

Chemistry, Alkaline Earth Metals

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Alkaline Earth Metals

Oxides of Ca, Ba and Sr are called 'Earth' in early days, because they occur in early days, because they occur in earth crust. The solution of these elements is alkaline to litmus. So, it was renamed as alkaline earth metals.

Periodic discussion

Alkaline earth metals belong to group IIA (2nd) of the P.T.

Alkaline earth metals

Alkaline earth metal's names, symbol, electronic configuration and important physical properties are as follows.

Expect Be and Mg, all the other metals of gr.IIA impart characteristics colour when heated to bunsen flame.

Ca(brick red), Sr(Crimson), Ba(Apple green), Ra(Carmine red).

Element	Symbol	Electronic configuration	M. pt. (°C)	B. pt. (°C)
Beryllium	⁴ Be	[He] 2s ²	1278	2920
Magnesium	¹² Mg	[Ne] 3s ²	649	1090
Calcium	²⁰ Ca	[Ar] 4s ²	839	1484
Strontium	³⁸ Sr	[Kr] 5s ²	769	1384
Barium	⁵⁶ Ba	[Xe] 6s ²	725	1640
Radium	⁸⁸ Ra	[Rn] 7s ²	700	1140

General Characteristics of alkaline earth metals

Physical properties

- i) Alkaline earth metals are reactive white soft metals having fairly low melting point and B.Pt as shown in table
- ii) The size of atoms of alkaline earth metals are fairly large though smaller than the corresponding alkali metals. This is due to higher nuclear charge of these atoms which tends to draw the orbital electrons inwards i.e. towards the nucleus. On account of the smaller atomic size, these elements are harder, have high densities than alkali metals.

Physical properties of Alkaline earth metals contd...

iii) Oxidation State

Alkaline earth metals release 2 electrons and change into bivalent cations. Therefore, alkaline earth metals exhibit +2 oxidation state in their compounds to acquire noble gas configuration.



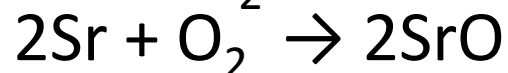
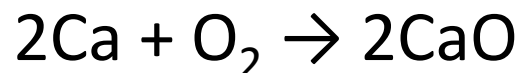
iv) Electropositive Character (Metallic Character)

Because of their relatively low values of ionization energies, the alkaline earth metals have great tendency to lose both the S-electrons present in their valence shells to form dipositive ions. Thus, these elements possess strong electropositive or metallic character.

Chemical properties

i) **Action with air**

The alkaline earth metals react slowly with air so that a tarnished layer of oxide is formed on the metals.



ii) **Action with water**

These metals react with water to form hydroxides.

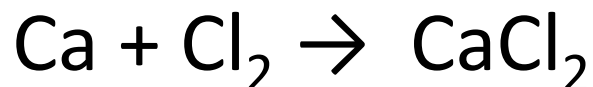
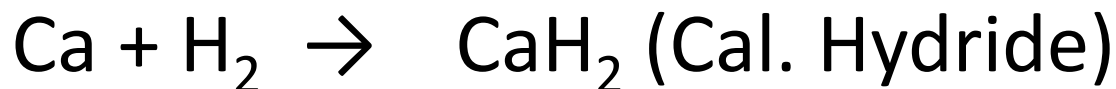


Be does not react with water.

Chemical properties of alk. Earth.

Metals contd....

ii) Action with H₂, N₂, and Halogens



Exception: Be does not react with H₂.

iv) Action with acids



Calcium

Calcium is the 3rd member of alkaline earth metals (gr IIA).

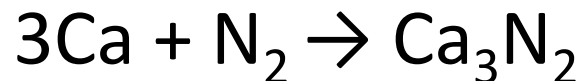
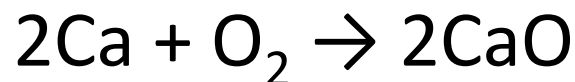
Physical properties

- i) Ca is silvery white metal.
- ii) It is soft metal of low density.
- iii) It is good conductor of heat and electricity.

Chemical properties

i) Action with air

Ca is slowly attacked by air on heating, it burns to form calcium oxide and calcium nitride.



ii) Action with water

Ca reacts with water evolving hydrogen gas.

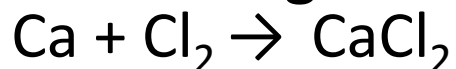


iii) Action with acids

It reacts with dilute mineral acids liberating H₂ gas



iv) With Halogens



Uses

i) Calcium is a powerful reducing agent. It is used in the extraction of metals which are difficult to reduce with carbon.

ii) It exhibits high reactivity towards O₂ and N₂. So, it is used to remove air from vacuum tubes.

iii) It is used to remove last traces of water from alcohol

Aluminium and Alloys

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Aluminium

It is in group III B of the periodic table

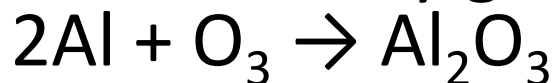
Physical properties

- i) It is a white metal with a bluish tinge.
- ii) It melts at about 658°C .
- iii) It is malleable, ductile and very light. But it possesses great toughness.
- iv) It's sp. gravity is about 2.7.
- v) It is a good conductor of heat and electricity.

