Saline hydrides (also known as ionic hydrides or pseudohalides) are compounds formed between hydrogen and the most active metals, especially with the alkali and alkaline-earth metals of group one and two elements. In this group, the hydrogen acts as the hydride ion (\(\text{H}^-\)). They bond with more electropositive metal atoms. Ionic hydrides are usually binary compounds (i.e., only two elements in the compound) and are also insoluble in solutions.

\[
\text{2A}_\text{(s)} + \text{H}_2\text{(g)} \rightarrow 2\text{AH}_\text{(s)} \tag{3}
\]

with \(\text{A}\) as any group 1 metal.

\[
\text{A}_\text{(s)} + \text{H}_2\text{(g)} \rightarrow \text{AH}_2\text{(s)} \tag{4}
\]

with \(\text{A}\) as any group 2 metal.

Ionic hydrides combine vigorously with water to produce hydrogen gas.

Example \(\PageIndex{1}\): Alkali Metal Hydrides

As ionic hydrides, alkali metal hydrides contain the hydride ion \(\text{H}^-\) as well. They are all very reactive and readily react with various compounds. For example, when an alkali metal reacts with hydrogen gas under heat, an ionic hydride is produced. Alkali metal hydrides also react with water to produce hydrogen gas and a hydroxide salt:

\[
\text{MH}_\text{(s)} + \text{H}_2\text{O}_\text{(l)} \rightarrow \text{MOH}_\text{(aq)} + \text{H}_2\text{(g)}\]

The instability of the hydride ion compared to the halide ions can be seen by comparison of the \(\Delta H_f\) for alkali metal hydrides and chlorides.

<table>
<thead>
<tr>
<th>Cation</th>
<th>(\Delta H_f \text{MH} ) / kJmol(^{-1})</th>
<th>(\Delta H_f \text{MCl} ) / kJmol(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td>-90.5</td>
<td>-409</td>
</tr>
<tr>
<td>Na</td>
<td>-56.3</td>
<td>-411</td>
</tr>
<tr>
<td>K</td>
<td>-57.7</td>
<td>-436</td>
</tr>
<tr>
<td>Rb</td>
<td>-52.3</td>
<td>-430</td>
</tr>
<tr>
<td>Cs</td>
<td>-54.2</td>
<td>-433</td>
</tr>
</tbody>
</table>

Evidence for the ionic nature of these hydrides is:

\[
\text{NaH} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2\text{}\]

(Their moisture sensitivity means that reaction conditions must be water-free.)
1. molten salts show ionic conductivity.
2. X-ray crystal data gives reasonable radius ratios expected for ionic compounds.
3. Observed and calculated Lattice Energies (from Born-Haber cycles etc.) are in good agreement (i.e. show little covalency).

NaH is capable of deprotonating a range of even weak Brønsted acids to give the corresponding sodium derivatives.

\[\text{NaH} + \text{Ph}_2\text{PH} \rightarrow \text{Na}[	ext{PPh}_2] + \text{H}_2\text{PH}\]

Sodium hydride is sold by many chemical suppliers as a mixture of 60% sodium hydride (w/w) in mineral oil. Such a dispersion is safer to handle and weigh than pure NaH. The compound can be used in this form but the pure grey solid can be prepared by rinsing the oil with pentane or tetrahydrofuran, THF, care being taken because the washings will contain traces of NaH that can ignite in air. Reactions involving NaH require an inert atmosphere, such as nitrogen or argon gas. Typically NaH is used as a suspension in THF, a solvent that resists deprotonation but solvates many organosodium compounds.