INORGANIC CHEMISTRY -III

- Representative Elements-I
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le 2.8: The hydration enthalpies of alkali meta

ion	Li^+	Na^+	K^+
py (kJ mol^{-1})	–506	–406	–330

thalpies of alkali metal ions become less
ergy liberated per mole being in the orde

$$Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$$

ximum degree of hydration and thereby t

$O(l) \rightarrow$

ce between the two terms *ionization enthalpy* a
regarded synonymous here for the sake of co
tween the values of $\Delta_i H^\circ$ and ionization energy a

lues therefore not only depend upon the ioniz
like hydration enthalpy of the ions in aqueous s
ple, it is seen that, despite having the highest
e highest difficulty among the alkali metals in

(i) **Reactivity towards air/O_2:** Alkali metal
forming oxides. Lithium forms *monoxide*
metals form *superoxides*.

$$4Li + O_2 \rightarrow 2Li_2O \text{(oxide}$$

$$2Na + O_2 \rightarrow Na_2O_2 \text{ (pero}$$

$$M + O_2 \rightarrow MO_2 \text{ (superc}$$

All these metals form their *monoxides* too
O_2.

$$4M + O_2 \rightarrow 2M_2O$$

Lithium shows exceptional behaviour in

$E^{\circ}_{M^+/M}/V$	−3.04	−2.

(iii) Reactivity towards water: The alka
and hydrogen.

$$2M(s) + 2H_2O(l) \rightarrow 2M^+(aq) +$$

Although the reaction of Li with w
react explosively with water. The exc
to its small size and very high hydrat

(iv) Reactivity towards hydrogen: All
high temperature to form ionic hydri

$$2M + H_2 \rightarrow 2M^+H^-$$

(v) Reactivity towards halogens : The a

charge/radius ratio) of its ion. Some points in this

1. The melting point and boiling point of Li are metals.
2. Li is much harder than other alkali metals.
3. Lithium is the least reactive but the strong alkali metals.
4. Li reacts with oxygen least readily among monoxide Li_2O whereas other alkali metals (M_2O_2) or superoxide (MO_2)] too.

$$4M + O_2 \rightarrow 2M_2O$$

$$2Na + O_2 \rightarrow Na_2O_2 \text{ (peroxide)}$$

9. Li_2CO_3, LiF and Li_3PO_4 are o
corresponding salts of other alkal

10. While the carbonates and hydroxi
Li_2CO_3 and LiOH undergo therma

$$Li_2CO_3 \rightarrow Li_2O +$$

$$2LiOH \rightarrow Li_2O +$$

11. Lithium nitrate when heated give
metal nitrates undergo thermal dec

$$4LiNO_3 \rightarrow 2Li_2O$$

$$2NaNO_3 \rightarrow 2NaNO$$

(iv) Both form a nitride each by direct combination

$$6Li + N_2 \rightarrow 2Li_3N$$

$$3Mg + N_2 \rightarrow Mg_3N_2$$

(v) Their monoxides, Li_2O and MgO, do not combin
do not yield superoxides.

(vi) The carbonates of Li and Mg decompose easily
and CO_2.

$$Li_2CO_3 \rightarrow Li_2O + CO_2$$

$$MgCO_3 \rightarrow MgO + CO_2$$

(vii) Both LiCl and $MgCl_2$, on account of their sign
soluble in ethanol.

lattice enthalpies. In fact, except Li_2CO_3, other alkali metal carb
before they eventually decompose into oxides at temperatures a

um carbonate is not so stable to heat and decomp
ry small in size, polarizes a large CO_3^{2-} ion leadin
$_2O$ and CO_2.

$$Li_2CO_3 \rightarrow Li_2O + CO_2$$

olubilities of the salts of Group 1 are determined b
thalpies, the hydration enthalpies of the concer
in going from solid to solution. Whereas Li_2C
e remaining carbonates of the Group 1 meta
s of the alkali metal carbonates increase as w
tion can be explained as follows.

alkali metal carbonates, the lattice enthalpies
ne hydration enthalpies of the alkali metal cati
Group with increase in the size of the cation [*Re*
ctors have opposing influences on solubility.
ubility on moving down the Group whereas
However, the decrease in the lattice enthalpy
herefore more than compensates for the decrea
nthalpy. As a result, the solubilities of the alkal

Hydroxides — Basicity

xcept LiOH, the alkali metal hydroxides are the strong
dissolve freely in water with evolution of much hea
ation of the ions. This is due to their low ionizati
ropositive characters.

ne basic character of the alkali metal hydroxides (M
the Group. This can be explained as follows.

moving down Group 1 from Li to Cs, the first ioniza
ectropositive character increases. As a result, in aqu
cleavage become easier on moving down the Group,
cter of the metal hydroxide.

$$MOH \rightarrow M^+ + OH^-$$