

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
6 March 2008 (06.03.2008)

PCT

(10) International Publication Number
WO 2008/027604 A2

(51) International Patent Classification:

C07C 311/09 (2006.01) C07C 22/02 (2006.01)
C07C 317/18 (2006.01) C07C 43/13 (2006.01)
C07C 19/075 (2006.01) C07C 69/653 (2006.01)
C07C 19/10 (2006.01) C07F 9/09 (2006.01)
C07C 19/16 (2006.01) C07F 9/14 (2006.01)
C07C 21/18 (2006.01)

(21) International Application Number:

PCT/US2007/019355

(22) International Filing Date:

4 September 2007 (04.09.2007)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

60/841,936 1 September 2006 (01.09.2006) US

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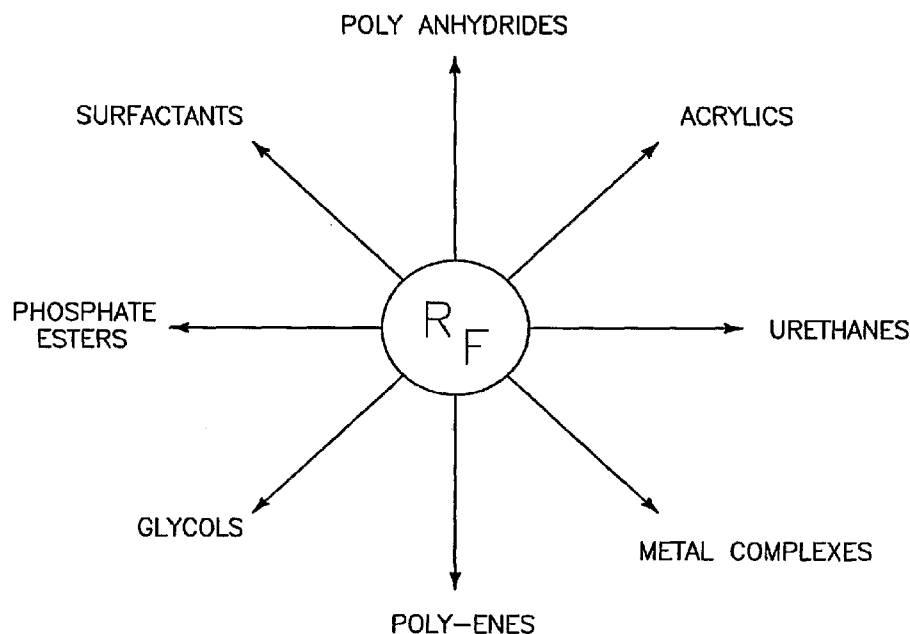
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY,

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(54) Title: PRODUCTION PROCESSES AND SYSTEMS, COMPOSITIONS, SURFACTANTS MONOMER UNITS, METAL COMPLEXES, PHOSPHATE ESTERS, GLYCOLS, AQUEOUS FILM FORMING FOAMS AND FOAM STABILIZERS



(57) Abstract: R_F-compositions including surfactants, foam stabilizers, monomers, polymers, urethanes, intermediates, metal complexes, phosphate esters as well as telomerization methods are provided.

WO 2008/027604 A2



TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *of inventorship (Rule 4.17(iv))*

Published:

- *without international search report and to be republished upon receipt of that report*
- *the filing date of the international application is within two months from the date of expiration of the priority period*

**PRODUCTION PROCESSES AND SYSTEMS, COMPOSITIONS,
SURFACTANTS, MONOMER UNITS, METAL COMPLEXES,
PHOSPHATE ESTERS, GLYCOLS, AQUEOUS FILM FORMING
FOAMS AND FOAM STABILIZERS**

5

RELATED PATENT DATA

This patent claims priority to U.S. provisional patent application 60/841,936 which was filed September 1, 2006, entitled "Production
Processes and Systems, Compositions, Surfactants, Monomer Units,
Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming
Foams and Foam Stabilizers" and which is incorporated by reference
herein.

TECHNICAL FIELD

The present invention relates to the filed of halogenated
compositions, processes for manufacturing halogenated compositions
and, more specifically, fluorinated compositions, processes for
manufacturing fluorinated compositions and methods for treating
substrates with the fluorinated compositions.

BACKGROUND OF THE INVENTION

Compositions such as surfactants and polymers, for example,
have incorporated fluorine to affect the performance of the
composition when the composition is used as a treatment for
materials and when the composition is used to enhance the
performance of materials. For example, surfactants incorporating
fluorinated functional groups can be used as fire extinguishants either
alone or in formulations such as aqueous film forming foams (AFFF).
Traditional fluorosurfactants, such as perfluoro-octyl sulfonate
derivatives (PFOS), have linear perfluorinated portions.

