

Hydrogen iodide

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Hydrogen iodide is a chemical compound with the formula **HI**. Aqueous solutions of HI are known as hydroiodic acid, a strong acid. Hydrogen iodide and hydroiodic acid are, however, different in that the former is a gas under standard conditions, whereas the other is an aqueous solution of said gas, which means their properties differ slightly.

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Properties

Chemical

Hydrogen iodide slowly reacts with oxygen to give water and iodine. This will also happen when exposed to light. In moist air it will give a mist of hydroiodic acid.

Physical

Hydrogen iodide is a colorless gas, with an acrid odor. It is exceptionally soluble in water (245 g/100 mL), giving hydroiodic acid. The dissolution is exothermic. It is also slightly soluble in alcohols.

Hydrogen iodide

Names	
IUPAC name	Hydrogen iodide
Systematic IUPAC name	Hydrogen iodide
Other names	Anhydrous hydroiodic acid
Properties	
Chemical formula	HI
Molar mass	127.904 g/mol
Appearance	Colorless to yellowish gas
Odor	Poignant
Density	2.85 g/mL (−47 °C)
Melting point	−50.80 °C (−59.44 °F; 222.35 K)
Boiling point	−35.36 °C (−31.65 °F; 237.79 K)
Solubility in water	245 g/100 ml
Solubility	Reacts with amines, alkali Slightly soluble in alcohols
Acidity (p <i>K</i> _a)	−10 (water) 2.8 (acetonitrile)
Hazards	
Safety data sheet	Matheson (https://www.mathesongas.com/pdfs/msds/MAT11100.pdf)
Flash point	Non-flammable
Related compounds	
Related compounds	Hydrogen fluoride Hydrogen chloride Hydrogen bromide
Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa).	
Infobox references	

Availability

Anhydrous hydrogen iodide is not sold by most chemical suppliers, due to its instability and reactivity. Even if it's sold, it would certainly not be available to the amateur chemist, as both hydrogen iodide and hydroiodic acid are DEA List I chemicals.

Preparation

There are several ways to prepare hydrogen iodide.

One common way involves reacting iodine and white phosphorus. 11 parts (by weight) of iodine is added in a small flask, and 1 part of dried white phosphorus is slowly added. The reaction takes place immediately, giving off light and the two reagents turn liquid on contact. This process yields phosphorous triiodide, which is treated with 1.5 parts water. This causes the phosphorous triiodide to hydrolyze and give off hydroiodic acid fumes. Gently heating the mixture will drive off most of the hydrogen iodide vapors. The resulting HI vapors from the reaction are passed over some moist red phosphorous which is placed in a U tube. Heating is continued until the liquid just becomes colorless, because if heating is continued further, phosphine and phosphonium iodide are formed, which can cause a powerful explosion, not to mention phosphine is extremely toxic.^[1]

A more convenient way involves the reaction of iodine with thiols. The reaction takes place in chloroform or THF at room temperature, over a period of 30 minutes.^[2]

Another method involves iodine in tetralin (Tetrahydronaphthalene). In a 500 ml flask, 40 grams of iodide is dissolved in 160 g of tetralin, at 40°C. In another 500 ml flask, a quantity of 40 g of tetrahydronaphthalene is heated to 200°C, close to its boiling point, under stirring. The iodine solution was continuously added in the second flask over a period of 2 hours, while keeping the temperature to 200°C. The resulting impure hydrogen iodide gas generated is collected in a cold finger if anhydrous hydrogen iodide is required. If hydroiodic acid is the desired substance, then the hydrogen iodide vapors are bubbled through a volume of 1 liter of water. The yield of the crude hydrogen iodide is 94.6%, with a purity of 99.5%.^[3]

The same reaction above can also be used to generate anhydrous hydrogen bromide.

This gas can also be prepared by reacting anhydrous potassium iodide with 85% phosphoric acid under careful heating.

More methods can be found here (<http://bitnest.ca/Rhodium/chemistry/hydroiodic.html>) and here (<https://www.erowid.org/archive/rhodium/chemistry/anhydrous.hi.html>)

Projects

- Make hydroiodic acid
- Make anhydrous iodide salts

Handling

Safety

Hydrogen iodide is corrosive and extremely toxic. It will cause severe burns to the skin, eyes and mucous tissues. If inhaled or ingested, it may prove fatal. It can also be absorbed through skin and contact may cause burns or if it's liquefied, frostbites. ^[4]

Legality

Like its aqueous solution, hydrogen iodide is classified as a DEA List I chemical and its sale is restricted.

Storage

Anhydrous hydrogen iodide is unstable and extremely corrosive and it's best to be made in situ and used as soon as it's made.

Disposal

Reacting it with a base or sodium thiosulfate will suffice.

References

1. <http://bitnest.ca/Rhodium/chemistry/hydriodic.html>
2. <http://pubs.acs.org/doi/abs/10.1021/o1991312d>
3. <http://www.google.com/patents/US5693306>
4. <http://cameochemicals.noaa.gov/chemical/11597>

Relevant Sciencemadness threads

- Hydrogen iodide(HI) (<http://www.sciencemadness.org/talk/viewthread.php?tid=17824>)

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