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(DE). **FLOHR, Felix** [DE/DE]; Wildefüerstrasse 14,
31134 Hildesheim (DE). **FISCHER, Reiner** [DE/DE];
Poststrasse 5, 38173 Dettum (DE).

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(74) Agents: **JACQUES, Philippe** et al.; Solvay (Société
Anonyme), Intellectual Property Department, Rue de
Ransbeek, 310, B-1120 Bruxelles (BE).

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(71) Applicant (*for all designated States except US*): **SOLVAY (SOCIÉTÉ ANONYME)** [BE/BE]; Rue du Prince Albert, 33, B-1050 Bruxelles (BE).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **UENVEREN, Ercan** [TR/DE]; Kleestrasse, 2, 30265 Hannover (DE). **MARHOLD, Michael** [DE/DE]; Carl-Rumpff-Str. 75, 51373 Leverkusen (DE). **EICHER, Johannes** [DE/DE]; Ratswinkel 6, 31319 Sehnde (DE). **MROSS, Stefan** [DE/BE]; Rue Seutin 43, B-1030 Brussels (BE). **SESEKE-KOYRO, Ulrich** [DE/DE]; Eichendorffstrasse, 3F, 30916 Isernhagen (DE). **MEURER, Christoph** [DE/DE]; Eckerstrasse 9, 30161 Hannover (DE). **RIVA, Marcello** [IT/DE]; Plathnerstrasse 43, 30173 Hannover

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(54) Title: METHODS OF USING A SOLVENT OR A FOAM BLOWING AGENT

(57) Abstract: The invention relates to methods using environmentally advantageous compounds or compositions, for example, fluoro ethers, fluoroalkanes, fluoroalkenes, fluoroketones, nitrogen-, sulfur- and phosphorous substituted fluorides, for applications such as foam blowing, solvent cleaning, and refrigeration, as etching gas for semiconductor etching or chamber cleaning, heat transfer, fire extinguishing and production of aerosols, and to specific azeotropes which can be applied in at least one of these processes.



WO 2009/019219 A2

Methods of using a solvent or a foam blowing agent

The invention relates to methods using compounds or compositions for useful applications such as foam blowing, solvent cleaning, and refrigeration, as etching gas for semiconductor etching or chamber cleaning, heat transfer, fire extinguishing and production of aerosols, and to specific azeotropes which can be applied in at least one of these processes.

Halofluorocarbons and especially chlorofluorocarbons had been used for many technical applications, for example, as solvents, foam blowing agents, for refrigeration, heat transfer and for fire extinguishing. In view of regulations in view of ozone depletion and greenhouse potential, alternatives are considered necessary.

In its broadest aspect, the invention concerns a method using compounds or compositions for useful applications such as foam blowing, solvent cleaning, refrigeration, as etching gas for semiconductor etching or chamber cleaning, heat transfer, fire extinguishing and production of aerosols comprising a step wherein at least one compound is applied selected from Tables 1 or 2 of the specification, namely at least one compound selected from the groups consisting of

Fluorosubstituted ethers consisting of 3,3,4,4-tetrafluoro-tetrahydrofuran, 2,2,5,5-tetrafluoro-2,5-dihydro-furan, methyl-(1,1,2-trifluoro-ethyl)-ether, (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, (1,1,2,2-tetrafluoro-ethyl)-(2,2,2-trifluoro-ethyl)-ether, methyl-(β H-octafluoro-isobutyl)-ether, bis-(2,2,2-trifluoro-ethyl) ether, 1,1,1,2,2-pentafluoro-3-methoxy-propane, 1,1,2,2-Tetrafluorethyl-fluormethylether, 1-difluoromethoxy-1,2,2-trifluoro-ethane, 1,1,1,2,2-pentafluoro-3-fluoromethoxy-propane, 3,3,3-trifluoro-1-(1,1,2,2,3,3,3-heptafluoro-propoxy)-propyne, 1,1,2,2-Tetrafluoroethyl-1,2,2-trifluoroethylether, difluoro-(2,2,2-trifluoro-1-methoxy-1-trifluoromethyl-ethyl)-amine, 1,1,2,2,3,3,4-heptafluoro-4-methoxy-cyclobutane, 4-difluoromethoxy-1,1,1,2,2,3,3-heptafluoro-butane, 1,1,1,3,3,3-hexafluoro-2-methoxymethyl-2-trifluoromethyl-propane, 2-difluoromethoxy-1,1,1-trifluoro-propane, 3-difluoromethoxy-1,1,1,2,2-pentafluoro-propane, 2-difluoromethoxy-1,1,2,3,3-pentafluoro-propane, 1-difluoromethoxy-1,1,2,3,3,3-hexafluoro-propane, 1,1,1,2,3,3-hexafluoro-3-fluoromethoxy-propane, 1,1,1,2,3,3,3-heptafluoro-2-(2,2,2-trifluoro-1-trifluoromethyl-ethoxy)-propane, methoxymethyl-bis-

trifluoromethyl-amine, 1,2,2,3,3-Pentafluoropropyl-difluormethylether, perfluoro-3,6-dioxa-1-heptene, 1,1,2-trifluoro-2-[1,1,2,2-tetrafluoro-2-(1,1,2,2,2-pentafluoro-ethoxy)-ethoxy]-ethene, 1,1,1,3,3-pentafluoro-3-(1,2,2,2-tetrafluoro-1-trifluoromethyl-ethoxy)-propan-2-one, Bis-(2-difluoramino-perfluorethyl)-ether, 2,2,3,4,4,5-hexafluoro-tetrahydro-furan, 2,3,3,4,4,5-hexafluoro-tetrahydro-furan, 1,1,2,2-tetrafluoro-1-(1,1,2,2-tetrafluoro-ethoxy)-ethane, 2,2,3,5,6,6-hexafluoro-[1,4]dioxane, 2,2,3,5,5,6-hexafluoro-[1,4]dioxane, 2-[(2,2-difluoro-vinyloxy)-difluoro-methoxy]-1,1-difluoro-ethene, 2,2,4,4-tetrakis-trifluoromethyl-[1,3]dioxolane, 1,1,2-trifluoro-1,2-bis-trifluoromethoxy-ethane, heptafluoro-[1,4]dioxane, 1,1,1-trifluoro-2-methoxy-ethane, methyl-(1,1,2-trifluoro-ethyl)-ether, difluoromethyl-fluoromethyl ether, 1,1,2,2-tetrafluoro-1,2-bis-trifluoromethoxy-ethane, 2,2,2-trifluoroethyl difluoromethyl ether, Perfluoropropylmethylether, 1,1,2,2-tetrafluoro-1-(1,2,2,2-tetrafluoro-ethoxy)-ethane, 1,1,1,2,2-pentafluoro-2-(1,1,2,2-tetrafluoro-ethoxy)-ethane, 1,3-difluoro-1,1,3,3-tetramethyl-disiloxane and 1,1,1,2,2,3-hexafluoro-3-trifluoromethoxy-propane,

N-containing compounds selected from the group consisting of 2,4,6-trifluoro-[1,3,5]triazine, 2,2,4,4,5,5-hexafluoro-1,3-bis-trifluoromethyl-imidazolidine, 1-isopropyl-3,3-bis-trifluoromethyl-diaziridine, 1,4-Bis(difluoramino)-1,1',4,4'-tetrafluorbutene-2, 1,4-Bis(difluoramino) perfluorbut-2-ene, N,N-bis-trifluoromethyl-acetamide, bis-(1,1,2,2-tetrafluoro-ethyl)-diazene, bis-(2,2,2-trifluoro-1-trifluoromethyl-ethylidene)-hydrazine, 1,1,2,2-tetrafluoro-N,N'-bis-trifluoromethyl-ethane-1,2-diamine, trifluoro-acetic acid difluoro-(trifluoromethyl-amino)-methyl ester, N,N'-bis-difluoromethyl-N,N'-bis-trifluoromethyl-hydrazine, Octafluoro-2,5-diaza-1,5-hexadiene, cis-1,2-Di-(bis-trifluoromethylamino)-1,2-difluorethylen, Perfluor-bis-dimethylamino-acetylene, 3,3,3-Trifluor-N,N-bis-(trifluoromethyl)-propylamine, perfluoro-2,5-diaza-hexa-2,4-diene, bis-trifluoromethyl-(3,3,3-trifluoro-propenyl)-amine, 4,4,5,5-tetrafluoro-1,3-bis-trifluoromethyl-imidazolidin-2-one, Methyl-bis-trifluorsilyl-amine, N,N,N'-tris-trifluoromethyl-hydrazine, 1,2-Difluoramino 1,1,4,4 tetrafluorobut-3-ene, trifluorosilyldimethylamine, Perfluoro-diethylamine, Hexafluorotrimethylamine, tris-difluoromethyl-amine, bis-difluoromethyl-(1,1,2,2,2-pentafluoro-ethyl)-amine,

Fluorosubstituted alkenes and alkynes selected from the group consisting of 1,1,2,3,3-pentafluoro-3-iodo-propene, 1,1,2,3,3,4,4-heptafluoro-4-iodo-but-1-ene, 1,1,2,3,3,4,4,5,6,6-decafluoro-hexa-1,5-diene, 1,2,3,3,3-pentafluoro-1-iodo-

- propene, 1,1,3,3,5,5-hexafluoro-penta-1,4-diene, 4,4,4-trifluoro-2-trifluoromethyl-but-1-ene, 1,1,1,5,5,5-hexafluoro-2,4-bis-trifluoromethyl-pent-2-ene, 1,1,1,3,5,5,5-heptafluoro-4-trifluoromethyl-pent-2-ene, 4H-tridecafluoro-hept-3-ene, trifluoromethyl-2-perfluorocyclopentene,
- 5 1H:4H-hexafluorocyclopentene, 1,1,2,3,3,4,5,6,6-decafluoro-5-trifluoromethyl-hex-1-ene, 1,2,3,3,4,6,6-heptafluoro-cyclohexa-1,4-diene, 1,2,3,3,4,4,5,5,6,6-decafluoro-cyclohexene, 1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-hex-2-ene, 1,3,3,4,4,5,5-heptafluoro-2-trifluoromethyl-cyclopentene, 4-difluoromethylene-3,3-difluoro-1,2-bis-trifluoromethyl-cyclobutene,
- 10 3,3,4,4,5,5-hexafluoro-cyclopentene, trifluoromethyl-3-perfluorocyclopentene, (E)-6H-undecafluoro-hex-2-ene, perfluoronorbornadiene, 1,2,3,4,5,5-hexafluoro-6-trifluoromethyl-bicyclo[2.2.0]hex-2-ene, 1,2,3,5-tetrafluoro-4,6-bis-trifluoromethyl-bicyclo[2.2.0]hexa-2,5-diene, (Z)-1,2-difluoro-1-iodoethene, 1,1,1,4,4,4-hexafluoro-but-2-ene, 1,1,3,3-tetrafluoro-2-methyl-propene,
- 15 1,1,3,3,5,5-hexafluoro-penta-1,4-diene, octafluoro-cyclopentene ; perfluorocyclopentene, 1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene, hexafluorocyclopentadiene, (E)-1,1,1,2,3,4,4,5,5,5-decafluoro-pent-2-ene, (Z)-1,1,1,3,4,4,4,5,5,5-nonafluoro-pent-2-ene and 1,1,1,5,5,5-hexafluoro-4,4-bis-trifluoromethyl-pent-2-yne,
- 20 Alkanes and iodoalkanes selected from the group consisting of 1,1,1-trifluoro-2-iodo-ethane, nonafluoro-1-iodo-butane (perfluorobutyl iodide), nonafluoro-2-iodo-butane, 1,1,2,3,3,4-hexafluoro-cyclobutane, 1H,3H-cctafluorocyclopentane, 1,1,2,2,3-pentafluoro-3-iodo-cyclopropane, 1,1,2-trifluoro-2-trifluoromethyl-cyclopropane, cis-1,1,2,3-tetrafluorocyclopropane,
- 25 Fluorinated compounds with a keto group selected from the group consisting of 1,1,1,3-tetrafluoro-propan-2-one, 3,3,4,4,5,5,5-heptafluoro-pentan-2-one, 1,3,3,4,4,4-hexafluoro-butan-2-one, decafluorocyclohexanone, 3,3,4,4-tetrafluoro-butan-2-one, 3,3,3-trifluoro-2-trifluoromethyl-propionaldehyde, Iodopentafluoroacetone, 3,4,4,4-tetrafluoro-butan-2-one,
- 30 1,1,1-trifluoro-butan-2-one, 3,3,4,4,4-pentafluoro-butan-2-one, 1,1,1,4,4,4-hexafluoro-2,3-butanedione, octafluoro-cyclopentanone, trifluoro-acetic acid 2,2,2-trifluoro-ethyl ester, perfluor-tert.-butyl perfluoroacetate, hexafluor-2-buten-2,3-diol bis(trifluoroacetic acid) ester, trifluoro-acetic acid 2,2-difluoro-1-trifluoromethyl-vinyl ester, and
- 35 trifluoro-acetic acid methyl ester,

Fluorinated alcohols selected from the group consisting of
1,1,1,3,3,3-hexafluoro-2-propanol, 1,1,1,3,3,3-hexafluoro-2-methyl-2-propanol
and 2,2,3,3,4,4-hexafluoro-1-trifluoromethyl-cyclobutanol,

Fluorinated silanes selected from the group consisting of 3,3,3-trifluoropropyl-
5 trifluorsilane, trifluoro-propyl-silane, trifluoro-(3,3,3-trifluoro-propyl)-silane,
hexa-Si-fluoro-Si,Si'-methanediyl-bis-silane, and Tris-trifluorsilylmethane, and
Fluorinated phosphorous and sulfur compounds selected from the group
consisting of 2,2,2-trifluoro-4,4,5,5-tetrakis-trifluoromethyl-2λ⁵-
[1,3,2]dioxaphospholane, methyl-bis-trifluoromethyl-phosphane, and
10 1,2-perfluoropropylene sulfate.

