Technical Information

Zyron®
electronic gases

High-Purity Fluorinated Gases for Plasma Etching Applications

Introduction

DuPont continues to develop high-purity fluorine-containing gases to meet the evolving needs of the semiconductor industry as new generations of thin-film plasma etching processes are developed. Fluorinated gases offering both high-purity and increased performance levels in terms of etch rate, selectivity, and profile control are needed to meet the required productivity and reliability levels demanded during manufacture of today's most advanced semiconductor and related devices.

Building on its long history of expertise and innovation in the manufacture, purification, packaging, and analysis of fluorinated molecules, DuPont is uniquely positioned to reliably supply the high-purity fluorinated gases required by the industry.

Along with this broad foundation in fluorine chemistry comes a product stewardship commitment to provide the physical property, safety, and handling information necessary to enable the safe and efficient use of the Zyron® family of gases in plasma-based process applications.

This bulletin provides a brief overview of the Zyron® family of gases and their applications. For further detail on these or other compounds, including specifications, please call your nearest DuPont representative or contact us through our Web site at **http://www.dupont.com/zyron**.

Zyron® is a registered trademark of DuPont.

Table 1
Properties

	Zyron® 23 (CHF_3)	Zyron® 125 (CF_2HCF_3)	Zyron® 32 (CH_2F_2)	Zyron® 134a (CH_2FCF_3)
Name	Trifluoromethane	Pentafluoroethane	Difluoromethane	1,1,1,2, Trifluoroethane
Boiling Point, °C (°F)	–82 (–115.7)	–48.5 (–55.3)	–53.1 (–63.6)	–26.1 (–15)
Critical Temperature, °C (°F)	25.9 (78.6)	66 (150.8)	78.2 (172.8)	101 (213.9)
Vapor Pressure @ 25°C (77°F), MPa (psia)	4.6 (666)	1.4 (199)	1.7 (247)	0.7 (97)
TSCA Listed	Yes	Yes	Yes	Yes
CAS No.	75-46-7	354-33-6	75-10-5	811-97-2
Molecular Weight	70	120	52	102
Specific Volume, cu ft/lb	5.5	3.17	7.19	3.17
Global Warming Potential, 100 yr ITH	11,700	2,800	650	1,300
Toxicity (AEL)*, ppm vol	1,000	1,000	1,000	1,000

	Zyron® C318 (cyclo-C_4F_8)	Zyron® 236fa ($CF_3CH_2CF_3$)	Zyron® 152a (CHF_3CH_3)	Zyron® 1216 ($CF_2 = CFCF_3$)
Name	Octafluorocyclobutane	1,1,1,3,3,3, Hexafluoropropane	1,1,Difluoroethane	Hexafluoropropylene
Boiling Point, °C (°F)	–6 (21.1)	–1.4 (29.5)	–25.8 (–14.4)	–29.6 (–21.3)
Critical Temperature, °C (°F)	115.3 (239.5)	124.9 (256.9)	113.3 (235.9)	94.8 (202.7)
Vapor Pressure @ 25°C (77°F), MPa (psia)	0.3 (45.4)	0.2 (39.5)	0.6 (87)	0.6 (94.2)
TSCA Listed	Yes	Yes	Yes	Yes
CAS No.	115-25-3	690-39-1	75-37-6	116-15-4
Molecular Weight	200	152	66	150
Specific Volume, cu ft/lb	1.85	2.5	5.80	2.55
Global Warming Potential, 100 yr ITH	8,700	6,300	140	n/a
Toxicity (AEL)*, ppm vol	1,000	1,000	1,000	2

* **AEL** = DuPont Acceptable Exposure Limit (8-hr TWA). Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence. Please refer to the specific Material Safety Data Sheets for further information.

Selected Etching Application References

The following list of references represents the type of reports available on thin film plasma-processing with fluorocarbon etch gases. A more complete listing of the references can be found through AEDEPT, DuPont's computer database and search system for dry etch process technology literature retrieval.

- "The Many Challenges of Oxide Etching," *Semiconductor International, 20(6), 1997*.
- "New Etch Chemistries," *Proc. SIA/SSA/ SEMATECH GWP Symp., paper #2, 1994*.
- "Alternatives to PFCs as Plasma Processing Gases: SiO_2 etch ...," *Proc. Electrochem. Soc., 94-20, 300, 1994*.
- "High Density Plasma Oxide and Contact Etching," *Proc. Semicon West Symp. Etch Technology Adv. Manuf., 29, 1994*.
- "Fluorocarbon High Density Plasmas. VII. Investigation of Selective SiO_2 to Si_3N_4 High Density Plasma Etch Processes," *J. Vac. Sci. Technol A 14(4), 1996*.
- "Selective SiO_2/Si_3N_4 Etching in a Magnetized Inductively Coupled C_4F_8 Plasma," *J. Vac. Sci. Technol B., 16(2), 500, 1998*.
- "Highly Selective SiO_2 Etching Using ICP ...," *Jpn.J Appl Phys., 37, 2343, 1998*.
- "Hydrofluorocarbon Plasma Submicron Silicon Dioxide Etch in an Axisymetric Static Magnetron," *Vaccum, 45(5), 555, 1994*.
- "Highly Anisotropic Silicon and Polysilicon Room-Temperature Plasma Etching ...," *Microelectron. Eng., 41/44, 411, 1998*.
- "Highly Selective SiO2 Etch Employing Inductively Coupled Hydrofluorocarbon Plasma Chemistry for Self-Aligned Contacts," *Jpn. J.Appl.Phys., 36, 5798, 1998*.
- "Mechanism of Selective SiO_2/Si Etching with Fluorocarbon Gases (CF_4, C_4F_8) and Hydrogen Mixture in Electron Cyclotron ...," *J.Vac.Sci. Technol. A, 14(5), 1996*.
- "Advanced MERIE Technology for High-Volume 0.25 µm Generation Critical Dielectric Etch," *Solid State Tech., 40(8), 1997*.

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