Polymers incorporating fluorine have been used to treat
materials. Exemplary fluorinated treatments include compositions
such as Scotchguard®.

SUMMARY

Compositions and methods for making compositions such as $R_F(R_T)_nQ$ are provided. The R_F group can include at least two $-CF_3$ groups, the R_T group having at least two carbons, n can be at least 1 and the Q group can include one or more atoms of the periodic table of elements.

R_F -Intermediates and methods for making same are also provided such as $R_F(R_T)_nQ_g$, with the Q_g group being one or more atoms of the periodic table of elements.

Surfactants and methods for making same are provided that can include $R_F(R_T)_nQ_S$, with the Q_S group being at least one atom of the periodic table of elements and at least a portion of the R_F and R_T groups are hydrophobic relative to the Q_S group and at least a portion of the Q_S group is hydrophilic relative to the R_F and R_T groups.

Foam stabilizers and methods for making same are provided that can include $R_F(R_T)_nQ_{FS}$, with the Q_{FS} group being at least one atom of the periodic table of elements and at least a portion of the R_F and R_T groups are hydrophobic relative to the Q_{FS} group and at least a portion of the Q_{FS} group is hydrophilic relative to the R_F and R_T groups.

Metal complexes and methods for making same are provided that can include $R_F(R_T)_nQ_{MC}$, with the Q_{MC} group being at least one atom of the periodic table of elements.

Phosphate ester and methods of making same are provided that can include $R_F(R_T)_nQ_{PE}$, with the Q_{PE} group being a portion of a phosphate ester group.

Polymers and methods of making same are provided that can include $R_F(R_T)_nQ_{MU}$, with the Q_{MU} group being a portion of a polymer chain backbone.

Urethanes and methods of making same are provided that can include $R_F(R_T)_nQ_U$, with the Q_U group being at least one atom of the periodic table of elements.

5 Glycols and methods of making same are provided that can include $R_F(R_T)_nQ_H$, with the Q_H group being a portion of a glycol chain backbone.

DRAWINGS

Embodiments are described below with reference to the
10 following accompanying drawings.

Fig. 1 is a general view of exemplary R_F -compositions.

Fig. 2 is an exemplary system for preparing compositions according to an embodiment.

DESCRIPTION

15 Exemplary R_F -compositions and production methods are described with reference to Figures 1-2. Starting materials and/or intermediate materials as well as processes for producing the same and/or introducing R_F -intermediates compositions into surfactants, polymers, glycols, monomers, monomer units, phosphate esters,
20 metal complexes, and/or foam stabilizers can be described in published International Patent applications: PCT/US05/03429, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed
25 January 28th, 2005; PCT/US05/02617, entitled Compositions, Halogenated Compositions, Chemical Production and Telomerization Processes, filed January 28th, 2005; PCT/US05/03433, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols,
30 Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005; PCT/US05/03137, entitled Production Processes and

Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005; and PCT/US05/03138, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005, the entirety of all of which are incorporated by reference herein ("Published International Applications").

Referring to Fig. 1, a general view of exemplary R_F -compositions is shown. R_F -compositions include, but are not limited to, R_F -surfactants, R_F -monomers, R_F -monomer units, R_F -metal complexes, R_F -phosphate esters, R_F -glycols, R_F -urethanes, and or R_F -foam stabilizers. In exemplary embodiments, poly-anhydrides, acrylics, urethanes, metal complexes, poly-enes, and/or phosphate esters can include R_F portions as well.

R_F -compositions include compositions that have an R_F portion and/or R_F portions. The R_F portion can be R_F groups, such as pendant groups and/or moieties of compositions. The R_F portion can include at least two $-CF_3$ groups and the $-CF_3$ groups may be terminal. The R_F groups can be $-C_3F_6$ or $-C_3F_7$, for example. The R_F portion can also include both $-CF_3$ groups and additional groups containing fluorine, such as $-CF_2-$ groups. In exemplary embodiments, the R_F portion can include a ratio of $-CF_2-$ groups to $-CF_3-$ groups that is less than or equal to two, such as $(CF_3)_2CF-$ groups. The R_F portion can also include three pendant $-CF_3$ groups, in other embodiments. The R_F portion can include at least three pendant $-CF_3$ groups and at least one $-CF_2-$ group. The R_F portion can include at least three pendant $-CF_3-$ groups, at least one $-CF_2-$ group and at least five $-CH_2-$, in exemplary embodiments. In exemplary embodiments, the R_F portion can include a ratio of $-CF_2-$ groups to $-CH_2-$ groups that can be 0.4 to 1. The R_F portion can include, in exemplary embodiments a ratio of $-CF_2-$ groups to $-CF_3-$

groups that can be 0.4 to 1. The R_F portion can be a 1,1,1,2,4,4,6,6,13,13,13-undecafluoro-2,8,10-tris(trifluoromethyl)tridecyl group, for example.