These compounds are environmentally advantageous, especially in view of
low or zero ODP (ozone depletion potential) and GWP (global warming
potential).

In a first aspect, the invention relates to a method for cleaning a surface
15 which comprises contacting said surface with a solvent comprising at least one
compound selected from the groups mentioned above.

The foregoing compounds are described in Tables 1 or 2 of this
specification. The tables 1 and 2 of the specification also include information
about the structure, the chemical formula, boiling point, a comment to the
20 general type of the compound (ether, alkane, alkene etc) and literature where the
respective compounds are cited. Said compounds are known and can be
obtained for example according to certain methods described or referred to in the
literature cited in the tables. In this first aspect, the compound is preferably
selected from those described in table 1. More preferably, the compound is
25 selected from compounds No. 1, 3, 5, 10, 23, 34, 39, 40, 53, 57, 60, 61, 73, 76,
83, 86, 94, 99 and 100 described in table 1, and most preferably from compounds
No. 1, 5, 10, 23 and 53 described in table 1.

In the first aspect of the invention the solvent has generally a GWP₁₀₀ of
less than 150, preferably equal to or less than 120, more preferably equal to or
30 less than 80 and most preferably equal to or less than 50.

In the first aspect of the invention the solvent has generally an atmospheric
boiling point equal to or higher than 20°C, preferably equal to or higher than
30°C and more preferably equal to or higher than 35°C. In the first aspect of the
invention the solvent has generally an atmospheric boiling point equal to or
35 lower than 100°C, preferably equal to or lower than 80°C and more preferably
equal to or lower than 60°C.

In the frame of the present invention, often the term “compound” is used. It is to be understood that, unless otherwise stated, of course, also two, three or more of the compounds mentioned in the tables can be present.

5 In the first aspect of the invention, the content of the compound described in Table 1 or 2 in the solvent is generally equal to or more than 1 % by weight relative to the weight of the solvent. Often this content is equal to or more than 10 % by weight, preferably equal to or more than 30 % by weight. In some embodiments of the first aspect of the invention, the content of the compound described in Table 1 or 2 in the solvent can be about 100 % by weight relative to
10 the weight of the solvent. Other typical contents in these embodiments are, for example equal to or less than 99 % by weight, equal to or less than 98 % by weight or even equal to or lower than 75 % by weight.

In the first aspect of the invention, the solvent can consist or consist essentially of a compound described in Table 1 or 2.

15 In the first aspect of the invention the solvent can for example comprise a non-fluoro organic solvent in addition to anyone of the fluorinated compounds described in Tables 1 and 2. The invention relates also to compositions of the compounds described in Tables 1 and 2 with a non-fluoro organic solvent in particular as described herein. Preferably, the content of the compound
20 described in Table 1 or 2 in these compositions is as described before in relation to the content of the compound in the solvent. The remainder of the composition can consist of non-fluoro organic solvent.

Examples of non-fluoro organic solvents, are hydrocarbons, halogenated hydrocarbons in particular chlorohydrocarbons, alcohols, esters, ketones or
25 ethers.

The hydrocarbons which can be used in the compositions according to the invention may be linear, branched or cyclic and generally contain 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12 carbon atoms. Hydrocarbons comprising at least 5 carbon atoms are suitable for use. The hydrocarbons preferably comprise at least 6 carbon
30 atoms. Among the alkanes or alkenes, compounds comprising from 5 to 12 carbon atoms are preferred. n-Hexane, n-heptane and n-octane are suitable for use. Among the aromatic hydrocarbons which are preferred are those comprising at least one alkyl substituent on a benzene ring. Toluene, 1,2-xylene, 1,3-xylene, 1,4-xylene or mixtures thereof are most particularly preferred.

35 The chlorohydrocarbons which can be used in the compositions according to the invention may be linear, branched or cyclic and generally contain 1, 2, 3,

4, 5, 6, 7, 8, 9 or 10 carbon atoms. Chlorohydrocarbons comprising 1, 2, 3 or 4 carbon atoms are suitable for use. The chlorohydrocarbons preferably comprise 1 or 2 carbon atoms. Among the chloroalkanes, dichloromethane, trichloromethane and 1,2-dichloroethane are preferred. Among the
5 chloroalkenes, perchloroethylene and 1,2-dichloroethylene are preferred. Trans-1,2-Dichloroethylene is most particularly preferred.

The alcohols which can be used in the compositions according to the invention may be linear, branched or cyclic and generally contain 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 carbon atoms. Alcohols comprising 1, 2, 3, 4 or 5 carbon atoms are
10 suitable for use. The alcohols preferably comprise 1, 2, 3 or 4 carbon atoms. Among the alkanols, methanol, ethanol, n-propanol, isopropanol, n-butanol, isobutanol and tert-butanol are preferred. Methanol, ethanol, isopropanol and isobutanol give good results. Methanol is most particularly preferred. Ethanol is also very suitable in the compositions according to the invention.

15 The esters which can be used in the compositions according to the invention can be linear, branched or cyclic and generally contain 3, 4, 5, 6, 7, 8, 9 or 10 carbon atoms. Esters comprising 4, 5, 6, 7, 8 or 9 carbon atoms are suitable for use. Preferably, the esters are derivatives of a carboxylic acid comprising at least 2 carbon atoms. Preferably, the esters are derivatives of an
20 alkanol, selected from the group consisting of methanol, ethanol, n-propanol, isopropanol, n-butanol, isobutanol and tert-butanol. Ethyl acetate, ethyl butyrate and ethyl caproate are suitable for use.

The ketones which can be used in the compositions according to the invention can be linear, branched or cyclic and generally contain 3, 4, 5, 6, 7, 8,
25 9 or 10 carbon atoms. Ketones comprising 3, 4, 5, 6, 7 or 8 carbon atoms are suitable for use. Among the ketones, acetone, 2-butanone, 2- or 3-pentanone, methyl isobutyl ketone, diisopropyl ketone, cyclohexanone and acetophenone are preferred. Methyl isobutyl ketone is particularly preferred.

The ethers which can be used in the compositions according to the invention can be linear, branched or cyclic and generally contain 2, 3, 4, 5, 6, 7,
30 8, 9 or 10 carbon atoms. Ethers comprising 4, 5, 6, 7, 8 or 9 carbon atoms are suitable for use. Among the aliphatic or alicyclic ethers, diethyl ether, methyl isopropyl ether, diethylene glycol monomethyl ether, diethylene glycol dimethyl ether, tetrahydrofuran and 1,4 dioxane are preferred.

Nitrogen-containing non fluoro solvents such as nitroalkanes, amides, e.g. dimethylformamide, dimethylacetamide or N-methylpyrrolidone or heterocycles such as pyridine can also be used.

5 Sulphur-containing non fluoro solvents such as dimethyl sulphoxide can also be used.

The content of non-fluoro organic solvents in the solvent is generally at equal to or more than 1 % by weight relative to the weight of the solvent. Often this content is equal to or more than 10 % by weight, preferably equal to or more than 25 % by weight. This content can be equal to or less than 99 % by weight
10 equal to or less than 98 % by weight or even equal to or lower than 75 % by weight.

The compositions according to the invention may further comprise at least one additional fluorinated compound, having typically from 1 to 6 carbon atoms. In one aspect of this embodiment the additional fluorinated compound is a
15 hydrofluoroalkane which is frequently selected from difluoromethane (HFC-32), 1,1-difluoroethane (HFC-152a), 1,1,1-trifluoroethane (HFC-143a), 1,1,1,2-tetrafluoroethane (HFC-134a), pentafluoroethane (HFC-125), 1,1,1,3,3-pentafluoropropane (HFC-245fa), 1,1,1,3,3,3-hexafluoropropane (HFC-236fa), 1,1,1,2,3,3,3-heptafluoropropane (HFC-227ea),
20 1,1,1,3,3-pentafluorobutane (HFC-365mfc) and 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC-43-10mee).

In a first preferred aspect of this embodiment, the hydrofluoroalkane is 1,1-difluoroethane.

In a second preferred aspect of this embodiment, the hydrofluoroalkane is
25 1,1,1,2-tetrafluoroethane (HFC-134a).

In a third preferred aspect of this embodiment, the hydrofluoroalkane is 1,1,1,3,3-pentafluoropropane.

In a fourth preferred aspect of this embodiment, the hydrofluoroalkane is 1,1,1,3,3-pentafluorobutane.

30 In a fifth preferred aspect of this embodiment, the hydrofluoroalkane is 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC-43-10mee).

In another aspect of this embodiment the additional fluorinated compound is a hydrofluoroether selected from 1,1,2,2-tetrafluoroethyl-methyl ether, perfluoropropylmethyl ether, perfluorobutylmethyl ether and perfluorobutylethyl
35 ether.

In still another aspect of this embodiment, the additional compound is a perfluoropolyether or a mixture thereof. Particular examples are perfluoropolyethers marketed by Solvay Solexis under the names GALDEN® and FOMBLIN®, especially the the perfluoropolyether GALDEN® HT55 which
5 has a boiling point of about 57°C at 101.3 kPa and forms an azeotrope with (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether (compound 10 in table 1) which will described below.

In still another aspect of this embodiment the additional fluorinated compound is a pentafluoropropene, in particular 1,1,1,2,3-pentafluoropropene.
10 This compound can be present in the form of the (Z) isomer, the (E) isomer or mixtures thereof.

When an additional fluorinated compound is present in a composition according to the invention, its content is generally chosen so that the composition has a GWP₁₀₀ as described in this specification for the solvent. In that case, the
15 content of the additional fluorinated compound is generally equal to more than 1 % by weight relative to the total weight of the composition of compound disclosed in table 1 or 2, optional non fluoro solvent and additional fluorinated compound. Often, this content is equal to or more than 2 % by weight, preferably equal to or more than 10 % by weight. In that case, the content of the
20 additional fluorinated compound is generally equal to or lower than 99 % by weight equal to or lower than 98 % by weight and preferably equal to or lower than 70 % by weight.

A first particular composition according to the invention comprises from 1-50 % by weight of trans-1,2-dichloroethylene and from 50-99 % by weight of a
25 compound disclosed in table 1 or 2. Non-limiting examples are the following compositions :

- 50 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane and 50 % by weight of 1,2-trans-dichloroethylene
- 75 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane and 25 % by weight
30 of 1,2-trans-dichloroethylene
- 50 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane and 50 % by weight of 1,2-trans-dichloroethylene
- 75 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane and 25 % by weight of 1,2-trans-dichloroethylene
- 35 • 50 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 50 % by weight of 1,2-trans-dichloroethylene

- 75 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 25 % by weight of 1,2-trans-dichloroethylene
- 50 % by weight of 1,1,3,3,5,5-hexafluoro-penta-1,4-diene and 50 % by weight of 1,2-trans-dichloroethylene
- 5 • 50 % by weight of 1,1,3,3,5,5-hexafluoro-penta-1,4-diene and 50 % by weight of 1,2-trans-dichloroethylene
- 50 % by weight of 1H:4H-Hexafluorocyclopentene and 50 % by weight of 1,2-trans-dichloroethylene

10 The mixtures described above are very suitable, for example, for degreasing metals.

A second particular composition according to the invention comprises from 1-50 % by weight of trans-1,2-dichloroethylene and from 35-98 % by weight of a compound disclosed in table 1 or 2 and from 1-15 % by weight of a C1-C3 alcohol, in particular methanol or ethanol. Non-limiting examples are the

15 following compositions :

- 50 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane, 40 % by weight of 1,2-trans-dichloroethylene and 10 % by weight of methanol
- 55 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane, 40 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of ethanol
- 20 • 75 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane, 20 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of methanol
- 50 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane, 40 % by weight of 1,2-trans-dichloroethylene and 10 % by weight of ethanol
- 50 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane, 40 % by weight of 1,2-trans-dichloroethylene and 10 % by weight of methanol
- 25 • 75 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane, 20 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of methanol
- 75 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane, 20 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of ethanol
- 30 • 70 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane, 20 % by weight of 1,2-trans-dichloroethylene and 10 % by weight of methanol
- 50 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, 45 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of methanol
- 75 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, 20 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of methanol
- 35

- 50 % by weight of 1,1,3,3,5,5-hexafluoro-penta-1,4-diene, 45 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of methanol
- 75 % by weight of 1,1,3,3,5,5-hexafluoro-penta-1,4-diene, 20 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of ethanol
- 5 • 50 % by weight of 1H:4H-Hexafluorocyclopentene, 45 % by weight of 1,2-trans-dichloroethylene and 5 % by weight of ethanol

The mixtures described above are very suitable, for example, for degreasing metals.

