

Fluorine

F

General Information

Discovery

Fluorine was first isolated by H. Moissan in Paris in 1886, after nearly 74 years of continuous effort by several investigators including Davy, Gay-Lussac, Lavoisier and Thenard.

Appearance

Fluorine is a pale yellow, corrosive gas. It has a characteristic pungent odour, detectable at very low concentrations.

Source

Fluorine occurs chiefly in the minerals fluor spar and cryolite, but is rather widely distributed in other minerals. It can be obtained by electrolysing a solution of potassium hydrogen fluoride in anhydrous hydrogen fluoride in a vessel of metal or transparent fluor spar.

Uses

There was no commercial production of fluorine until World War II, when the production of the atom bomb and other nuclear energy projects made it necessary to produce large quantities. The element and its compounds are used in producing uranium and many fluorochemicals, including high-temperature plastics. Hydrofluoric acid is used for etching the glass of light bulbs and similar applications, and fluorochloro-hydrocarbons are used in air conditioning and refrigeration. The presence of fluorides below 2ppm in drinking water is believed to prevent dental cavities, but above this concentration may cause mottled enamel in children acquiring permanent teeth.

Biological Role

The element fluorine and the fluoride ion are highly toxic.

General Information

Fluorine is the most reactive of the non-metals, and will combine with most other elements. Only a few of the inert gases do not combine with this element. It corrodes platinum, a metal that resists most other chemicals. In a stream of fluorine gas many substances burn with a bright flame, including finely-divided metals, glass, ceramics, carbon, wood, rubber and even water.

Physical Information

Atomic Number	9
Relative Atomic Mass ($^{12}\text{C}=12.000$)	18.998
Melting Point/K	53.53
Boiling Point/K	85.01
Density/kg m ⁻³	1.696 (gas, 273K)
Ground State Electron Configuration	[He]2s ² 2p ⁵
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	333

Key Isotopes

Nuclide	¹⁸ F	¹⁹ F
Atomic mass		18.998
Natural abundance	0%	100%
Half-life	109.7 mins	stable

Ionisation Energies/kJ mol⁻¹

M - M ⁺	1681
M ⁺ - M ²⁺	3374
M ²⁺ - M ³⁺	6050
M ³⁺ - M ⁴⁺	8408
M ⁴⁺ - M ⁵⁺	11023
M ⁵⁺ - M ⁶⁺	15164
M ⁶⁺ - M ⁷⁺	17867
M ⁷⁺ - M ⁸⁺	92036
M ⁸⁺ - M ⁹⁺	106432

Other Information

Enthalpy of Fusion/kJ mol⁻¹ 1.02

Enthalpy of Vaporisation/kJ mol⁻¹ 3.26

Oxidation States

F⁻¹

Covalent Bonds/kJ mol⁻¹

F - F 159

F - O 190

F - N 272