The R_F -compositions can include $R_F(R_T)_nQ$, where the R_F group
 5 has a carbon amount greater than C5 and at least one terminal and at least one pendant $-CX_3$ group, with X being one or both of H and F, for example. The R_F group can have carbon amount between C5 and C17. Example R_F groups can include $(CF_3)_2CF(CH_2CF_2)_l-$, with l being from 1 to 2; $(CF_3)_2CF(CH_2C(CF_3)H)_m-$, with m being from 1 to 3;
 10 and/or $(CF_3)_2CF(CH_2CF_2)_l(CH_2C(CF_3)H)_m-$, with l being from 1 to 2 and m being from 1 to 3.

More particularly, the R_F groups can be one or more of:
 $(CF_3)_2CFCH_2CH(CF_3)-$, $(CF_3)_2CFCH_2C(CF_3)HCH_2-$,
 $(CF_3)_2CFCH_2C(CF_3)HCH_2CF_2-$, $(CF_3)_3CCH_2C(CF_3)H-$,
 15 $(CF_3)_2CFCH_2CF_2-$, $(CF_3)_2CFCH_2CF_2CH_2-$, $(CF_3)_2CFCH_2CF_2CH_2CF_2-$,
 $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2-$, $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)H-$,
 $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)HCH_2C(CF_3)H-$,
 $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)HCH_2C(CF_3)H-$, and/or
 $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)HCH_2C(CF_3)HCH_2C(CF_3)H-$.
 20 According to exemplary embodiments, the R_F group can further comprise at least a portion of an (R_T) group or groups.

The R_T group can include at least one C-2 group. The R_T group can include a C-3 group and be incorporated into and form a part of R_F groups via processes described herein, such as addition reactions
 25 employing a carbon nucleophile. The R_T group can be $-C_nH_{2n}-$ wherein n is at least 1, for example. The R_T group can be butyl, in exemplary embodiments. The R_T group can be $-CH_2CX_2-$, with X being H and/or F, for example. The R_T group can be $-CH_2CH_2-$ and/or $-CH_2CF_2-$. The R_T group can be one or more of:
 30 $-CH_2CF_2CH_2CH(CF_3)-$, $-CF_2CH_2CF_2CH_2CH(CF_3)-$,
 $-CH_2CF_2CH_2CF_2CH_2CH(CF_3)-$, $-CF_2CH_2CH(CF_3)CH_2-$,
 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)-$, $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2-$,
 and/or $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)-$. The R_T group can

repeat in units and the units can be designated as n with n being greater than 1. In example implementations these R_T groups can be incorporated into and form a part of R_F groups via processes described herein, such as telomerization processes.

5 In exemplary implementations, R_F -compositions can demonstrate desirable surface energies, affect the surface tension of solutions to which they are exposed, and/or affect the environmental resistance of materials to which they are applied and/or incorporated. Exemplary compositions include, but are not limited to, substrates
10 having R_F -compositions thereover and/or liquids having R_F -compositions therein. R_F portions can be incorporated into compositions such as polymers, acrylate monomers and polymers, glycols, fluorosurfactants, and/or AFFF formulations. These compositions can be used as dispersing agents or to treat substrates
15 such as textile fabric, textile yarns, leather, paper, plastic, sheeting, wood, ceramic clays, as well as, articles of apparel, wallpaper, paper bags, cardboard boxes, porous earthenware, construction materials such as brick, stone, wood, concrete, ceramics, tile, glass, stucco, gypsum, drywall, particle board, chipboard, carpet, drapery,
20 upholstery, automotive, awning fabrics, and rainwear. R_F -compositions can be prepared from R_F -intermediates.

R_F portions can be incorporated into R_F -compositions and/or can be starting materials for R_F -compositions via R_F -intermediates. Exemplary R_F -intermediates include an R_F portion described above,
25 as well as at least one functional portion that allows for incorporation of the R_F portion into compositions to form R_F -compositions. The Q group of the R_F -composition can be a Q_g group for R_F -intermediates and this Q_g group can be the functional portion. Functional portions can include halogens (e.g., iodine), mercaptan, thiocyanate, sulfonyl
30 chloride, acid, acid halides, hydroxyl, cyano, acetate, allyl, epoxide, acrylic ester, ether, sulfate, thiol, phosphate, and/or amines, for example. Without incorporation and/or reaction, R_F -intermediates can

include R_F -compositions, such as R_F -monomers and/or ligands of R_F -metal complexes, for example.

