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 Chracteristics of alkaline earth metals

Physical propertes

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 orbitals 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.

$Mg \rightarrow Mg^{++} + 2e^{-}$

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 reacts slowly with air so that a tarnished layers of oxide is formed on the metals.

$2Ca + O_2 \rightarrow 2CaO$

$2Sr + O_2 \rightarrow 2SrO$

ii) **Action with water**

These metals reacts with water to form hydroxides.

$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2 \uparrow$

Be does not reacts with water.

Chemical properties of alk. Earth. Metals contd….

ii) Action with H_2, N_2, and Halogens

$Ca + H_2 \rightarrow CaH_2$ (Cal. Hydride)

$3Ca + N_2 \rightarrow Ca_3N_2$ (Cal. nitride)

$Ca + Cl_2 \rightarrow CaCl_2$

Exception: Be doexnot reacts with H_2.

iv) Action with acids

$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2 \uparrow$

$Ca + 2HCl \rightarrow CaCl_2 + H_2 \uparrow$

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 elecricity.

Chemical properties

i) **Action with air**

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

$2Ca + O_2 \rightarrow 2CaO$

$3Ca + N_2 \rightarrow Ca_3N_2$

ii) **Action with water**

Ca reacts with water evolving hydrogen gas.

$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2 \uparrow$

iii) Action with acids

It reacts with dilute mineral acids liberating H_2 gas

$Ca + 2HCl \rightarrow CaCl_2 + H_2 \uparrow$

iv) With Halogens

$Ca + Cl_2 \rightarrow CaCl_2$

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 O_2 and N_2. 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.

$2Al + O_3 \rightarrow Al_2O_3$

ii) **ii) Action of water**

Al– powder decomposes water at 100˚C; giving of H_2 and slowly converted into $Al(OH)_3$.

$2Al + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2 \uparrow$ (at 100˚C)

Chemical properties of Al contd…

iii) Action with acids

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

$2Al + 6HCl \rightarrow Al_2(SO_4) + 6H_2O + 3SO_2$

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

$2Al + 6H_2SO_4 \rightarrow Al_2(SO_4) + 6\ H_2O + 3SO_2$

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

$Al + HNO_3 \rightarrow Al(NO_3)_3 + 3H_2O + NH_4NO_3$

Chemical properties of Al contd…

iv) Action with Alkalies– Formation of aluminates.

$$2Al + 2KOH + H_2O \rightarrow KAlO_3 + 3H_2$$

Pot. Aluminates

v) With Halogens

$$2Al + 3Cl_2 \rightarrow 2AlCl_2$$

vi) With Nitrogen

$$2Al + N_2 \rightarrow 2AlN$$

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.

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$
$3SiO_2 + 4Al \rightarrow 2Al_2O_3 + 3Si.$

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 utencils, 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 on 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 **1. Steel**	**Compostion** **Fe 98-99.8%** **Cu 0.2-2.0%**	**Uses** **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 utencils, sheets etc.**
4. Bronze	Cu 75-90% Sn 10-25%	Utencils, coins, statues, ornaments etd
5. Bell Metal	Cu 80% Sn 20%	Bells and gongs
6. Aliminium alloy a) Aluminium bronze	Cu 90%,Al 9.5% Sn 0.5%	Cheap ornaments, golden paint, photo frames etc
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.