# *Beryllium*


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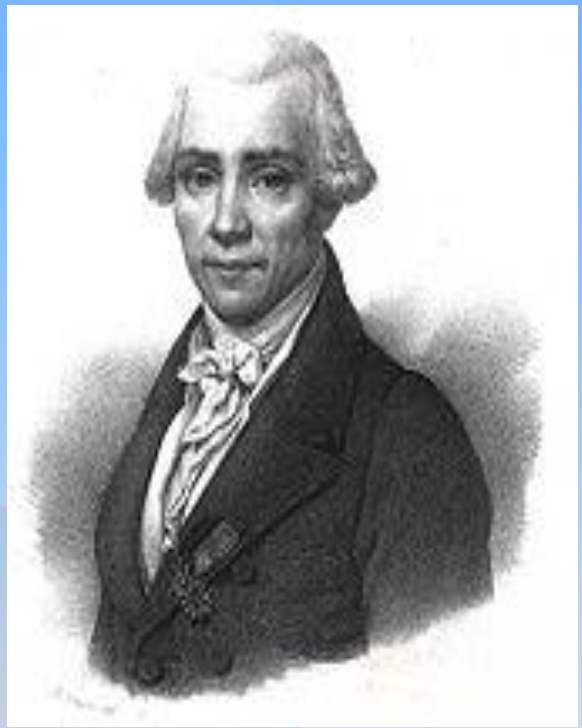
# *Lecture plan*

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

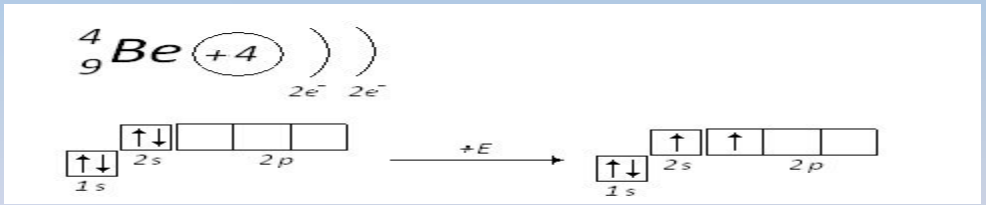
Beryllium was first discovered in 1794 by french chemists Nicholas Vauquelin.The name beryllium comes from the name of beryl mineral.



- 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*