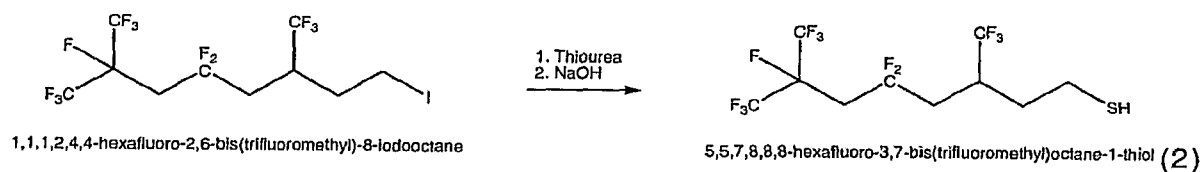
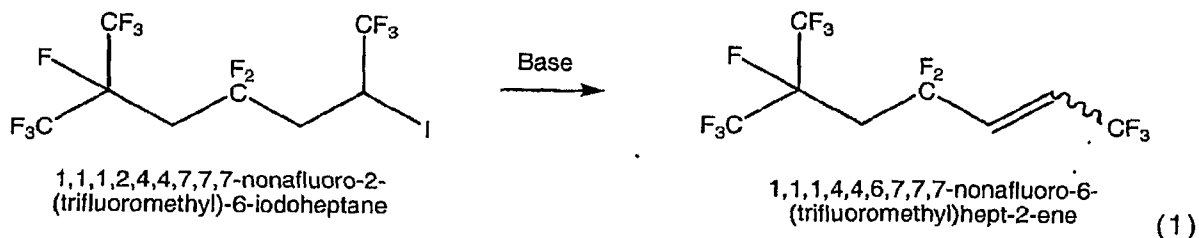
R_F -intermediates can include R_F-Q_g with R_F representing the R_F portion and Q_g representing, for example, the functional portion,

- 5 and/or, as another example, an element of the periodic table of elements. In exemplary embodiments, Q_g is not a proton, methyl, and/or a methylene group. Exemplary R_F -intermediates include, but are not limited to, those in Table 1 below.

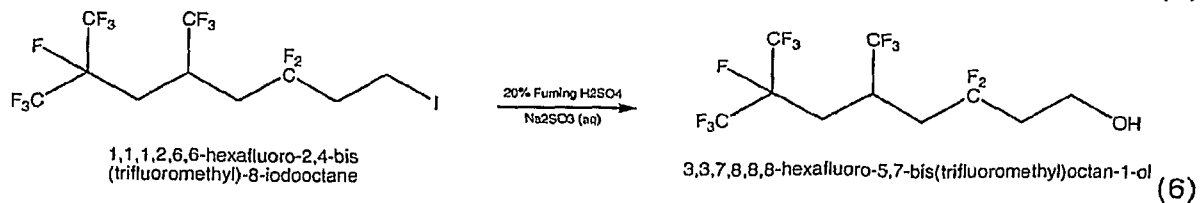
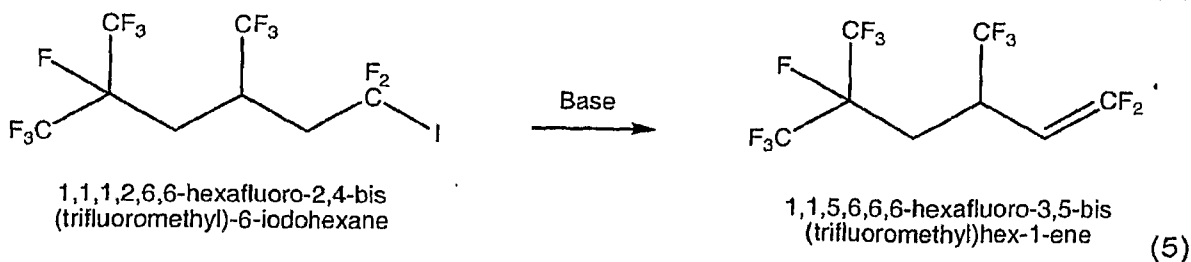
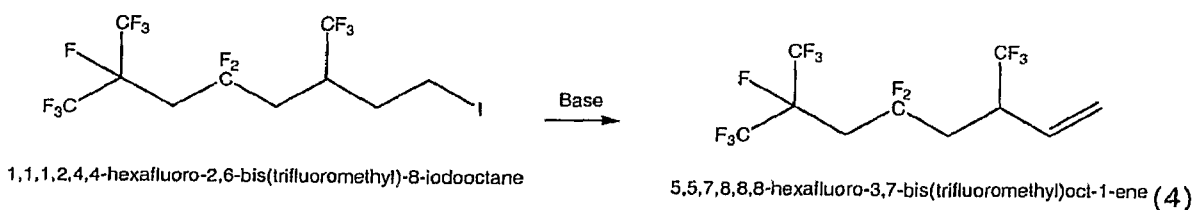
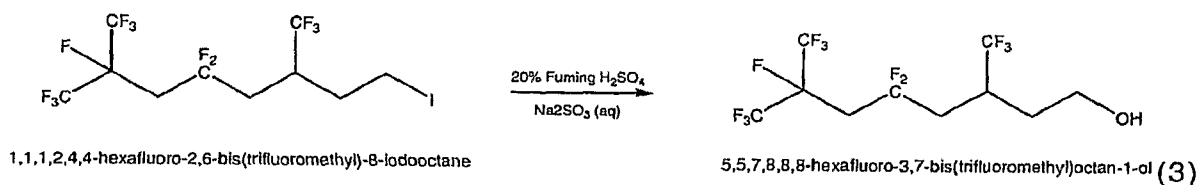
Table 1. Exemplary R_F -Intermediates

