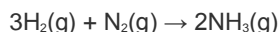
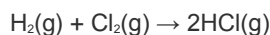


Hydrides

The term hydride is commonly named after binary compounds that hydrogen forms with other elements of the periodic table. Hydride compounds in general form with almost any element, except a few noble gases. The trends and properties vary according to the type of intermolecular force that bonds the elements together, the temperature, its molecular masses, and other components. Hydrides are classified into three major groups, depending on what elements the hydrogen bonds to. The three major groups are covalent, ionic, and metallic hydrides. Formally, hydride is known as the negative ion of a hydrogen, H^- , also called a hydride ion. Because of this negative charge, hydrides have reducing, or basic properties. Its special characteristics will be further discussed.

Covalent Hydrides

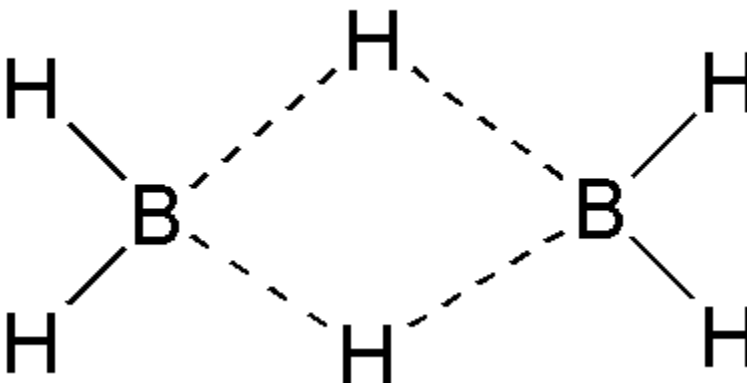
The first major group is covalent hydrides, which is when a hydrogen atom and one or more non-metals form compounds. This occurs when hydrogen covalently bonds to a more electropositive element by sharing electron pairs. These hydrides can be volatile or non-volatile. Volatile simply means being readily able to be vaporized at low temperatures. One such example of a covalent hydride is when hydrogen bonds with chlorine and forms hydrochloric acid (HCl). Examples are listed below:



The hydrides of nonmetals on the periodic table become more electronegative as you move from group 13 to 17. This means that they are less capable of donating an electron, and want to keep them because their electron orbital becomes fuller. Instead of donating a H^- , they would instead donate a H^+ because they are more acidic.

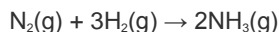
Boron Hydrides

Boron can form many different types of hydrides. One of them is borane (BH_3). They react violently with air and is easily oxidized. Borane occurs as a gaseous substance, and can form B_2H_6 by two borane molecules combined with each other. Borane is not a stable compound because it does not follow a complete octet rule since it has six valence electrons. Synthesizing organic compounds require boron hydrides, therefore they are significant in our daily lives.



Nitrogen Hydrides

Ammonia is an important nitrogen hydride that is possible due to the synthesis of nitrogen and water which is called the Haber-Bosch process. The chemical equation for this reaction is:



In order to yield ammonia, there needs to be a catalyst to speed up the reaction, a high temperature and a high pressure. Ammonia is a reagent used in many chemistry experiments and is used as fertilizer.

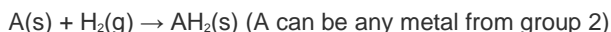
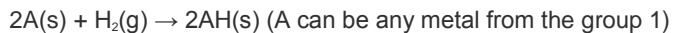
Ammonia can react with sulfuric acid to produce ammonium sulfate, which is also an important fertilizer. In this reaction, ammonia acts as a base since it receives electrons while sulfuric acid gives off electrons.



Other hydrides of nitrogen include ammonium chloride, hydrazine and hydroxylamine. Ammonium chloride is widely used in dry-cell batteries and clean metals.

Ionic Hydrides

The second category of hydrides are ionic hydrides, also known as saline hydrides or pseudohalides. These compounds form 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 (H^-). They bond with more electropositive metal atoms. They are usually binary compounds. Binary compounds occur when there are two elements in a compound. They are also insoluble in solutions.



Ionic hydrides combine vigorously with water to produce hydrogen gas.

