$BeCl_2 + 2\ K \rightarrow 2\ KCl + Be$$

- At the present time beryllium is obtained by reducing beryllium fluoride with magnesium:

$$BeF + Mg \rightarrow Be + MgF_2$$

Chemical properties

- The chemical properties of beryllium are very similar to aluminium. It has only +2 oxidation number in it's compounds. Metallic beryllium is relatively little reactive at room temperature. In a compact form it doesn't react with water.

- Beryllium reacts with diluted H2SO4 and HNO3 solutions.

$$Be + H_2SO_{4\,(dil)} \rightarrow BeSO_4 + H_2\uparrow$$

$$3Be + 8HNO_{3\,(dil)} \rightarrow 3Be(NO_3)_2 + 4H_2O + 2NO$$

- Beryllium also can be affected by concentrated H2SO4 and HNO3

$$Be + 2H_2SO_{4\,(conc)} \rightarrow BeSO_4 + 2H_2O + SO_2$$

$$Be + 4HNO3_{\,(conc)} \rightarrow Be(NO_3)_2 + 2H_2O + 2NO_2$$

- Beryllium reacts with nonmetals and several compounds at high temperature:

$$2Be + O_2 \rightarrow 2BeO$$

$$Be + N_2 \xrightarrow{650^\circ C} Be_3N_2$$

- Beryllium forms binary compounds with many non-metals. Anhydrous halides are known for F, Cl,Br and I:

$$Be + F_2 \rightarrow BeF_2$$

$$Be + Cl_2 \rightarrow BeCl_2$$

$$Be + Br_2 \rightarrow BeBr_2$$

$$Be + I_2 \rightarrow BeJ_2$$

Since beryllium is an amphoteric metal it also reacts with strong bases and liberates H2 gas

$$Be + NaOH \rightarrow Na_2BeO_2 + H_2 \uparrow$$

$$Be + 2NaOH + 2H_2O \rightarrow Na_2[Be(OH)_4] + H_2 \uparrow$$

Compounds

- Beryllium oxide

  Beryllium oxide, BeO, is a white refractory solid, which has the wurtzite crystal structure and a thermal conductivity as high as in some metals. BeO is amphoteric.

$$BeO + 2HCl_{(conc)} \rightarrow BeCl_2 + H_2O$$

$$BeO + 2NaOH_{(conc)} + H_2O \rightarrow Na_2[Be(OH)_4]$$

Beryllium hydroxide

- **Beryllium hydroxide**, $Be(OH)_2$, is an amphoteric hydroxide, dissolving in both acids and alkalis. Industrially, it is produced as a by-product in the extraction of beryllium metal from the ores beryl and bertrandite.

  With alkalis it dissolves to form the tetrahydroxidoberyllate anion.With sodium hydroxide solution:

$$2NaOH(aq) + Be(OH)_2(s) \rightarrow Na_2Be(OH)_4(aq)$$

- With acids, beryllium salts are formed. For example, with sulfuric acid, H_2SO_4, beryllium sulfate is formed:

$$Be(OH)_2 + H_2SO_4 \rightarrow BeSO_4 + 2H_2O$$

- Beryllium hydroxide dehydrates at 400 °C to form the soluble white powder, beryllium oxide:

$$Be(OH)_2 \rightarrow BeO + H_2O$$

Beryllium sulphide

- Beryllium sulphide is a chemical compound with the formula BeS. It is a white crystalline substance.
- Beryllium sulphide is slowly hydrolyzed by cold water, in hot water the reaction proceeds quickly:

$$BeS + H_2O \rightarrow Be(OH)_2 + H_2S$$

- Diluted acids decompose beryllium sulfide with the release of hydrogen sulfide:

$$BeS + H_2Cl_{(dil)} \rightarrow BeCl_2 + H_2S$$

$$BeS + H_2SO_{4\,(dil)} \rightarrow BeSO_4 + H_2S$$

- Beryllium sulphide reacts with hot solutions of alkali and alkali metal carbonates:

$$BeS+4NaOH \rightarrow Na_2[Be(OH)_4]+Na_2S$$

$$BeS+2Na_2CO_3+H_2O \rightarrow Na_2[Be(OH)_6]+Na_2S+CO_2$$

- Halogens, with the exception of iodine (which does not react with beryllium sulphide) form halides in the interaction with BeS:

$$BeS+Cl_2 \rightarrow BeCl_2+S$$

Application

- in roentgen technology
- in nuclear power as a retarder of netrons
- in laser technology for the manufacture of radiators
- in aerospace engineering in the manufacture of thermal screens
- as a refractory material

Thank you for the attention