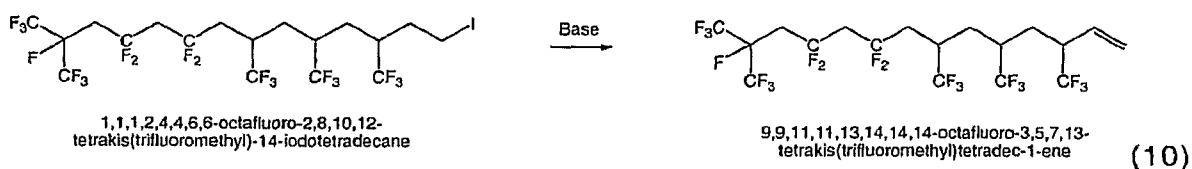
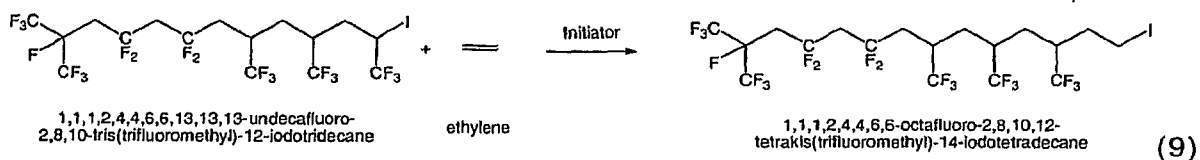
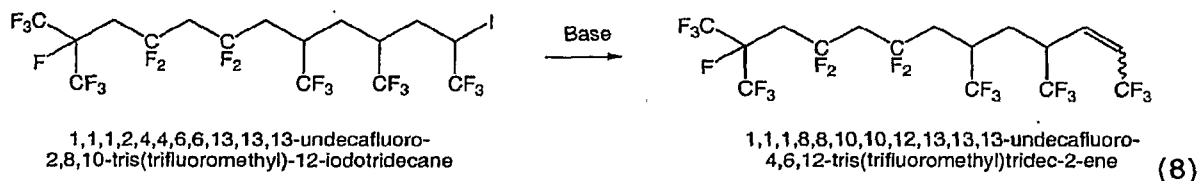
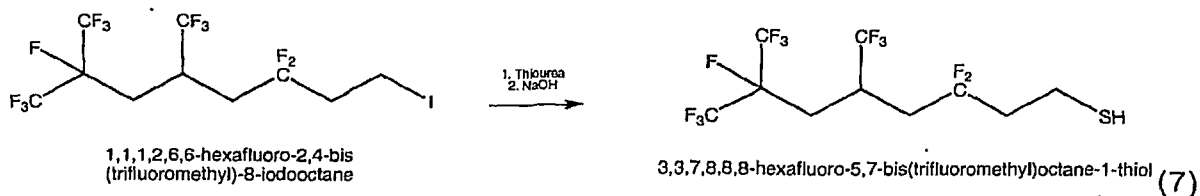
Utilizing the systems and methods to prepare starting materials and/or reaction products described in the Published International Applications, novel R_F -Intermediates can be prepared according to examples 1-15 below.