Chemical properties of Aluminium

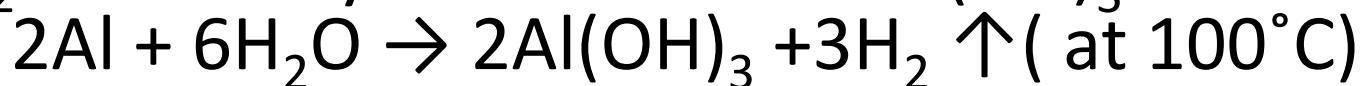
i) Action of air

Dry air has no action; moist air produces a thin film of oxide which protects the metal from the further action. When strongly heated in air, it burns brilliantly giving Al_2O_3 .



ii) Action of water

Al– powder decomposes water at 100°C ; giving of H_2 and slowly converted into $\text{Al}(\text{OH})_3$.



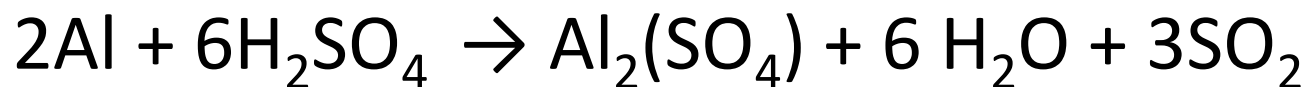
Chemical properties of Al contd...

iii) Action with acids

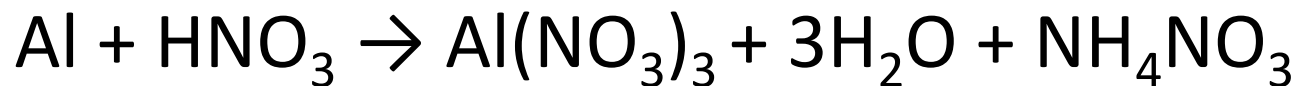
a) Dil.HCl or Conc. HCl reacts with Al, giving off H_2 .



b) Hot and conc. H_2SO_4 attacks Al with the liberation of SO_2 .

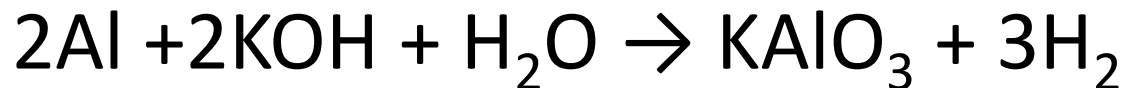


c) Dil. HNO_3 very slowly acts on Al producing Ammonium nitrate.



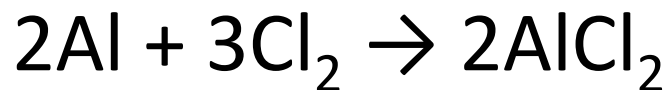
Chemical properties of Al contd...

iv) Action with Alkalies– Formation of aluminates.

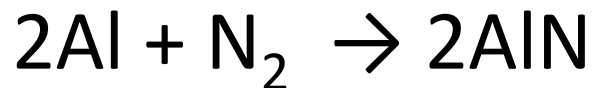


Pot. Aluminates

v) With Halogens

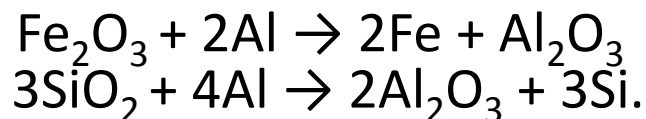


vi) With Nitrogen



vii) Reducing action

Al reduces the oxides of Fe, Cr, Mn, Si etc, when they are mixed with the powdered solid and are strongly heated.



Uses of Al

- i) It is used as reducing agent, in the production of Cr, Sr, Mn etc.
- ii) It is used in making alloys (Aluminium Bronze, an alloy of Al and Cu, looks like gold; Mangalium is an alloy of Al and Mn)
- iii) In the manufacture of cooking utensils, surgical instruments etc.)
- iv) It is used as 'Silver Paper' for packing chocolates etc.

Alloys (Imp)

An alloy is a homogeneous mixture of metal with other elements. The other element may be metal or non metal. For examples, steel, brass, bronze, bell metal etc.

Purpose of making alloys

To get a product having desirable properties which the constituent element do not possess.

Composition and uses of some Alloys are as follows

Alloy	Compostion	Uses
1. Steel	Fe 98-99.8% Cu 0.2-2.0%	For making machinery knife, tools, swords etc
2.Stainless steel	Cr 12-18% Ni 1-8% Fe 74-80%	utencils, auto mobile parts, hospital equipments etc.

Alloy, composition and uses

3. Copper alloy Brass	Cu 60-80% Zn 20-40%	Household utensils, sheets etc.
4. Bronze	Cu 75-90% Sn 10-25%	Utensils, coins, statues, ornaments etc.
5. Bell Metal	Cu 80% Sn 20%	Bells and gongs
6. Aluminium alloy	Cu 90%, Al 9.5%	Cheap ornaments, golden paint, photo frames etc.
a) Aluminium bronze	Sn 0.5%	
b) Alnico	Steel 50%, Ni 2%, Al 20% and Co 1%	For making permanent magnet.
7) Duraluminium	Al 95%, Cu 4% Mg 0.5%, Mn 0.5%	Body of aircraft, pressure cooker, ships etc.