10 A third particular composition according to the invention which is useful as water displacement agent comprises from 80-99 %, preferably 90-99 % and most preferably about 95 % by weight of a compound disclosed in table 1 or 2 and from 1-15 %, preferably 1 to 10 % and most preferably about 5 % by weight of a C1-C3 alcohol, in particular methanol or ethanol. Non-limiting examples are the following compositions :

- 15 • 80 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane and 20 % by weight of methanol
- 85 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane and 15 % by weight of ethanol
- 80 % by weight of 3,3,4,4-tetrafluoro-tetrahydro-furane, and 20 % by weight of methanol
- 20 • 80 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane and 20 % by weight of ethanol
- 85 % by weight of 2,2,5,5-tetrafluoro-2,5-dihydro-furane and 15 % by weight of methanol
- 25 • 80 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 20 % by weight of methanol
- 85 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 15 % by weight of methanol
- 85 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 15 % by weight of ethanol
- 30 • 87 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 13 % by weight of ethanol which is azeotrope or near-azeotrope
- 88 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and 12 % by weight of ethanol which is an azeotrope or near-azeotrope
- 35 • 85 % by weight of 1,1,3,3,5,5-hexafluoro-penta-1,4-diene and 25 % by weight of methanol

- 85 % by weight of 1,1,3,3,5,5-hexafluoro-penta-1,4-diene and 25 % by weight of ethanol

The mixtures described above are very suitable, for example, for degreasing metals.

5 Often, it can be advantageous to add the nitrogen-containing non fluoro solvents such as nitroalkanes, amides, e.g. dimethylformamide, dimethylacetamide or N-methylpyrrolidone or heterocycles such as pyridine or sulphur-containing non fluoro solvents such as dimethyl sulphoxide can as additional component to the binary and ternary compositions given above. For
10 example, the resulting compositions can contain the mentioned nitrogen or sulfur compounds preferably in an amount from equal to or greater than 0.5 % by weight to equal to or lower than 15 % by weight.

 If desired, the process according to the present invention can be one step in a process comprising several cleaning steps. For example, items can in a first
15 step be treated by high boiling hydrocarbons, for example, n-octane, toluene or xylene, and in a further, preferably a second step, the method of the present is applied.

 In a further embodiment of the first aspect of the method according to the invention, the surface is dried. In that case, the solvent functions as a drying
20 agent. A drying agent is used, for example, in the electronics or electromechanical industry or optionally the cosmetic industry when it is desired to remove the water adsorbed onto a solid surface of an object after an aqueous treatment. The aqueous treatment can consist, for example, of a cleaning operation, optionally in the presence of a surfactant. Generally, after the aqueous
25 treatment, the object is immersed in a drying agent in the boiling state comprising a surfactant, and the surfactant which adheres to the surface of the object is then removed in a washing bath. The compositions according to the invention comprising a surfactant are suitable for the drying operation. The compositions according to the invention which are free of surfactant are suitable
30 for the washing bath intended to remove the surfactant.

 A number of surfactants which can be used in this embodiment are described, for example, in Ullmann's Encyclopedia of Industrial Chemistry, 5th edition, 1987, vol. A8, pp. 338 350. Cationic, anionic, nonionic and amphoteric
35 surfactants can be used. It is possible, for example, to use fatty acids, fatty esters, alkylbenzenesulphonates, alkanesulphonates, α -olefin sulphonates, α -sulphonated fatty acid esters (SES), alkyl sulphates, alkyl ether sulphates,

quaternary ammonium compounds, polyethylene glycol alkyl ethers, polyethylene glycol phenyl ethers, fatty acid alkanolamides, polyglycol fatty alkyl ethers, ethylene oxide and propylene oxide block copolymers, alkylbetaines, alkylsulphobetaines, tetraalkylammonium salts of mono or dialkylphosphoric acids or surfactants comprising at least one imidazoline group. It is also possible to use surfactants such as those described above containing at least one fluorine substituent. More specifically, surfactants comprising at least one polyfluoro alkyl chain or a polyfluoro aromatic substituent can be used.

A surfactant of alkylbenzenesulphonate type is particularly preferred. This surfactant often comprises an alkyl chain comprising from 4 to 22 and preferably from 10 to 14 carbon atoms. Dodecylbenzenesulphonate salts, in particular the salts of a quaternary amine, give good results. Isopropylammonium dodecylbenzenesulphonate is particularly preferred.

When a surfactant is present in a composition according to the invention, its content is generally at least 100 ppm (mg/kg). It is often at least 500 ppm. Preferably, it is at least 1000 ppm. Generally, the surfactant content is not more than 5000 ppm. It is often not more than 4000 ppm. Preferably, it is not more than 3000 ppm.

In a particular aspect, the solvent is used as a water displacement agent. In another embodiment of the first aspect of the invention, the surface is degreased. In this case, the solvent functions as a degreasing solvent.

A degreasing solvent is used, for example, in the electronics or electromechanical industry to remove the grease adsorbed in particular onto metal components machined with grease. Generally, a component to be degreased is immersed in a bath of boiling degreasing solvent. The compositions according to the invention comprising a non-fluoro organic solvent of high polarity, such as alkanols, in particular methanol or ethanol and/or those which comprise a chlorohydrocarbon, are particularly suitable as degreasing solvents.

In another embodiment of the first aspect of the invention, the solvent is used to remove flux residues. For example, flux residues of soldered electric components are defluxed.

A second aspect of the invention relates to a method for producing polymer foam which comprises using a blowing agent comprising at least one compound described in Tables 1 or 2 of the specification which are mentioned above with their chemical name. In this aspect, the compound is preferably selected from

those described in table 2. More preferably, the compound is selected from compounds No. 4, 17, 25, 26, 28, 30, 38 and 39 described in table 2.

In the second aspect of the invention the foam blowing agent has generally an atmospheric boiling point equal to or higher than 0°C, preferably equal to or higher than 20°C. In the second aspect of the invention the foam blowing agent has generally an atmospheric boiling point equal to or lower than 45°C, preferably equal to or lower than 40°C.

In the second aspect of the invention, the content of the compound described in Table 1 or 2 in the foam blowing agent is generally equal to or more than 10 % by weight relative to the weight of the foam blowing agent. Often this content is equal to or more than 30 % by weight and preferably equal to or more than 50 % by weight. In some embodiments of the second aspect of the invention, the content of compound described in Table 1 or 2 in the foam blowing agent can be equal to or lower than 90 % by weight relative to the weight of the foam blowing agent. Other typical contents in these embodiments are equal to or lower than 80 % by weight or even equal to or lower than 75 % by weight.

In the second aspect of the invention, the foam blowing agent can consist or consist essentially of compound described in Table 1 or 2.

In the second aspect of the invention the foam blowing agent can for example comprise a non-fluoro organic co-blowing agent as described above for the first aspect of the invention in addition to anyone of the fluorinated compounds described in Tables 1 and 2. Preferably non fluoro organic co-blowing agents to be used in the foam blowing agent are selected from hydrocarbons and halogenated hydrocarbons. If in the second aspect of the invention the foam blowing agent comprises a hydrocarbon, then it is preferred to use a hydrocarbon, in particular an alkane having 3, 4, 5 or 6 carbon atoms. More particularly, cyclopentane, n-pentane and isopentane are preferred. Non-limiting examples of suitable mixtures are the following :

- 65 % by weight of 1,1,1,4,4,4-hexafluoro-but-2-ene and 35 % by weight of cyclopentane
- 65 % by weight of N,N,N'-tris-trifluoromethyl-hydrazine and 35 % by weight of isopentane
- 65 % by weight of 1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene and 35 % by weight of n-pentane

- 65 % by weight of octafluoro-cyclopentanone and 35 % by weight of n-pentane
- 65 % by weight of (preferably freshly cracked) hexafluoro-cyclopentadiene and 35 % by weight of cyclopentane
- 5 • 65 % by weight of (Z)-1,1,1,3,4,4,5,5,5-nonafluoro-pent-2-ene and 35 % by weight of isopentane
- 65 % by weight of 1,1,1,2,2-pentafluoro-2-(1,1,2,2-tetrafluoro-ethoxy)-ethane and 35 % by weight of n-pentane
- 65 % by weight of 1,1,1,2,2,3-hexafluoro-3-trifluoromethoxy-propane and
10 35 % by weight of n-pentane

Other non-limiting examples of blowing agent mixtures include those wherein at least one compound of the group consisting of compounds No. 4, 17, 25, 26, 28, 30, 38 and 39 described in table 2, carbon dioxide and dichloromethane, n-pentane, isopentane or cyclopentane are comprised.

- 15 In a first particular embodiment of the second aspect of the invention, the polymer foam is a thermoset foam. Thermoset foams which can be produced according to the method according to the invention include, for example, phenolic foams and, preferably, isocyanate-based foams.

- 20 The first particular embodiment of the second aspect of the invention relates consequently in particular to a process for producing foams based on polyisocyanates by reacting polyisocyanates, compounds having at least two hydrogen atoms reactive towards isocyanate groups, blowing agents and, if appropriate, further additives, which comprises using a blowing agent as described here above.

- 25 Polyisocyanates suitable for the process according to the invention are the aliphatic, cycloaliphatic and aromatic diisocyanates or polyisocyanates usual for this purpose. 2,4- and 2,6-toluyl diisocyanate, diphenylmethane diisocyanate, polymethylenepolyphenyl isocyanate and mixtures thereof are preferred. Polyisocyanates which contain carbodiimide groups, urethane groups,
30 allophanate groups, isocyanurate groups, urea groups or biuret groups and which are termed "modified polyisocyanates" and "isocyanate prepolymers", can also be used.

- 35 The polyisocyanates are reacted with compounds which contain at least two hydrogen atoms reactive towards isocyanate groups, for example compounds containing hydroxyl groups and based on polyethers, polyesters and amines, and also compounds having amino groups and/or carboxyl groups and/or thiol

groups. As a rule, these compounds have 2-8 hydrogen atoms reactive towards isocyanates.

The catalysts used in this reaction are often tertiary amines which, if desired, can also contain hydrogen atoms active towards isocyanate groups,
5 and/or organic metal compounds, preferably tin salts of carboxylic acids.

In addition, surface-active additives such as emulsifiers and foam stabilizers are in general also used. The emulsifiers are, for example, salts of fatty acids. Polyethersiloxanes are frequently used as foam stabilizers.

The blowing agent and the polyol component, optionally in the presence of
10 phosphate or phosphonate-type flame retardants, can be present in a premix. Suitable phosphate type flame retardants are, for example, triethyl phosphate, tris-chloropropyl phosphate and tris-chloroethyl phosphate. Suitable phosphonate-type flame retardants are, for example, the diethyl esters of methyl or ethyl phosphonate and the dimethyl esters of methyl or ethyl phosphonate.

15 In a second particular embodiment of the second aspect of the invention, the polymer foam is a thermoplastic foam. In this embodiment the polymer foam is often a polyalkenylaromatic foam, preferably a polystyrene foam and most preferably an extruded polystyrene foam. The polymer foam can also be an expanded polystyrene foam or a thermoplastic polyurethane foam.

20 In a third aspect, the invention relates to the use of a fluorinated olefin having at least 4 carbon atoms and an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent, an etching gas, in particular for semiconductor etching or chamber cleaning or an aerosol
25 propellant. The fluorinated olefin can be cyclic. In that case it often comprises a 3-, 4-, 5-, 6-, or 7-membered ring, preferably a 5-, or 6-membered ring. In a particular embodiment, said fluorinated olefin is a conjugated or non-conjugated diene.

The fluorinated olefin of the third aspect can be combined with non fluoro
30 organic solvents and/or additional fluorinated compounds, as described in the first aspect of the invention, to form compositions having typically the same GWP₁₀₀ as the solvent in the first aspect of the invention. The invention also concerns these compositions. In said compositions the content of the fluorinated olefin often corresponds to the content of compounds described in Table 1 or 2 in
35 the compositions according to the first aspect of the invention. In this aspect, the olefine 1,1,3,3,5,5-hexafluoro-penta-1,4-diene cited under numbers 23 of table 1

and 15 of table 2 and 1H:4H-hexafluorocyclopenten cited under number 53 of table 1 and the olefins cited under numbers 4, 25 and 30 in table 2, 1,1,1,4,4,4-hexafluoro-but-2-ene, 1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene and (Z)-1,1,1,3,4,4,5,5,5-nonafluoro-pent-2-ene are preferred. Often,
5 the compositions described above are preferred compositions in this third aspect.