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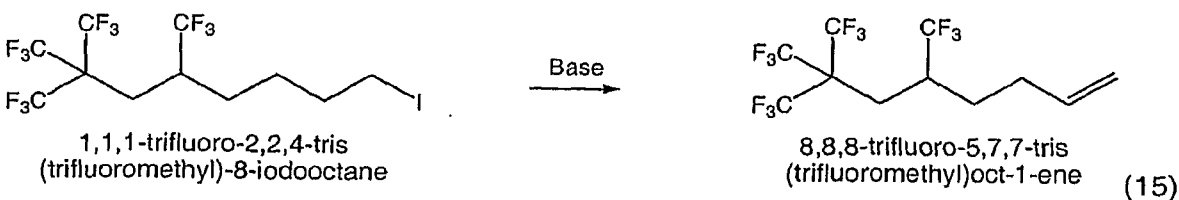
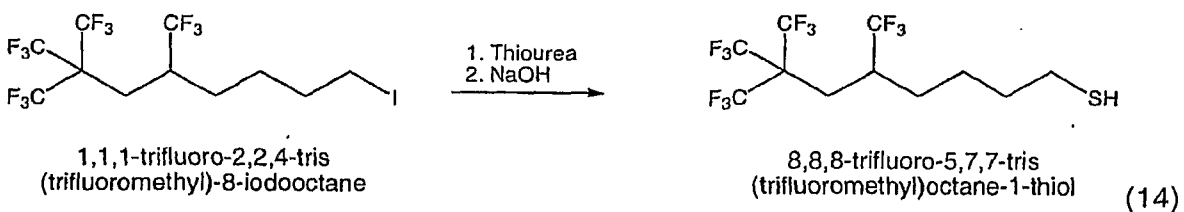
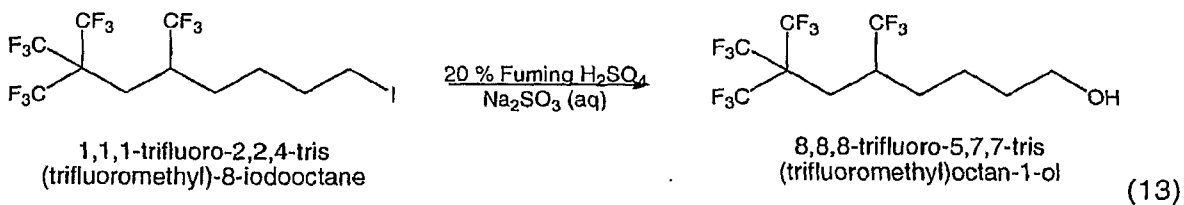
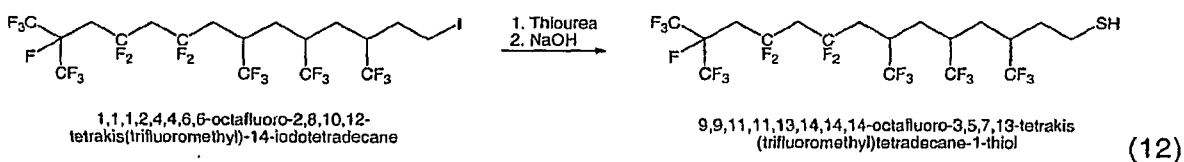
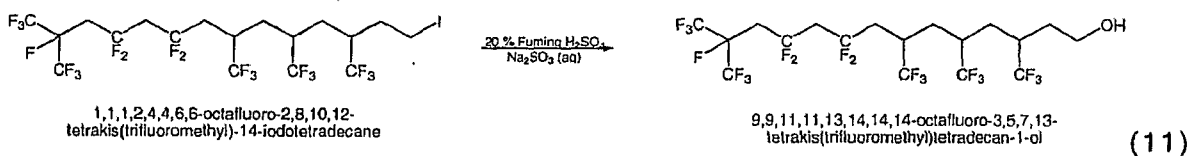


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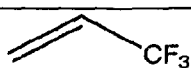
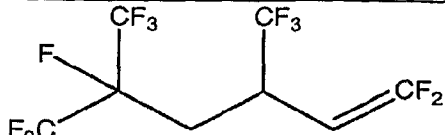
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R_F-Compositions and methods of making R_F-compositions are described with reference to Figure 2. Telomerization process can include exposing a taxogen to a telogen to form a telomer.

Referring to Figure 2, a system 10 is shown for preparing
5 halogenated compositions that includes reagents such as a taxogen 2, a telogen 4 and an initiator 6 being provided to reactor 8 to form a product such as telomere 9. In exemplary embodiments, system 10 can perform a telomerization process. According to an embodiment, taxogen 2 can be exposed to telogen 4 to form a telomer 9. In
10 accordance with another embodiment, taxogen 2 can be exposed to telogen 4 in the presence of initiator 6. Reactor 8 can also be configured to provide heat to the reagents during the exposing.

