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Study Notes on Alkali Metal Trends

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Summary of Alkali Metals (Group 1) Trends

1. All metals are **malleable** and tends to become softer down the group. For instance, Lithium can be cut by knife, whereas, Rb and Cs are of the consistency of putty.

2. Reactivity of metals towards O_2 and H_2O increases as we go down the group.

Reaction with H_2O	**Reaction with O_2**
Li reacts slowly	Li forms Li_2O
Na reacts vigorously	Na forms Na_2O_2
K evolves H_2	K forms KO_2
Rb and Cs are explosive	Rb and Cs forms RbO_2 and CsO_2 respectively

3. Lithium does not replace proton on PhC=CH, whereas, all other elements from the group do.

4. Group 1 elements generally forms **ionic compounds**, with Lithium being an exception.

5. They form a wide range of salts with **ionic properties**; such as-
   - High Melting Points.
   - Water solubility that gives conducting solutions.
   - Halide salts are ionic and are not hydrolysed.
   - Basic nature of oxides and hydroxides.
   - Their hydrides are ionic, basic and are strong reducing agents.

6. **Thermal stability** of their sulphates, carbonates, nitrates, peroxides, and superoxide increases as we go down the group.

7. With the increase in size of metal atom, any electron pair which is bonded becomes father from the nucleus of metal and it gets least attracted towards the same. This leads to decrease in **electronegativity** down the group 1.

8. **Solubility of hydroxide** in water increases as we go down the group.
   LiOH < NaOH < KOH < RbOH < CsOH

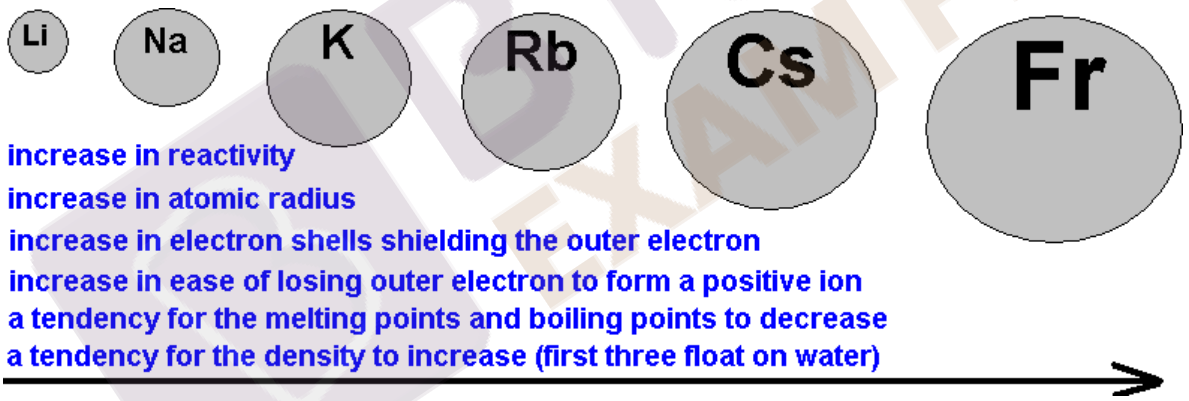
9. Lithium possess high **charge/size ratio**, which leads to anomalies, such as-
   - LiH is more stable than other hydrides.
   - Li_2CO_3 is very much less stable than other carbonates in the group.
   - Lithium salts are less soluble in water whereas, more soluble in organic solvents.
   - Li and Na forms a number of hydrated salts. Whereas, K forms some hydrated salts and Rb and Cs does not form any hydrated salts.

10. Alkali metal ions do not readily form **complexes** with ligands such as NH_3 or CN^- but forms complexes with polydentate ligands or chelates, such as crown ethers and cryptands.
    The **bonding** in the complex ions is primarily electrostatic, i.e., ionic, and very hard; and the relative size of cation and cavity plays an important role. For instance, the complex ions with 18-crown-6 ether ligand follows the order of stability: $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$. This implies that different ring sizes prefer different ions. For example,
    12-crown-4 and 15-crown-5 prefers Li^+;
    24-crown-8 prefers Rb^+ and Cs^+.

11. RLi are used as reagent in organic chemistry as they're readily synthesized. These are soluble in organic solvents and provide slightly more reactive source of carbanions than the Grignard reagent, RMgX.

    RLi compounds also forms oligomers or clusters in form of rings and polyhedral which has hydrocarbon residues which dominates the surface.

    In comparison to this, Alkyls of Na and K are more ionic in nature and forms infinite 3-D structure in its solid state. These are soluble in hydrocarbons and are also extremely air/moisture sensitive.



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