In a fourth aspect, the invention relates to use of a cyclic fluorinated ether having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent, an etching gas, in particular for semiconductor etching
10 or chamber cleaning or an aerosol propellant. The cyclic ether often comprises a 3-, 4-, 5-, 6-, or 7-membered ring, preferably a 5-, or 6-membered ring. The compounds cited under numbers 1 and 5 described in table 1 are preferred.

The cyclic ether of the fourth aspect can be combined with non fluoro organic solvents and/or additional fluorinated compounds, as described in the first aspect of the invention, to form compositions having typically the same
15 GWP₁₀₀ as the solvent in the first aspect of the invention. The invention also concerns these compositions. In said compositions the content of the cyclic ether often corresponds to the content of compounds described in Table 1 or 2 in the compositions according to the first aspect of the invention. The compounds cited
20 under numbers 1 and 5 described in table 1 are preferred.

In a fifth aspect, the invention relates to the use of a fluorinated N-heterocyclic compound having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent an etching gas, in
25 particular for semiconductor etching or chamber cleaning or an aerosol propellant. The N-heterocycle is often a 3-, 4-, 5-, 6-, or 7-membered ring, preferably a 5-, or 6-membered ring.

The fluorinated N-heterocyclic compound of the fifth aspect can be combined with non fluoro organic solvents and/or additional fluorinated
30 compounds, as described in the first aspect of the invention, to form compositions having typically the same GWP₁₀₀ as the solvent in the first aspect of the invention. The invention also concerns these compositions. In said compositions the content of the fluorinated N-heterocyclic compound often corresponds to the content of compounds described in Table 1 or 2 in the
35 compositions according to the first aspect of the invention.

In a sixth aspect, the invention relates to use of a fluorinated unsaturated nitrogen containing compound having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent an etching gas, in particular for semiconductor etching or chamber cleaning or an aerosol propellant.

The fluorinated unsaturated nitrogen containing compound of the sixth aspect can be combined with non fluoro organic solvents and/or additional fluorinated compounds, as described in the first aspect of the invention, to form compositions having typically the same GWP₁₀₀ as the solvent in the first aspect of the invention. The invention also concerns these compositions. In said compositions the content of the unsaturated nitrogen containing compound often corresponds to the content of compounds described in Table 1 or 2 in the compositions according to the first aspect of the invention.

In a seventh aspect, the invention relates to use of a cyclic fluorinated ketone having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent, an etching gas, in particular for semiconductor etching or chamber cleaning or an aerosol propellant.

The cyclic fluorinated ketone of the seventh aspect can be combined with non fluoro organic solvents and/or additional fluorinated compounds, as described in the first aspect of the invention, to form compositions having typically the same GWP₁₀₀ as the solvent in the first aspect of the invention. The invention also concerns these compositions. In said compositions the content of the cyclic fluorinated ketone often corresponds to the content of compounds described in Table 1 or 2 in the compositions according to the first aspect of the invention.

In an eight aspect, the invention relates to use of a compound disclosed in table 1 or 2 as etching gas, in particular for semiconductor etching or chamber cleaning. In this embodiment, in particular silicon-free compounds are used. More preferably the atmospheric boiling point of the compound is equal to or lower than 30°C.

In an ninth aspect, the invention relates to the use of a compound disclosed in table 1 or 2 as carrier fluid to depose layers of material, for example organic materials and in particular greases on a surface.

A tenth aspect of the present invention concerns mixtures of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, and ethanol or perfluoropolyether available under GALDEN® HT 55 available from Solvay Solexis. The preferred binary mixtures of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, and ethanol consist of 1.6 to 50 % by volume ethanol, preferably 6.3 % by volume to 38.8 % by volume, the remainder to 100 % by volume is (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether. The preferred binary mixtures of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, and GALDEN® HT 55 consist of 1.5 to 75 % by weight GALDEN® HT 55, preferably 10 to 70 % by weight, the remainder to 100 % by weight is (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether. The advantage of these mixtures is their unexpected low boiling point which is lower than the lower-boiling component. To these mixtures, further solvents, foam blowing agents, propellants or other components and additives can be added.

The following tables list the boiling points for specific mixtures :

Ethanol [vol-%]	Hexafluormethoxypropan [vol-%]	Boiling point [°C]
1.6	98.4	52.5
3.2	96.6	51.8
6.3	93.8	51.3
11.8	88.2	51.1
16.7	83.3	51.1
23.1	76.9	51.4
38.8	61.2	52.0
49.2	50.8	52.5

GALDEN® HT 55 [mass-%]	Hexafluormethoxypropan [mass-%]	Boiling point [°C]
5	95	46.5
10	90	44
20	80	43
30	70	42
50	50	41.3
60	40	42

It was observed that the mixtures of mixtures of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, and ethanol or perfluoropolyether include azeotropes and azeotrope like compositions formed from the compound described under number 10 of table 1, (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, and ethanol or perfluoropolyether available under GALDEN® HT 55 available from Solvay Solexis. An azeotrope-like mixture in the frame of the present invention is a mixture of two or more fluids having a vapor composition substantially equal to

that of the liquid and which undergoes phase changes without substantially modifying its composition and temperature. According to the present invention, a mixture is azeotrope-like when, after evaporation at a constant temperature of 50 % of the initial liquid mass, the per cent variation of the vapor pressure
5 between that of the initial mixture and that of the final mixture results lower than about 10 %. See on the matter the paper of D.A. Didion and D.B. Bivens in Int. J. of Refrigeration 13 (1990), pages 163 to 175.

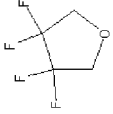
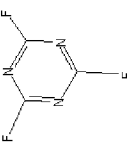
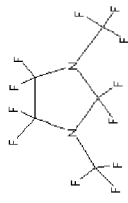
The binary azeotrope formed from (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and ethanol has a minimum boiling point of about 51.1°C at about
10 990 mbar. The composition is about 13 % by volume of ethanol and about 87 % by volume of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether.

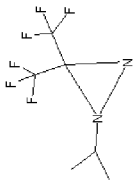
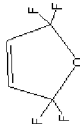
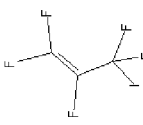
The binary azeotrope formed from (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and GALDEN[®] HT 55 has a minimum boiling point of about 41.3°C at 977 mbar. The minimum boiling point appears at range of the composition at
15 about 50 to about 55 mol- % of GALDEN[®] HT 55 and the remainder to 100 mol % of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether.

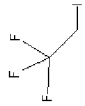
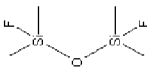
These binary azeotropes and respective near azeotropes are suitable, for example, as foam blowing agents or solvents. When used as solvents, they may contain further solvents, e.g. 1,2-trans-dichloroethylene, or additives, e.g.
20 surfactants, for example, surfactants as those described above. When used as foam blowing agents, they may contain further blowing agents, e.g. one or more of those mentioned above, e.g. carbon dioxide, cyclopentane, n-pentane and/or isopentane.

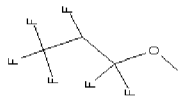
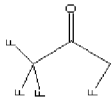
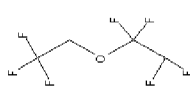
Here after table 1 and 2 describe compounds which are useful in this
25 invention.

TABLE 1

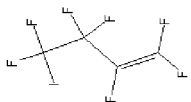
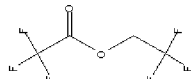
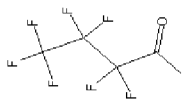
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
1		C ₄ H ₄ F ₄ O	3,3,4,4-tetrafluoro-tetrahydrofuran	68	68	Cyclic ether	Chemosphere, 44, 4, 2001, 897 - 906
2		C ₃ F ₃ N ₃	2,4,6-trifluoro-[1,3,5]triazine	70	70 - 72	N-heterocyclic compounds	J. Org. Chem., 27, 1962, 2577 - 2579
3		C ₅ F ₁₂ N ₂	2,2,4,4,5,5-hexafluoro-1,3-bis-trifluoromethyl-imidazolidine	56	56	N-heterocyclic compounds	J. Fluorine Chem., 24, 1984, 457 - 466

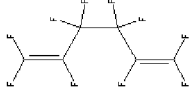
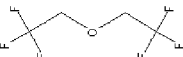
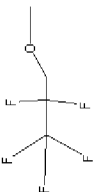
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
4		C ₆ H ₈ F ₆ N ₂	1-isopropyl-3,3-bis-trifluoromethyl-diaziridine	69	69 - 70	N-heterocyclic compounds	Dokl.Chem., 219, 1974, 831
5		C ₄ H ₂ F ₄ O	2,2,5,5-tetrafluoro-2,5-dihydrofuran	62	62	Cyclic ether	Chemosphere, 44, 4, 2001, 897 - 906
6		C ₃ F ₅ I	1,1,2,3,3-pentafluoro-3-iodopropene	54,7	54,7	Olefine	J. Am. Chem. Soc., 79, 1957, 4159 - 4163

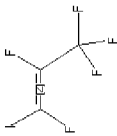
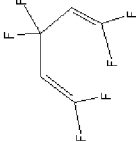
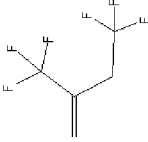
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7		C2H2F3I	1,1,1-trifluoro-2-iodo-ethane	55	55, 60 - 61	Iodoalkane	Chemosphere, 44, 4, 2001, 897 - 906
8		C3H5F3O	methyl-(1,1,2-trifluoro-ethyl)-ether	45,2	45,2	Aliphatic Ether	J. Am. Chem. Soc., 73, 1951, 711
9		C4H12F2OSi2	1,3-difluoro-1,1,3,3-tetramethyl-disiloxane	69	69 - 72	Silyl ether	J. Gen. Chem. USSR, 39, 1969, 528-532

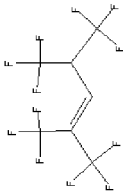
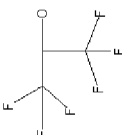
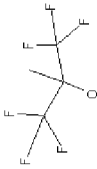
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10		C ₄ H ₄ F ₆ O	(1,1,2,3,3,3-hexafluoro-propyl)-methyl ether	49	49, 54 - 55	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897 - 906
11		C ₃ H ₂ F ₄ O	1,1,1,3-tetrafluoro-propan-2-one	50	50 - 51	Ketone	Bull.Acad.Sci.USSR Div.Chem.Sci, 1963, 1439-1444
12		C ₄ H ₃ F ₇ O	(1,1,2,2-tetrafluoro-ethyl)-(2,2,2-trifluoro-ethyl)-ether	55,5	55,5, 56,7	Aliphatic Ether	J. Am. Chem. Soc., 72, 1950, 4378

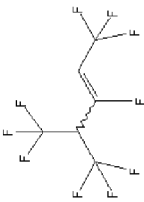
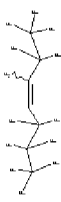
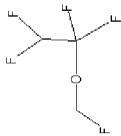
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13		C5H4F8O	methyl-(<i>H</i> -octafluoro-isobutyl)-ether	68,5	68,5	Aliphatic Ether	J. Am. Chem. Soc., 79, 1957, 1741, 1742
14		C4F9I	nonafluoro-1-iodo-butane ; Perfluorobutyl iodide	64	64	Iodoalkane	GB 868494 ; US, 57, 13608a, 1962
15		C4F9I	nonafluoro-2-iodo-butane	64	64	Iodoalkane	J. Am. Chem. Soc. ; J. Am. Chem. Soc., 79 ; 80, 1957 ; 1958, 2549 ; 846

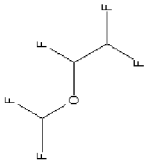
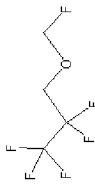
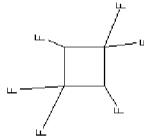
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16		C4F7I	1,1,2,2,3,3,4,4-heptafluoro-4-iodo-but-1-ene	70	70	Iodo Olefine	J. Chem. Soc., 1954, 4026
17		C4H2F6O2	trifluoro-acetic acid 2,2,2-trifluoro-ethyl ester	55	55, 57	Ester	J. Org. Chem., 38, 23, 1973, 4028 - 4031
18		C5H3F7O	3,3,4,4,5,5,5-heptafluoro-pentan-2-one	63	63 - 63,5	Ketone	Tetrahedron, 20, 1964, 2162 - 2166

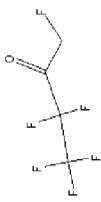
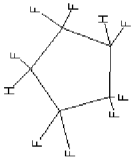
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19		C ₆ F ₁₀	1,1,2,3,3,4,4,5,6,6-decafluoro- hexa-1,5-diene	59,6	59,6	Olefine	J. Am. Chem. Soc., 79, 1957, 4170, 4174
20		C ₄ H ₄ F ₆ O	bis-(2,2,2-trifluoro-ethyl) ether	63,9	63,9, 64	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897 - 906
21		C ₄ H ₅ F ₅ O	1,1,1,2,2-pentafluoro-3-methoxy- propane	46	46, 48,5	Aliphatic Ether	J. Org. Chem., 28, 1963, 492 - 494