Taxogen 2 can include at least one CF₃-comprising compound. The CF₃-comprising compound can have at least two carbons. In
15 exemplary embodiments, taxogen 2 can comprise an olefin, such as 3,3,3-trifluoropropene (TFP, trifluoropropene), ethylene (ethene), 1,1-difluoroethene (VDF), 1,1,3,3,3-pentafluoropropene (PFP, pentafluoropropene). In exemplary embodiments, taxogen 42 can include TFP and telogen 44 can include (CF₃)₂CFI with a mole ratio of
20 taxogen 42 to telogen 44 being from about 0.2:1 to about 10:1, from about 1:1 to about 5:1, and/or from about 2:1 to about 4:1. Taxogen 2 can include 4,5,5,5-tetrafluoro-4-(trifluoromethyl)pent-1-ene and/or 6,7,7,7-tetrafluoro-6-(trifluoromethyl)hept-1-ene and telogen 4 can include (CF₃)₂CFI, for example.

25 According to additional embodiments, taxogen 2 can include those compounds shown below in Table 2.

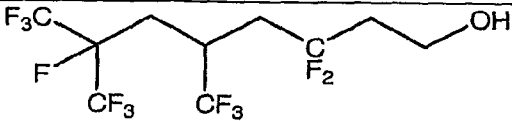
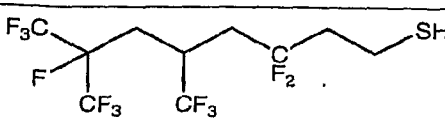
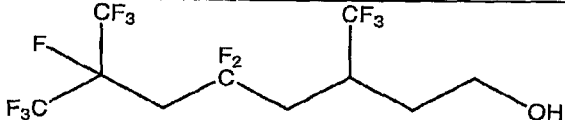
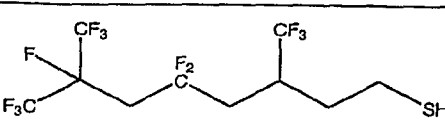
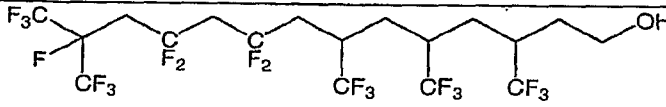
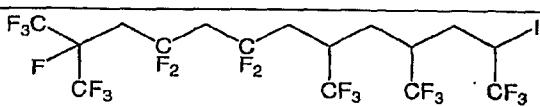
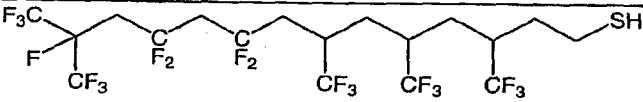
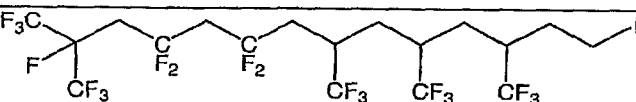
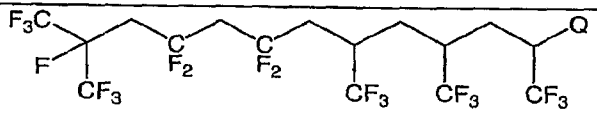
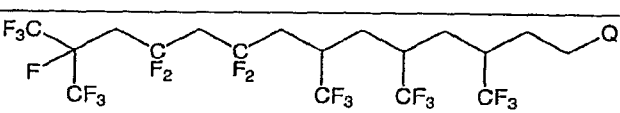
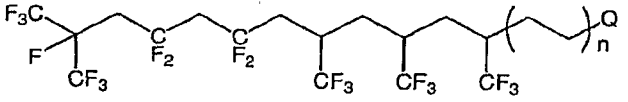
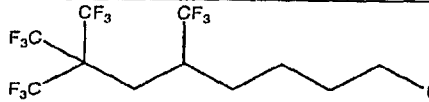
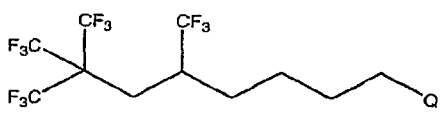
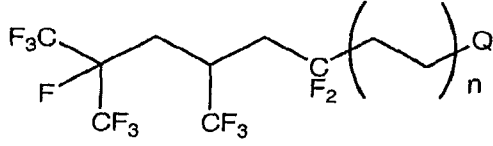
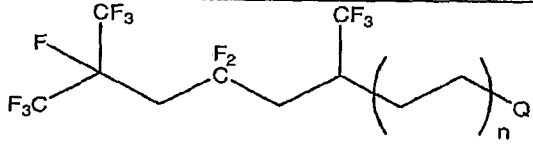
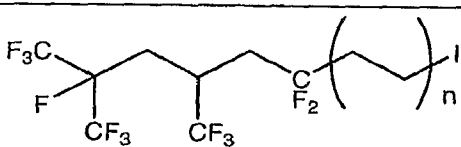
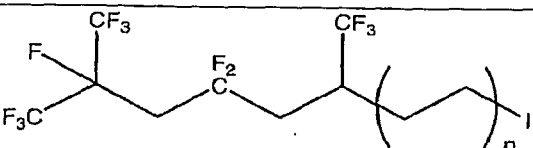
Table 2. Exemplary Taxogens	
=CF_2	
=	

