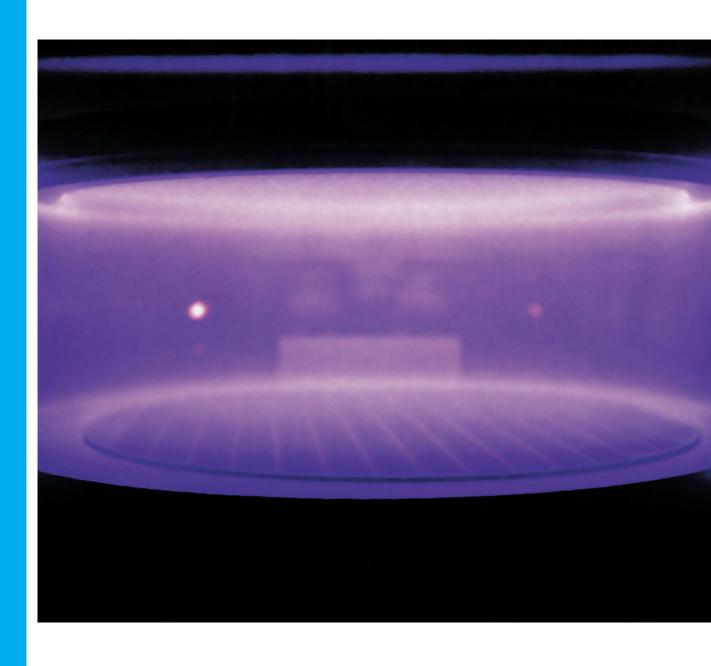


SIFREN®46

High Performance Etch Gas



Solvay Fluor



Solvay Fluor SIFREN®46

Product Description

SIFREN® 46 (C_4F_6 or Hexafluoro-1,3-butadiene) is an unsaturated fluorocarbon with an alternating double bond. It is a colourless, odourless, toxic and flammable gas showing very high performance for critical plasma etching in semiconductor devices manufacturing. Due to the short atmospheric lifetime (< 1day), the negligible global warming potential and the inertness to the stratospheric ozone layer, SIFREN® 46 is an environmentally friendly gas.

Thanks to the high C:F ratio of its molecule, it is possible to balance in the plasma etching and deposition species, by which superior results are achieved compared to other fluorinated gases, both in terms of selectivity and aspect ratio. This intrinsic characteristic and a wider process window than e.g. C_4F_8 (Octafluorocyclebutane) are particularly beneficial for sub 130 nm nodes productions.

Use Conditions

At about 20 °C, SIFREN® 46 is a stable gas and is compatible with the most carbon- or stainless-steel types. The chemically behaviour in presence of other metals like e.g. copper, tin, brass, zinc is not completely studied. In contact with magnesium or alloys with high magnesium (> 2 %) content, reactions are possible, contact must be avoided. The compatibility with plastics and elastomers depends on the temperature employed and additional additives in the plastics materials. Fluoro-rubbers are not always the best solution. LDPE, EPDM, PVC and Nylon are suitable plastics for SIFREN® 46. Material compatibility tests with SIFREN® 46 are recommended.

Toxicology

SIFREN® 46 is classified according to the EU Directives as a harmful substance by inhalation or in contact with skin and eyes, in case of intense or continuous exposure.

Toxicity testing shows a LC_{50} inhalation value (4h) of 4.42 mg/l for rats.

In vitro testing shows that SIFREN® 46 is not geno-toxic. The inhalation of gas is irritating to the respiratory tract. The contact of liquid SIFREN® 46 with skin and eyes may cause in frostbites. The recommended Occupational Exposure Level (OEL), also taken as the Company Internal Limit is 0.5 ppm for a 8-hour working day.

Warnings

Cylinders filled with SIFREN® 46 should be stored in a cool, dry and well ventilated area.

Keep cylinders away from heat and ignition sources or flammable substances. The product may be only used in plants equipped with explosion protected electrical devices: Working and storage areas have to be provided with a fire extinguishing system.

For preventing oxygen displacement ventilation of depressed areas e.g. floors, cellars are necessary. Further information can be obtained from our Technical Service Department.

Packaging

SIFREN® 46 can be ordered in 10, 20, 40 and 47 l cylinder.

Cylinders Capacity	10I TPED	201 TPED	401 TPED	471 DOT
Max filling weight	10kg	20 kg	40 kg	47 kg
Height with cap	960 mm	970 mm	1,670 mm	1,565 mm
Outer diam.	140 mm	204 mm	204 mm	232 mm
Tare with cap	14kg	29 kg	48kg	55 kg
Valve	DIN6/ DISS-724	DIN6/ DISS-724	DIN6/ DISS-724	DISS-724

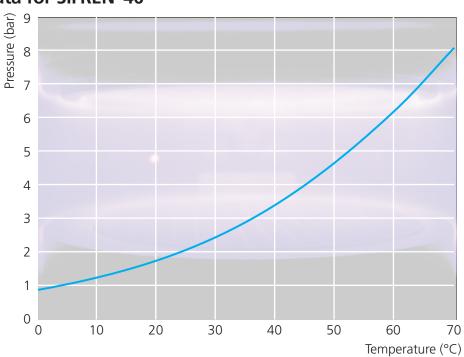
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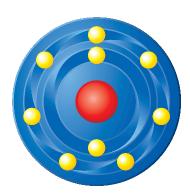
Chemical and Physical Properties

Chemical Formula		CF ₂ =CF-CF=CF ₂
Molecular Weight	g/mol	162.03
Boiling Temperature	°C	5.5
Freezing Temperature	°C	-130.0
Critical Temperature	°C	139.6
Critical Pressure	bar	31.9
Liquid Density (15°C)	kg/l	1.44
Vapour Density (15 °C)	kg/m³	6.8
Specific Volume of Vapour (at b.p.)	dm³/kg	135.8
Vapour Pressure (0 °C)	bar	0.81
Vapour Pressure (25°C)	bar	2.11
Heat of Vaporization (at b.p., 1.013 bar)	kJ/kg	161.8
Enthalpy of Formation (Vapour)	kJ/mol	- 942.2
Sat. Liquid Specific Heat (Cp, 25°C)	J/kg·K	1,134.1
Sat. Vapour Specific Heat (Cp, 25°C)	J/kg·K	843.7
Sat. Liquid Thermal Conductivity	W/m·K	0.107
Sat. Vapour Thermal Conductivity	W/m·K	0.00972
Ionization Energy	eV	9.5
Solubility in Water	g/l	insoluble
Flammability Limits in Air	%vol	7-73
Occupational Exposure Limit (OEL)	ppm	0.5
ODP		0
Lifetime	day	<1
GWP (estimated)	ITH 100 y	<1

Pressure/Temperature Data for SIFREN®46

Temperature (°C)	Pressure (bar)
0	0.81
10	1.22
20	1.77
30	2.51
40	3.46
50	4.66
60	6.16
70	7.99





Solvay Fluor – Competence in Fluorine Chemistry. Worldwide.

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