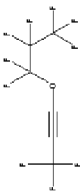
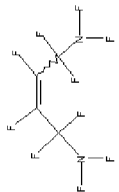
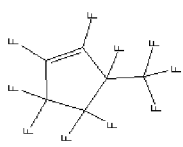
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22		C3F5I	1,2,3,3,3-pentafluoro-1-iodo-propene	53	53 - 55	Iodo Olefine	Can. J. Chem., 54, 1976, 1700
23		C5H2F6	1,1,3,3,5,5-hexafluoro-penta-1,4-diene	44,6	44,6 - 45,1	Olefine	J. Org. Chem., 25, 1960, 1661 - 1662
24		C5H4F6	4,4,4-trifluoro-2-trifluoromethyl-but-1-ene	47	47 - 49	Olefine	J. Am. Chem. Soc., 82, 1960, 543 - 551

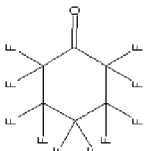
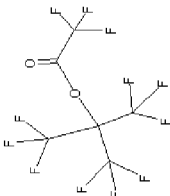
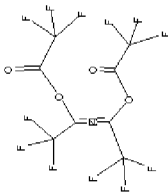
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25		C7H2F12	1,1,1,5,5,5-hexafluoro-2,4-bis-trifluoromethyl-pent-2-ene	68	68 - 70	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 1967, 1689 - 1697
26		C3H2F6O	1,1,1,3,3,3-hexafluoro-2-propanol	58,62	58,62	Alcohol	Suom. Kemistil. B, 40, 1967, 250, 251 - 256
27		C4H4F6O	1,1,1,3,3,3-hexafluoro-2-methyl-2-propanol	60,5	60,5 - 61,5	Alcohol	Bull.Acad.Sci.USSR Div.Chem.Sci, 4, 1960, 647 - 653

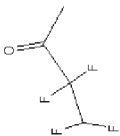
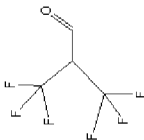
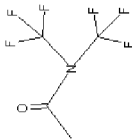
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28		C6H2F10	1,1,1,3,5,5,5-heptafluoro-4-trifluoromethyl-pent-2-ene	68	68 - 73	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 2, 1966, 360
29		C7HF13	4H-tridecafluoro-hept-3-ene	68	68 - 70	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 12, 1975, 2614 - 2617
30		C3H3F5O	1,1,2,2-Tetrafluoroethyl-fluoromethylether	53	53	Aliphatic Ether	J. Med. Chem., 15, 1972, 604 - 606

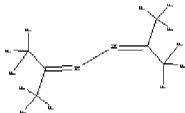
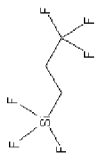
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
31		C ₃ H ₃ F ₅ O	1,1-difluoromethoxy-1,2,2-trifluoro-ethane	52,5	52,5	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897 - 906
32		C ₄ H ₄ F ₆ O	1,1,1,2,2-pentafluoro-3-fluoromethoxy-propane	60	60, 62,2	Aliphatic Ether	J. Org. Chem., 28, 1963, 492 - 494
33		C ₄ H ₂ F ₆	1,1,2,3,3,4-hexafluoro-cyclobutane	63	63	Cycloalkane	Chemosphere, 44, 4, 2001, 897 - 906

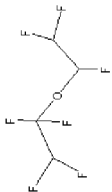
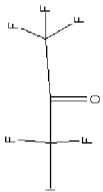
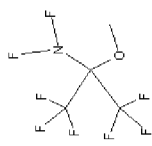
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
34		C ₄ H ₂ F ₆ O	1,3,3,3,4,4,4,4-octafluoro-butan-2-one	68,5	68,5 - 70,5	Ketone	J. Org. Chem., 27, 1962, 599 - 602
35		C ₅ H ₂ F ₈	1H,3H-Octafluorocyclopentan	65,5	65,5	Cycloalkane	Chemosphere, 44, 4, 2001, 897 - 906
36		C ₄ H ₂ F ₈ N ₂	1,4-Bis(difluoramino)-1,1',4,4'-tetrafluorbuten-2	61	61	Amino Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci,12, 1970, 2578 - 2582

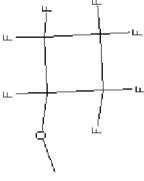
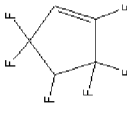
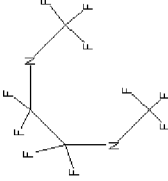
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
37		C6F10O	3,3,3-trifluoro-1-(1,1,2,2,3,3,3-heptafluoro-propoxy)-propyne	49	49 - 50	Aliphatic Ether	J. Org. Chem., 43, 1978, 43 - 47
38		C4F10N2	1,4-Bis(difluoramino)perfluorbut-2-en	55	55 - 56	Amino Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci,12, 1970, 2578 - 2582
39		C6F10	Trifluoromethyl-2-perfluorocyclopenten	50,3	50,3	Cycloalkene	Ann.Chim.(Rome), 61, 1971, 245, 248

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
40		C6F10O	decafluorocyclohexanone	54	54 – 56, 56	Cycloketone	J. Org. Chem., 33, 7, 1968, 2692 - 2696
41		C6F12O2	Perfluor-tert.-butyl perfluoracetat	56	56	Ester	J. Org. Chem., 38, 23, 1973, 4028 - 4031
42		C8F12O4	Hexafluor-2-buten-2,3-diol bis(trifluoroessigsaeure)ester	66	66 - 68	Diester	J. Org. Chem. USSR, 7, 11, 1971, 2407 - 2409

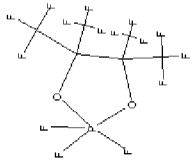
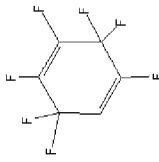
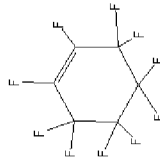
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
43		C ₄ H ₄ F ₄ O	3,3,4,4-tetrafluoro-butan-2-one	63	63 - 64	Ketone	Nagoya Kogyo Gijutsu Shikensho Hokoku, 11 ; 59, 11314e, 1962 ; 1963, 754
44		C ₄ H ₂ F ₆ O	3,3,3-trifluoro-2-trifluoromethyl-propionaldehyde	49	49	Aldehyde	Bull.Acad.Sci.USSR Div.Chem.Sci, 8, 1965, 1440 - 1442
45		C ₄ H ₃ F ₆ NO	<i>N,N</i> -bis-trifluoromethyl-acetamide	66	66	Amide	J. Am. Chem. Soc., 84, 1962, 2105 - 2109

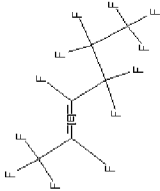
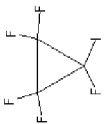
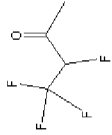
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
46		C ₄ H ₂ F ₈ N ₂	bis-(1,1,2,2-tetrafluoro-ethyl)-diazene	58	58	Diazene	Dokl.Chem., 142, 1962, 4 - 7
47		C ₆ F ₁₂ N ₂	bis-(2,2,2-trifluoro-1-trifluoromethyl-ethylidene)-hydrazine	67	67 - 67,5, 67 - 70	Hydrazine	J. Org. Chem., 30, 1965, 1398 - 1402
48		C ₃ H ₄ F ₆ Si	3,3,3-Trifluoropropyl-trifluorsilan	45	45	Silane	Bull.Acad.Sci.USSR Div.Chem.Sci, 20, 1971, 2549 - 2555

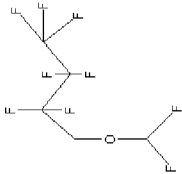
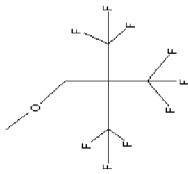
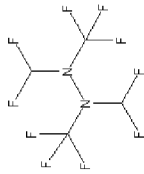
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49		C ₄ H ₃ F ₇ O	1,1,2,2-Tetrafluoroethyl-1,2,2-trifluoroethyl ether	68	68	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897 - 906
50		C ₃ F ₅ IO	Iodopentafluoroacetone	54	54 - 55	Iodo ketone	J. Org. Chem. USSR, 11, 8, 1975, 1588 - 1591
51		C ₄ H ₃ F ₈ NO	difluoro-(2,2,2-trifluoro-1-methoxy-1-trifluoromethyl-ethyl)-amine	68	68	Amino Ether	J. Org. Chem., 38, 1973, 1065 - 1074

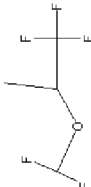
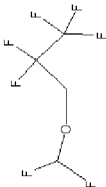
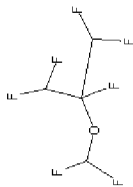
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
52		C ₅ H ₃ F ₇ O	1,1,2,2,3,3,4,4-heptafluoro-4-methoxy-cyclobutane	51	51, 56	Cycloalkane / Aliphatic Ether	J. Am. Chem. Soc., 83, 1961, 2205 - 2206
53		C ₅ H ₂ F ₆	1H:4H-Hexafluorocyclopenten	66	66	Cyclo Olefine	J. Chem. Soc., 1965, 2382 - 2391
54		C ₄ H ₂ F ₁₀ N ₂	1,1,2,2-tetrafluoro-N,N'-bis-trifluoromethyl-ethane-1,2-diamine	70	70 - 72	Amine	DE 2013435, 1970

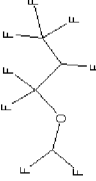
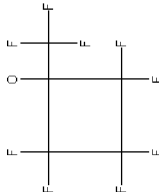
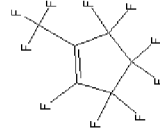
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55		C4HF8NO2	trifluoro-acetic acid difluoro-(trifluoromethyl-amino)-methyl ester	61	61 - 62	Amino ester	Bull.Acad.Sci.USSR Div.Chem.Sci, 26, 1977, 2214 - 2216
56		C5F8O2	trifluoro-acetic acid 2,2-difluoro-1-trifluoromethyl-vinyl ester	45	45 - 46	Ester	J.Org.Chem.USSR, 11, 1975, 1584 - 1587
57		C7HF13	1,1,2,3,3,4,5,6,6,6-decafluoro-5-trifluoromethyl-hex-1-ene	68	68 - 70	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 27, 7, 1978, 1432 - 1434

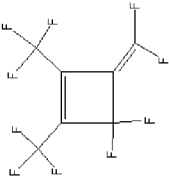
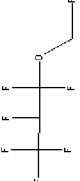
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
58		C ₆ F ₁₅ O ₂ P	2,2,2-trifluoro-4,4,5,5-tetrakis-trifluoromethyl-2-[1,3,2]dioxaphospholane	55	55	Phospholane	J. Chem. Soc. Dalton Trans., 1975, 918 - 924
60		C ₆ HF ₇	1,2,3,3,4,4,6,6-heptafluorocyclohexa-1,4-diene	67	67, 67 - 68	Cyclo Olefine	Tetrahedron, 8, 1960, 38-41
61		C ₆ F ₁₀	1,2,3,3,4,4,5,5,6,6-decafluorocyclohexene	54	54	Cyclo Olefine	Chemosphere, 44, 4, 2001, 897 - 906

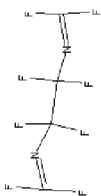
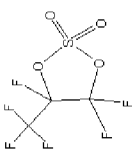
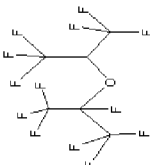
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
62		C ₆ F ₁₂	1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-hex-2-ene	52	52 - 53	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 27, 7, 1978, 1432 - 1434
63		C ₃ F ₅ I	1,1,2,2,3-pentafluoro-3-iodo-cyclopropane	48,5	48,5	Iodocycloalkane	J. Chem. Soc. Perkin Trans. 1, 1973, 1773 - 1779
64		C ₄ H ₄ F ₄ O	3,4,4,4-tetrafluoro-butan-2-one	68	68 - 70	Ketone	Bull.Acad.Sci.USSR Div.Chem.Sci, 23, 4, 1974, 913 - 915

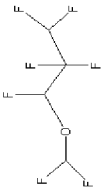
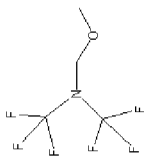
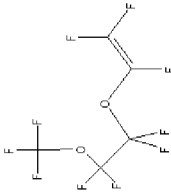
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
65		C5H3F9O	4-difluoromethoxy-1,1,1,2,2,3,3-heptafluoro-butane	69	69 - 69,5	Aliphatic Ether	US 3794688, 1974
66		C6H5F9O	1,1,1,3,3,3-hexafluoro-2-methoxymethyl-2-trifluoromethyl-propane	65	65 - 67	Aliphatic Ether	J.Org.Chem.USSR, 10, 5, 1974, 947 - 952
67		C4H2F10N2	<i>N,N'</i> -bis-difluoromethyl- <i>N,N'</i> -bis-trifluoromethyl-hydrazine	55	55	Hydrazine	Dokl.Chem., 142, 1962, 4 - 7