Alkali Metal Hydrides

As ionic hydrides, alkali metal hydrides contain the hydride ion 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. The following reaction is shown below:



Metallic Hydrides

The third category of hydrides are metallic hydrides, also known as interstitial hydrides. Hydrogen bonds with transition metals. One interesting and unique characteristic of these hydrides are that they can be nonstoichiometric, meaning basically that the fraction of H atoms to the metals are not fixed. Nonstoichiometric compounds have a variable composition. The idea and basis for this is that with metal and hydrogen bonding there is a crystal lattice that

H atoms can and may fill in between the lattice while some might, and is not a definite ordered filling. Thus it is not a fixed ratio of H atoms to the metals. Even so, metallic hydrides consist of more basic stoichiometric compounds as well.

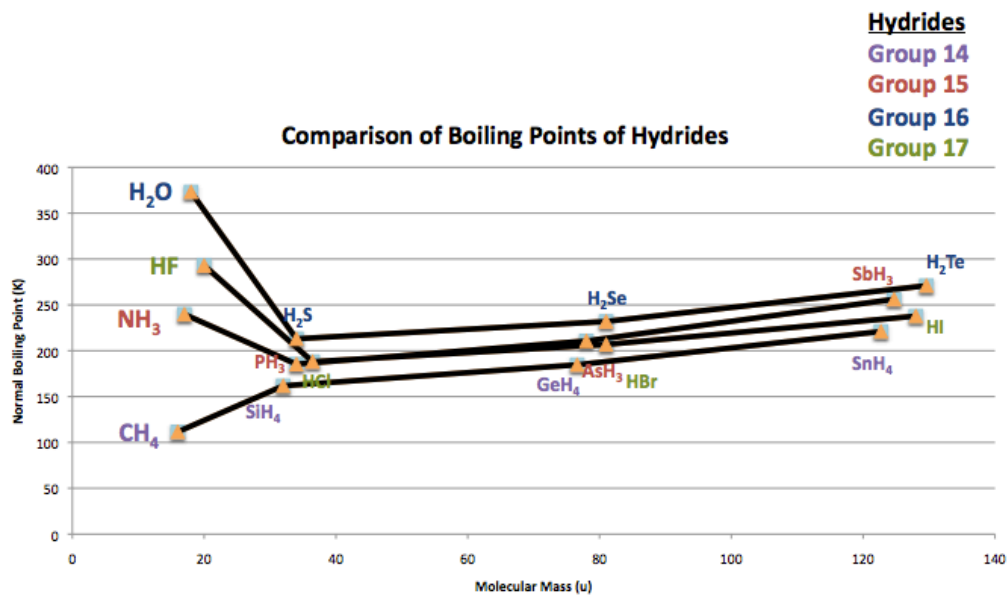
Trends and Properties

Hydrogen Bonds

You may think that hydrides are all intact through hydrogen bonding because of the presence of at least a hydrogen atom, but that is false. Only some hydrides are connected with hydrogen bonding.

Hydrogen bonds have energies of the order of 15-40 kJ/mol, which are fairly strong but in comparison with covalent bonds at energies greater than 150 kJ/mol, they are still much weaker. Some hydrogen bonding can be weak if they are mildly encountered with neighboring molecules. Specifically fluorine, oxygen, and nitrogen are more vulnerable to hydrogen bonding.

In hydrides, hydrogen is bonded with a highly electronegative atom so their properties are more distinguished. Such that in the chart below comparing boiling points of groups 14-17 hydrides, the values of ammonia (NH_3), water (H_2O), and hydrogen fluoride (HF) break the increasing boiling point trend.



The following image plots the boiling points of various hydrides with elements from groups 14-17. Hydrides of NH_3 , H_2O , and HF break the trend due to hydrogen bonds.

Supposedly, as the molecular mass increases, the boiling points increase as well. Due to the hydrogen bonds of the three following hydrides, they distinctly have high boiling points instead of the initial assumption of having the lowest boiling points. What occur in these hydrogen bonds are strong dipole-dipole attractions because of the high ionic character of the compounds.

Noble Gases

Hydrides form elements with almost every element on the periodic table except some noble gases. The reason for this is because noble gases already have a full octet and a filled electron orbital. They are in a stable state in which a proton or electron is not necessarily wanted so they are chemically nonreactive. Unless they have the potential to expand their octet like krypton and xenon, other noble gases do not have the ability to form hydrides.

Source: http://chemwiki.ucdavis.edu/Inorganic_Chemistry/Descriptive_Chemistry/Compounds/Hydrides