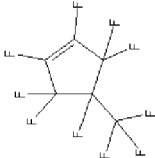
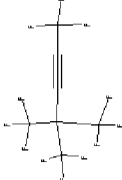
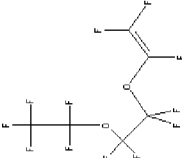
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
68		C4H5F5O	2-difluoromethoxy-1,1,1-trifluoro-propane	48	48	Aliphatic Ether	US 3869519, 1975
69		C4H3F7O	3-difluoromethoxy-1,1,1,2,2-pentafluoro-propane	46,2	46,2 - 46,3	Aliphatic Ether	FR 2233986 ; US 3943256, 1975
70		C4H3F7O	2-difluoromethoxy-1,1,2,3,3-pentafluoro-propane	68,1	68,1 - 68,2	Aliphatic Ether	FR 2233986 ; US 3943256, 1975

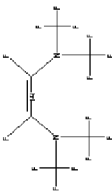
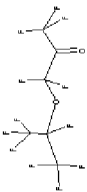
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71		C4H2F8O	1,1,2,3,3,3-hexafluoro-1-propanol	47	47 - 47,3	Aliphatic Ether	FR 2233986 ; US 3943256, 1975
72		C5HF9O	2,2,3,3,4,4-hexafluoro-1-butanol	64	64 - 65	Cycloalcohol	Tetrahedron Lett., 1974, 1111 - 1114
73		C6F10	1,3,3,4,4,5,5-heptafluoro-2-trifluoromethylcyclopentene	44,8	44,8 - 45,2, 49,5	Cyclo Olefine	J.Org.Chem.USSR, 8, 5, 1972, 1050 - 1053

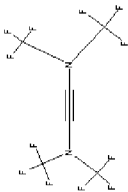
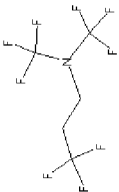
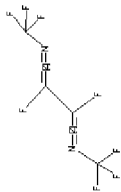
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
74		C7F10	4-difluoromethylene-3,3-difluoro-1,2-bis-trifluoromethyl-cyclobutene	61,8	61,8	Cyclo Olefine	J. Chem. Soc. C, 1966, 2051 - 2052
75		C4H3F7O	1,1,1,2,3,3-hexafluoro-3-fluoromethoxy-propane	69	69	Aliphatic Ether	FR 2233986; US 3943256, 1975
76		C5H2F6	3,3,4,4,5,5-hexafluoro-cyclopentene	68	68 - 69	Cyclo Olefine	J. Chem. Soc., 1965, 2382 - 2391

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
77		C4F8N2	Octafluoro-2,5-diaza-1,5-hexadien	62	62	Imine	J. Am. Chem. Soc., 89, 1967, 5007 - 5011
78		C3F6O4S	1,2-Perfluoropropylensulfat	55	55 - 56	Sulfate	Bull.Acad.Sci.USSR Div.Chem.Sci, 22, 1973, 2659 - 2662
79		C6HF13O	1,1,1,2,3,3,3-heptafluoro-2-(2,2,2-trifluoro-1-trifluoromethylethoxy)-propane	52	52 - 55	Aliphatic Ether	Bull.Acad.Sci.USSR Div.Chem.Sci, 21, 1972, 1085 - 1088

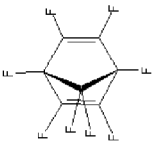
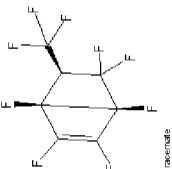
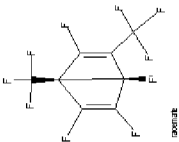
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
80		C4H3F7O	1,2,2,3,3-Pentafluoropropyl-difluoromethyl ether	68	68	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897 - 906
81		C4H5F6NO	methoxymethyl-bis-trifluoromethyl-amine	48	48 - 49	Aminoether	Ref. Zh. Khim., 14, N127P, 1974
82		C5F10O2	perfluoro-3,6-dioxo-1-heptene	46	46	Ether Olefine	J.Org.Chem.USSR, 8, 1972, 1836 - 1838

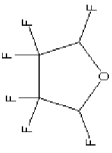
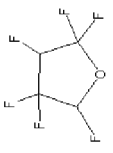
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
83		C6F10	Trifluoromethyl-3-perfluorocyclopenten	52,1	52,1	Cyclo Olefine	Ann.Chim.(Rome), 61, 1971, 245,2 48
84		C7F12	1,1,1,5,5,5-hexafluoro-4,4-bis-trifluoromethyl-pent-2-yne	47	47 - 49	Alkine	Bull.Acad.Sci.USSR Div.Chem.Sci, 23, 7, 1974, 1594
85		C6F12O2	1,1,2-trifluoro-2-[1,1,2,2-tetrafluoro-2-(1,1,2,2,2-pentafluoro-ethoxy)-ethoxy]-ethene	63	63	Ether Olefine	J.Org.Chem.USSR, 8, 1972, 1836 - 1838

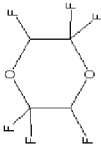
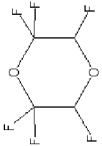
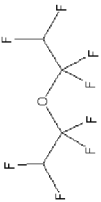
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
86		C6F14N2	cis-1,2-Di-(bis-trifluoromethylamino)-1,2-difluoroethylen	60	60	Amino Olefine	J. Chem. Soc. Perkin Trans. 1, 1972, 1877 - 1879
87		C6F12O2	1,1,1,3,3-pentafluoro-3-(1,2,2,2-tetrafluoro-1-trifluoromethylethoxy)-propan-2-one	56	56 - 59,5	-Ketoether	J. Org. Chem., 43, 1978, 637 - 640
88		C4F12N2O	Bis-(2-difluoramino-perfluorethyl)-ether	66	66	Aminoether	J. Org. Chem., 33, 1968, 3675 - 3678

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
89		C ₆ F ₁₂ N ₂	Perfluor-bis-dimethylamino-acetylen	56,6	56,6	Aminoalkine	J. Chem. Soc. C, 1968, 1096 - 1103
90		C ₅ H ₄ F ₉ N	3,3,3-Trifluor-N,N-bis-(trifluormethyl)-propylamin	61,8	61,8	Amine	J. Chem. Soc. C, 1968, 1096 - 1103
91		C ₄ F ₈ N ₂	perfluoro-2,5-diazahexa-2,4-diene	58	58	Imine	J. Am. Chem. Soc., 89, 1967, 5007 - 5011

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
92		C ₆ H ₂ F ₁₁	(E)-6H-undecafluoro-hex-2-ene	68	68 - 69	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 27, 7, 1978, 1432 - 1434
93		C ₅ H ₂ F ₉ N	bis-trifluoromethyl-(3,3,3-trifluoro-propenyl)-amine	48,2	48,2	Amino Olefine	J. Chem. Soc. C, 1968, 1096 - 1103
94		C ₅ F ₁₀ N ₂ O	4,4,5,5-tetrafluoro-1,3-bis-trifluoromethyl-imidazolidin-2-one	63	63	Urea	J. Fluorine Chem., 24, 1984, 457 - 466

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
95		C7F8	perfluoronorbornadiene	54,4	54,4	Bicyclic Olefine	J. Chem. Soc. Perkin Trans. 1, 1973, 596 - 598
96		C7HF9	1,2,3,4,5,5-hexafluoro-6-trifluoromethylbicyclo[2.2.0]hex-2-ene	70	70	Bicyclic Olefine	J. Chem. Soc. C, 1969, 489 - 500
97		C8F10	1,2,3,5-tetrafluoro-4,6-bis-trifluoromethylbicyclo[2.2.0]hexa-2,5-diene	67,5	67,5	Bicyclic Olefine	J. Chem. Soc. Perkin Trans. 1, 1975, 2005 - 2010

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
98		C ₂ HF ₂ I	(Z)-1,2-difluoro-1-iodoethene	49	49 - 50	Iodo Olefine	J. Organomet. Chem., 367, 1989, 1-10
99		C ₄ H ₂ F ₆ O	2,3,3,4,4,5-hexafluoro-tetrahydrofuran	53	53, 60,5	Cyclicether	Chemosphere, 44, 4, 2001, 897
100		C ₄ H ₂ F ₆ O	2,2,3,3,4,4,5,5-octafluoro-tetrahydrofuran	53	53	Cyclicether	Chemosphere, 44, 4, 2001, 897

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
101		C ₄ H ₂ F ₆ O ₂	2,2,3,3,5,5,6,6-hexafluoro- [1,4]dioxane	68	68	Cyclic ether	Chemosphere, 44, 4, 2001, 897
102		C ₄ H ₂ F ₆ O ₂	2,2,3,3,5,5,6,6-hexafluoro- [1,4]dioxane	58	58	Cyclic ether	Chemosphere, 44, 4, 2001, 897
103		C ₄ H ₂ F ₈ O	1,1,2,2-tetrafluoro-1-(1,1,2,2- tetrafluoro-ethoxy)-ethane	54	54	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897

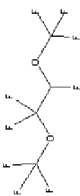
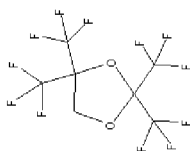
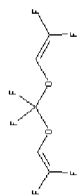
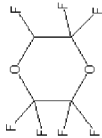
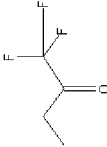
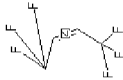
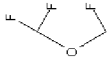
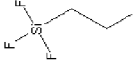
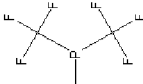
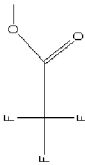
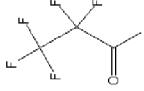
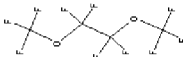
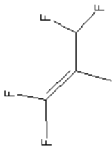
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
104		C4HF9O2	1,1,2-trifluoro-1,2-bis-trifluoromethoxy-ethane	55	55	Aliphatic Ether	Chemosphere, 44, 4, 2001, 897
105		C7H2F12O2	2,2,4,4-tetrakis-trifluoromethyl-[1,3]dioxolane	70	70 - 72	Cyclic ether / Acetal	Synthesis, 15, 2002, 2225 - 2231
106		C5H2F6O2	2-[(2,2-difluoro-vinyl)-difluoro-methoxy]-1,1-difluoro-ethene	60	60 - 62	Ether Olefine	Macromolecules, 37, 21, 2004, 7918 - 7923

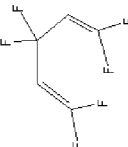
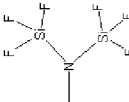
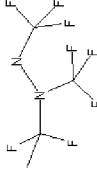
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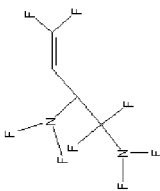
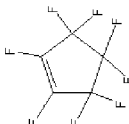
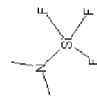
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
1		C ₄ H ₂ F ₇ O ₂	heptafluoro-[1,4]dioxane	39	39	Cycloether	Chemosphere, 44, 4, 2001, 897 - 906
3		C ₄ H ₅ F ₃ O	1,1,1-trifluoro-butan-2-one	43	43 - 45, 45 - 46	Ketone	Tetrahedron, 20, 64, 2162-2166
4		C ₄ H ₂ F ₆	1,1,1,4,4,4-hexafluoro-but-2-ene	33,2	33,2	Olefine	J. Am. Chem. Soc., 71, 1949, 298

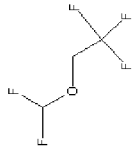
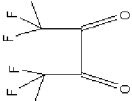
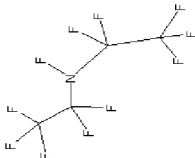
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
5		C2H3F5O	difluoromethyl-fluoromethyl ether	29	29 - 30	Aliphatic ether	J.Gen.Chem.USSR, 31, 31, 1961, 2561-2564
6		C3H5F5O	methyl-(1,1,2-trifluoro-ethyl)-ether	43	43	Aliphatic ether	J.Gen.Chem.USSR, 37, 1967, 797-801
7		C3H5F5O	1,1,1-trifluoro-2-methoxy-ethane	30	30, 31 - 32	Aliphatic ether	DE 1076113, 1958

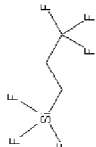
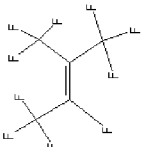
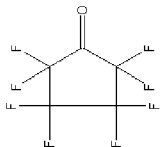
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
8		C ₃ H ₇ F ₃ Si	trifluoro-propyl-silane	25	25	Silane	Bull.Acad.Sci.USSR Div.Chem.Sci, 1964, 1127-1132
10		C ₃ H ₃ F ₆ P	methyl-bis-trifluoromethyl-phosphane	35,2	35,2	Phosphane	J. Chem. Soc., 1957, 3880, 3883
11		C ₃ H ₃ F ₃ O ₂	trifluoro-acetic acid methyl ester	42	42 - 42,5, 43	Ester	Can. J. Chem., 50, 1972, 1886,1888,1889, 2175, 2176-2178

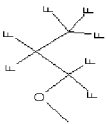
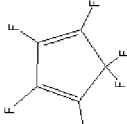
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
12		C4H3F5O	3,3,4,4,4-pentafluoro-butan-2-one	38	38	Ketone	J. Org. Chem. USSR, 14, 6, 1978, 1240-1241
13		C4F10O2	1,1,2,2-tetrafluoro-1,2-bis-trifluoromethoxy-ethane	30	30	Aliphatic ether	Chemosphere, 44, 4, 2001, 897 - 906
14		C4H4F4	1,1,3,3-tetrafluoro-2-methylpropene	19	19 - 20	Olefine	J. Org. Chem., 32, 1967, 2749-2751

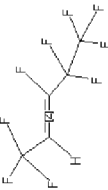
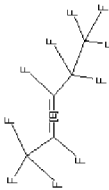
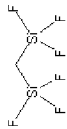
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
15		C ₅ H ₂ F ₆	1,1,3,3,5,5-hexafluoro-penta-1,4-diene	44,6	44,6 - 45,1	Olefine	J. Org. Chem., 25, 1960, 1661-1662
16		CH ₃ F ₆ NSi ₂	Methyl-bis-trifluorsilyl-amin	27	27	Aminosilane	J. Chem. Soc. Dalton Trans., 1973, 2675-2681
17		C ₃ HF ₉ N ₂	N,N,N'-tris-trifluoromethyl-hydrazine	35	35	Hydrazine	J. Chem. Soc. A, 1966, 933-935

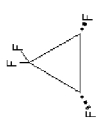
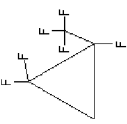
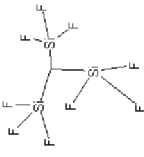
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
18		C ₄ H ₂ F ₈ N ₂	1,2-Difluoramino 1,1,4,4 tetrafluorbut-3-en	29	29	Amino Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 12, 1970, 2578-2582
19		C ₅ F ₈	octafluoro-cyclopentene ; Perfluorocyclopentene	26	26	Cyclo Olefine	Chemosphere, 44, 4, 2001, 897 - 906
20		C ₂ H ₆ F ₃ NSi	Trifluorosilyldimethylamin	20,5	20,5, 21	Aminosilane	J. Chem. Soc. Dalton Trans., 1973, 2675-2681

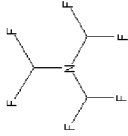
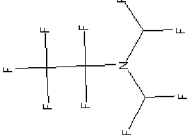
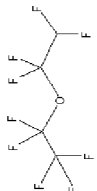
No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
21		C3H3F5O	2,2,2-trifluoroethyl difluoromethyl ether	29	29	Aliphatic ether	J. Med. Chem., 15, 1972, 604-606, DE 1814962, 1970
22		C4F6O2	1,1,1,4,4,4-hexafluoro-2,3-butanedione	34	34 - 35	Diketone	J. Org. Chem. USSR, 7, 11, 1971, 2407-2409
23		C4F11N	Perfluor-diethylamin	23,9	23,9	Amine	J. Am. Chem. Soc., 85, 1963, 83-86

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
24		C ₃ H ₄ F ₆ Si	trifluoro-(3,3,3-trifluoro-propyl)-silane	43	43, 45	Silane	J. Fluorine Chem., 60, 2,3, 1993, 211-223
25		C ₅ F ₁₀	1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene	28	28 - 30	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 27, 7, 1978, 1432-1434
26		C ₅ F ₈ O	octafluoro-cyclopentanone	23	23 - 24, 24	Cycloketone	J. Chem. Soc., 1965, 7370-7377, J. Org. Chem., 33, 7, 1968, 2692-2696

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
27		C4H3F7O	Perfluoropropylmethyl ether	34	34	Aliphatic ether	FR 2233986 ; US 3943256, 1975
28		C5F6	hexafluorocyclopentadiene	28	28, 29	Cyclo Olefine	J. Chem. Soc., 1965, 808 - 810, J. Chem. Soc. C, 1966, 2102 - 2106
29		C4H2F8O	1,1,2,2-tetrafluoro-1-(1,2,2,2-tetrafluoro-ethoxy)-ethane	42	42	Aliphatic ether	Chemosphere, 44, 4, 2001, 897 - 906

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
30		C ₅ HF ₉	(<i>Z</i>)-1,1,1,3,4,4,5,5,5-nonafluoropent-2-ene	32	32 - 33	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 24, 12, 1975, 2614-2617
31		C ₅ F ₁₀	(<i>E</i>)-1,1,1,2,3,4,4,5,5,5-decafluoropent-2-ene	26	26 - 28, 27 - 29	Olefine	Bull.Acad.Sci.USSR Div.Chem.Sci, 24, 12, 1975, 2614-2617
32		CH ₂ F ₆ Si ₂	hexa- <i>Si</i> -fluoro- <i>Si</i> , <i>Si'</i> -methanediylobis-silane	35,5	35,5	Silane	Chem. Ber., 97, 1964, 1673,1675, 1676

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
33		C ₃ H ₂ F ₄	cis-1,1,2,3-Tetrafluorocyclopropan	34	34	Cycloalkane	J. Chem. Soc. Perkin Trans. 1, 1973, 1773-1779
34		C ₄ H ₂ F ₆	1,1,2-trifluoro-2-trifluoromethyl-cyclopropane	21,5	21,5	Cycloalkane	J. Chem. Soc. Perkin Trans. 1, 1973, 1773-1779
35		CHF ₉ Si ₃	Tris-trifluorsilylmethan	42	42	Silane	Chem. Ber., 97, 1964, 1673,1675, 1676

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
36		C3H3F6N	Hexafluorotrimethylamin, tris-difluoromethyl-amine	41,5	41,5	Amine	J. Fluorine Chem., 15, 1980, 231-238
37		C4H2F9N	bis-difluoromethyl-(1,1,2,2,2-pentafluoro-ethyl)-amine	43,1	43,1	Amine	J. Fluorine Chem., 17,1981, 65-74
38		C4HF9O	1,1,1,2,2-pentafluoro-2-(1,1,2,2,2-tetrafluoro-ethoxy)-ethane	32,5	32,5	Aliphatic ether	Chemosphere, 44, 4, 2001, 897

No.	Chemical Structure	Chemical Formula	Chemical Name	Bp (°C)	Bp range (°C)	Comment	Literature
39		C4HF9O	1,1,1,2,2,3-hexafluoro-3-trifluoromethoxy-propane	20	20	Aliphatic ether	Chemosphere, 44, 4, 2001, 897

The following examples are intended to explain the invention in further detail without intending to limit it.

Examples concerning solvent uses :

Example 1 : Solvents for degreasing

Example 1.1 : An azeotropic mixture was prepared from (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and GALDEN® TH55 by mixing them in a molar ratio of 1:1. To the resulting mixture, 1,2-trans-dichloroethylene is added in an amount that, in the resulting mixture, it is contained in an amount of about 25 % by weight. The resulting mixture is used for degreasing metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.2 : Example 1.1 is repeated, but this time, ethanol is added in an amount that it is contained in the resulting mixture in an amount of 10 % by weight. The resulting mixture is used for removal of water adhering to metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.3 : An azeotropic mixture was prepared from (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and ethanol by mixing them in a volume ratio of 87:13. The resulting mixture is used for removal of water adhering to metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.4 : Example 1.3 is repeated. To the resulting azeotropic mixture, 1,2-trans-dichloroethylene is added in an amount that, in the resulting mixture, it is contained in an amount of about 25 % by weight. The resulting mixture is used for degreasing metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.5 : 3,3,4,4-tetrafluoro-tetrahydro-furane and 1,2-trans-dichloroethylene are mixed in a weight ratio of 1:1. The resulting mixture is used for degreasing metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.6 : Example 1.5 is repeated, but this time, methanol is added in such an amount that the resulting mixture contains 10 % by weight of methanol. The resulting mixture is used for removal of water adhering to metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.7 : Example 1.6 is repeated, but this time, a Isopropylammonium dodecylbenzenesulphonate is added as surfactant in such an amount that it is contained in the resulting mixture in an amount of 1 % by weight. The resulting mixture is used for degreasing metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 1.8 : Example 1.6 is repeated, but this time, N-methylpyrrolidone is added in such an amount that in the resulting mixture, it is contained in an amount of 5 % by weight. The resulting mixture is used for degreasing metal parts by immersing the metal parts into the mixture, lifting the parts out of the mixture, removing adhering liquid and drying the parts.

Example 2 : Use as foam blowing agents :

Example 2.1 : Preparation of a thermoplastic foam

200 kg of Polystyrol (melt index 3.0 to 110) are mixed with 2 kg talcum as nucleating agent. The resulting mixture is filled into a conventional extruder apparatus and molten therein. Into the melt, 1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene is injected such that this blowing agent is contained in an amount of about 8.5 % by weight in the resulting mixture. The resulting mixture is extruded via an extruder die to provide a closed cell foam.

Example 2.2 : Preparation of a polyurethane foam

2.2.1. Preparation of a premix : A mixture containing 80 % by weight of polyetherpolyol (Tercarol A350), 10 % by weight of 1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene and 10 % by weight of triethylphosphate is prepared by mixing the respective compounds.

2.2.2. Foaming : The premix of 2.2.1. is mixed with diphenylmethane diisocyanate ; the latter is applied in an amount which was 10 % higher than stoichiometrically needed. The extrusion is then performed in a low pressure extruder to provide a closed cell polyurethane foam.

Example 3 : Use as etching agent

Etching can be performed in an Inductive Coupled Plasma Source (ICP) etch reactor or in a Capacitively Coupled Plasma Source (CCP) reactor which is available from Applied Materials. A self-aligned contact (SAC) is formed as described in FIG. 1 and page 3 of WO 2000/302168. A polysilicon gate layer, a tungsten silicide barrier and glue layer, and a silicon nitride cap layer are deposited and photolithographically formed into two closely related spaced gate structures having a gap there between. Then, a silicon nitride layer is deposited

- 70 -

via CVD on the structure, and dopant ions are implanted. A dielectric SiO₂ layer is deposited over the structure, a photoresist layer is deposited over the oxide layer and photographically defined using light with a wavelength of 193 nm into a mask. Then, using 1,1,3,3-tetrafluoro-2-methyl-propene and argon, delivered in a weight ratio of 1:4 into the plasma reactor, the SiO₂ layer is etched.

Example 3 can be repeated using low-k dielectric layers or ultra-low-k dielectric layers instead of SiO₂ layers.

Example 3 is repeated using 1,1,3,3,5,5-hexafluoro-penta-1,4-diene.

CLAIMS

1 – A method using compounds or compositions for useful applications such as foam blowing, solvent cleaning, refrigeration, as etching gas for semiconductor etching or chamber cleaning, heat transfer, fire extinguishing and production of aerosols comprising a step wherein

at least one compound is applied selected from Tables 1 or 2 of the specification, namely at least one compound selected from the groups consisting of

Fluorosubstituted ethers consisting of 3,3,4,4-tetrafluoro-tetrahydrofuran, 2,2,5,5-tetrafluoro-2,5-dihydro-furan, methyl-(1,1,2-trifluoro-ethyl)-ether, (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, (1,1,2,2-tetrafluoro-ethyl)-(2,2,2-trifluoro-ethyl)-ether, methyl-(β H-octafluoro-isobutyl)-ether, bis-(2,2,2-trifluoro-ethyl) ether, 1,1,1,2,2-pentafluoro-3-methoxy-propane, 1,1,2,2-Tetrafluoroethyl-fluormethylether, 1-difluoromethoxy-1,2,2-trifluoro-ethane, 1,1,1,2,2-pentafluoro-3-fluoromethoxy-propane, 3,3,3-trifluoro-1-(1,1,2,2,3,3,3-heptafluoro-propoxy)-propyne, 1,1,2,2-Tetrafluoroethyl-1,2,2-trifluoroethylether, difluoro-(2,2,2-trifluoro-1-methoxy-1-trifluoromethyl-ethyl)-amine, 1,1,2,2,3,3,4-heptafluoro-4-methoxy-cyclobutane, 4-difluoromethoxy-1,1,1,2,2,3,3-heptafluoro-butane, 1,1,1,3,3,3-hexafluoro-2-methoxymethyl-2-trifluoromethyl-propane, 2-difluoromethoxy-1,1,1-trifluoro-propane, 3-difluoromethoxy-1,1,1,2,2-pentafluoro-propane, 2-difluoromethoxy-1,1,2,3,3-pentafluoro-propane, 1-difluoromethoxy-1,1,2,3,3,3-hexafluoro-propane, 1,1,1,2,3,3-hexafluoro-3-fluoromethoxy-propane, 1,1,1,2,3,3,3-heptafluoro-2-(2,2,2-trifluoro-1-trifluoromethyl-ethoxy)-propane, methoxymethyl-bis-trifluoromethyl-amine, 1,2,2,3,3-Pentafluoropropyl-difluormethylether, perfluoro-3,6-dioxa-1-heptene, 1,1,2-trifluoro-2-[1,1,2,2-tetrafluoro-2-(1,1,2,2,2-pentafluoro-ethoxy)-ethoxy]-ethene, 1,1,1,3,3-pentafluoro-3-(1,2,2,2-tetrafluoro-1-trifluoromethyl-ethoxy)-propan-2-one, Bis-(2-difluoramino-perfluoroethyl)-ether, 2,2,3,4,4,5-hexafluoro-tetrahydro-furan, 2,3,3,4,4,5-hexafluoro-tetrahydro-furan, 1,1,2,2-tetrafluoro-1-(1,1,2,2-tetrafluoro-ethoxy)-ethane, 2,2,3,5,6,6-hexafluoro-[1,4]dioxane, 2,2,3,5,5,6-hexafluoro-[1,4]dioxane, 2-[(2,2-difluoro-vinyloxy)-difluoromethoxy]-1,1-difluoro-ethene, 2,2,4,4-tetrakis-trifluoromethyl-[1,3]dioxolane, 1,1,2-trifluoro-1,2-bis-trifluoromethoxy-ethane, heptafluoro-[1,4]dioxane, 1,1,1-trifluoro-2-methoxy-ethane, methyl-(1,1,2-trifluoro-ethyl)-ether, difluoromethyl-fluoromethyl ether, 1,1,2,2-tetrafluoro-1,2-bis-trifluoromethoxy-

ethane, 2,2,2-trifluoroethyl difluoromethyl ether, Perfluoropropylmethylether, 1,1,2,2-tetrafluoro-1-(1,2,2,2-tetrafluoro-ethoxy)-ethane, 1,1,1,2,2-pentafluoro-2-(1,1,2,2-tetrafluoro-ethoxy)-ethane, 1,3-difluoro-1,1,3,3-tetramethyl-disiloxane and 1,1,1,2,2,3-hexafluoro-3-trifluoromethoxy-propane,

N-containing compounds selected from the group consisting of 2,4,6-trifluoro-[1,3,5]triazine, 2,2,4,4,5,5-hexafluoro-1,3-bis-trifluoromethyl-imidazolidine, 1-isopropyl-3,3-bis-trifluoromethyl-diaziridine, 1,4-Bis(difluoramino)-1,1',4,4'-tetrafluorbutene-2, 1,4-Bis(difluoramino) perfluorbut-2-ene, N,N-bis-trifluoromethyl-acetamide, bis-(1,1,2,2-tetrafluoro-ethyl)-diazene, bis-(2,2,2-trifluoro-1-trifluoromethyl-ethylidene)-hydrazine, 1,1,2,2-tetrafluoro-N,N'-bis-trifluoromethyl-ethane-1,2-diamine, trifluoro-acetic acid difluoro-(trifluoromethyl-amino)-methyl ester, N,N'-bis-difluoromethyl-N,N'-bis-trifluoromethyl-hydrazine, Octafluoro-2,5-diaza-1,5-hexadiene, cis-1,2-Di-(bis-trifluoromethylamino)-1,2-difluorethylen, Perfluor-bis-dimethylamino-acetylene, 3,3,3-Trifluor-N,N-bis-(trifluoromethyl)-propylamine, perfluoro-2,5-diaza-hexa-2,4-diene, bis-trifluoromethyl-(3,3,3-trifluoro-propenyl)-amine, 4,4,5,5-tetrafluoro-1,3-bis-trifluoromethyl-imidazolidin-2-one, Methyl-bis-trifluorsilyl-amine, N,N,N'-tris-trifluoromethyl-hydrazine, 1,2-Difluoramino 1,1,4,4 tetrafluorobut-3-ene, trifluorosilyldimethylamine, Perfluoro-diethylamine, Hexafluorotrimethylamine, tris-difluoromethyl-amine, bis-difluoromethyl-(1,1,2,2,2-pentafluoro-ethyl)-amine,

Fluorosubstituted alkenes and alkynes selected from the group consisting of 1,1,2,3,3-pentafluoro-3-iodo-propene, 1,1,2,3,3,4,4-heptafluoro-4-iodo-but-1-ene, 1,1,2,3,3,4,4,5,6,6-decafluoro-hexa-1,5-diene, 1,2,3,3,3-pentafluoro-1-iodo-propene, 1,1,3,3,5,5-hexafluoro-penta-1,4-diene, 4,4,4-trifluoro-2-trifluoromethyl-but-1-ene, 1,1,1,5,5,5-hexafluoro-2,4-bis-trifluoromethyl-pent-2-ene, 1,1,1,3,5,5,5-heptafluoro-4-trifluoromethyl-pent-2-ene, 4H-tridecafluoro-hept-3-ene, trifluoromethyl-2-perfluorocyclopentene, 1H:4H-hexafluorocyclopentene, 1,1,2,3,3,4,5,6,6-decafluoro-5-trifluoromethyl-hex-1-ene, 1,2,3,3,4,6,6-heptafluoro-cyclohexa-1,4-diene, 1,2,3,3,4,4,5,5,6,6-decafluoro-cyclohexene, 1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-hex-2-ene, 1,3,3,4,4,5,5-heptafluoro-2-trifluoromethyl-cyclopentene, 4-difluoromethylene-3,3-difluoro-1,2-bis-trifluoromethyl-cyclobutene, 3,3,4,4,5,5-hexafluoro-cyclopentene, trifluoromethyl-3-perfluorocyclopentene, (E)-6H-undecafluoro-hex-2-ene, perfluoronorbornadiene, 1,2,3,4,5,5-hexafluoro-6-trifluoromethyl-

bicyclo[2.2.0]hex-2-ene, 1,2,3,5-tetrafluoro-4,6-bis-trifluoromethyl-bicyclo[2.2.0]hexa-2,5-diene, (Z)-1,2-difluoro-1-iodoethene, 1,1,1,4,4,4-hexafluoro-but-2-ene, 1,1,3,3-tetrafluoro-2-methyl-propene, 1,1,3,3,5,5-hexafluoro-penta-1,4-diene, octafluoro-cyclopentene ; perfluorocyclopentene, 1,1,1,2,4,4,4-heptafluoro-3-trifluoromethyl-but-2-ene, hexafluorocyclopentadiene, (E)-1,1,1,2,3,4,4,5,5,5-decafluoro-pent-2-ene, (Z)-1,1,1,3,4,4,5,5,5-nonafluoro-pent-2-ene and 1,1,1,5,5,5-hexafluoro-4,4-bis-trifluoromethyl-pent-2-yne,

Alkanes and iodoalkanes selected from the group consisting of 1,1,1-trifluoro-2-iodo-ethane, nonafluoro-1-iodo-butane (perfluorobutyl iodide), nonafluoro-2-iodo-butane, 1,1,2,3,3,4-hexafluoro-cyclobutane, 1H,3H-cctafluorocyclopentane, 1,1,2,2,3-pentafluoro-3-iodo-cyclopropane, 1,1,2-trifluoro-2-trifluoromethyl-cyclopropane, cis-1,1,2,3-tetrafluorocyclopropane,

Fluorinated compounds with a keto group selected from the group consisting of 1,1,1,3-tetrafluoro-propan-2-one, 3,3,4,4,5,5,5-heptafluoro-pentan-2-one, 1,3,3,4,4,4-hexafluoro-butan-2-one, decafluorocyclohexanone, 3,3,4,4-tetrafluoro-butan-2-one, 3,3,3-trifluoro-2-trifluoromethyl-propionaldehyde, Iodopentafluoroacetone, 3,4,4,4-tetrafluoro-butan-2-one, 1,1,1-trifluoro-butan-2-one, 3,3,4,4,4-pentafluoro-butan-2-one, 1,1,1,4,4,4-hexafluoro-2,3-butanedione, octafluoro-cyclopentanone, trifluoro-acetic acid 2,2,2-trifluoro-ethyl ester, perfluor-tert.-butyl perfluoroacetate, hexafluor-2-buten-2,3-diol bis(trifluoroacetic acid) ester, trifluoro-acetic acid 2,2-difluoro-1-trifluoromethyl-vinyl ester, and trifluoro-acetic acid methyl ester,

Fluorinated alcohols selected from the group consisting of 1,1,1,3,3,3-hexafluoro-2-propanol, 1,1,1,3,3,3-hexafluoro-2-methyl-2-propanol and 2,2,3,3,4,4-hexafluoro-1-trifluoromethyl-cyclobutanol,

Fluorinated silanes selected from the group consisting of 3,3,3-trifluoropropyl-trifluorsilane, trifluoro-propyl-silane, trifluoro-(3,3,3-trifluoro-propyl)-silane, hexa-Si-fluoro-Si,Si'-methanediyl-bis-silane, and Tris-trifluorsilylmethane, and

Fluorinated phosphorous and sulfur compounds selected from the group consisting of 2,2,2-trifluoro-4,4,5,5-tetrakis-trifluoromethyl-2λ⁵-[1,3,2]dioxaphospholane, methyl-bis-trifluoromethyl-phosphane, and 1,2-perfluoropropylene sulfate.

- 74 -

2 – The method according to claim 1 for cleaning a surface which comprises contacting said surface with a solvent comprising at least one compound described in Tables 1 or 2 of the specification.

3 – The method according to claim 2, wherein the compound is described in table 1.

4 – The method according to claim 2 or 3, wherein the compound is selected from compounds No. 1, 3, 5, 10, 23, 34, 39, 40, 53, 57, 60, 61, 73, 76, 83, 86, 94, 99 and 100 described in table 1, preferably from compounds No. 1, 5, 10, 23 and 53.

5 – The method according to anyone of claims 2 to 4 wherein the surface is dried.

6 – The method according to anyone of claims 2 to 4 wherein the surface is degreased.

7 – The method according to anyone of claims 2 to 5 wherein the solvent has a GWP₁₀₀ less than 150.

8 – The method according to anyone of claims 2 to 6 wherein the solvent has an atmospheric boiling point from 30°C to 80°C.

9 – The method according to anyone of claims 2 to 7 wherein the solvent contains from 10 to about 100 % by weight of the compound.

10 – A method according to claim 1 for producing a polymer foam which comprises using a blowing agent comprising at least one compound described in Tables 1 or 2 of the specification.

11 – The method according to claim 10, wherein the compound is described in table 2.

12 – The method according to claim 11, wherein the compound is selected from compounds No. 4, 17, 25, 26, 28, 30, 38 and 39 described in table 2.

13 – The method according to anyone of claims 10 to 12 wherein the polymer foam is a thermoset foam.

14 – The method according to claim 13 wherein the polymer foam is an isocyanate-based foam.

15 – The method according to anyone of claims 10 to 12 wherein the polymer foam is a thermoplastic foam.

16 – The method according to claim 15 wherein the polymer foam is an alkenylaromatic foam, preferably a polystyrene foam.

17 – The method according to anyone of claims 10 to 16 wherein the foam blowing agent has a GWP₁₀₀ less than 150.

18 – The method according to anyone of claims 10 to 17 wherein the foam blowing agent has an atmospheric boiling point from 0°C to 45°C.

19 – The method according to anyone of claims 10 to 18 wherein the foam blowing agent contains from 10 to about 100 % by weight of the compound.

20 – Use of a fluorinated olefin having at least 4 carbon atoms and an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent or an aerosol propellant.

21 – Use according to claim 20, wherein the fluorinated olefin is cyclic.

22 – Use according to claim 20 or 21, wherein the fluorinated olefin is a conjugated or non-conjugated diene.

23 – Use of a cyclic fluorinated ether having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent or an aerosol propellant.

24 – Use of a fluorinated N-heterocyclic compound having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent or an aerosol propellant.

- 76 -

25 – Use of a fluorinated unsaturated nitrogen containing compound having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent or an aerosol propellant.

26 – Use of a cyclic fluorinated ketone having an atmospheric boiling point from 0°C to 100°C, preferably 10 to 80°C as constituent of a foam blowing agent, a solvent, a refrigerant, a heat transfer fluid, a fire extinguishing agent or an aerosol propellant.

27 – Composition comprising a compound disclosed in table 1 or 2, a non fluoro organic solvent and optionally a hydrofluoroalkane.

28 – Composition comprising a fluorinated compound in accordance with anyone of claims 19 to 25, a non fluoro organic solvent and optionally a hydrofluoroalkane.

29 – Mixtures, preferably azeotropes and azeotrope like compositions, formed from the compound described under number 10 of table 1, (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether, and ethanol or perfluoropolyether available under GALDEN® HT 55.

30 – The azeotrope of claim 29 consisting of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and ethanol, having a minimum boiling point of about 51.1°C at about 990 mbar and a composition of about 13 % by volume of ethanol and about 87 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether.

31 – The azeotrope of claim 29 consisting of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether and GALDEN® HT 55 has a minimum boiling point of about 41.3°C at 977 mbar and a composition of about 50 % by weight of GALDEN® HT 55 and about 50 % by weight of (1,1,2,3,3,3-hexafluoro-propyl)-methyl ether.