- 5 Telogen 4 can include halogens such as fluorine and/or chlorine. Telogen 4 can include at least 4 fluorine atoms and can be represented as R_FQ and/or $R_{Cl}Q$. The R_F group can include at least four fluorine atoms and the Q group can include one or more atoms of the periodic table of elements. Exemplary R_F groups can include:
- 10 $(CF_3)_2CFCH_2CH(CF_3)CHCF_2^-$; $(CF_3)_2CFCH_2CF_2CH_2CH(CF_3)^-$; $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)^-$.

- R_F-Q can be 1,1,1,2,3,3,3-heptafluoro-2-iodopropane (2-iodoheptafluoropropane, $i-C_3F_7I$, F_7I), for example. Exemplary telogens can include the halogenated compounds described above,
- 15 such as $(CF_3)_2CF^-$, $C_6F_{13}I$, trichloromethane, $HP(O)(OEt)_2$, $BrCFClCF_2Br$, $R-SH$ (R being a group having at least one carbon) and/or ROH (R being a group having at least one carbon). The Q group can be H or I with the R_F group being $(CF_3)_2CF^-$ and/or $-C_6F_{13}$, for example. The R_{Cl} group can include at least one $-CCl_3$ group.

- 20 According to additional embodiments, telogen 4 can include those compounds shown below in Table 3. As exemplary implementations are shown in Table 3 below, telogens can be products of telomerizations.

Table 3. Exemplary Telogens

In exemplary embodiments, taxogen 2 can include

- 5 trifluoropropene and telogen 4 can include $(\text{CF}_3)_2\text{CFI}$, with a mole ratio of taxogen 2 to telogen 4 being from about 1:1 to about 1:10, 1:4 to about 4:1, and/or to about 2:1 to about 4:1.

Reactor 8 can be any lab-scale or industrial-scale reactor and, in certain embodiments, reactor 8 can be configured to control the temperature of the reagents therein. According to exemplary embodiments reactor 8 can be used to provide a temperature during the exposing of the reagents: of from about 90°C to about 180°C; of from about 60°C to about 220°C; and/or of from about 130°C to about 150°C.

According to example implementations, the taxogen can be one or more of VDF, TFP, and ethylene, and the telogen can include one of $C_3F_6(R_T)_nX$ or $C_3F_7(R_T)_nX$, wherein X is a halogen. The R_T can be one or both of $-CH_2CF_2-$ and $-CH_2C(CF_3)H-$, and n is 1 to 4. More particularly: the taxogen can be VDF and the telogen can be $(CF_3)_2CFCH_2CH(CF_3)I$; the taxogen can be TFP and the telogen can be $(CF_3)_2CFCH_2CF_2I$; the taxogen can be TFP and the telogen can be $(CF_3)_2CFCH_2CF_2CH_2CF_2I$; the taxogen can be TFP and the telogen can be $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2CH(CF_3)I$; the taxogen can be TFP and the telogen can be $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2CH(CF_3)CH_2CH(CF_3)I$; the taxogen can be ethylene and the telogen can be $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)I$; and the taxogen can be ethylene and the telogen can be $(CF_3)_3CCH_2CH(CF_3)I$.

Telomerization processes can also include exposing a taxogen to a telogen to form a telomer, with the taxogen comprising an olefin having greater than two carbon atoms, and the telogen comprising at least five carbon atoms and having at least two $-CF_3$ groups. As an example, the taxogen can be one of ethylene, VDF, TFP, VDF, 4,5,5,5-tetrafluoro-4-(trifluoromethyl)pent-1-ene and/or 6,7,7,7-tetrafluoro-6-(trifluoromethyl)hept-1-ene.

Telomer 9, produced upon exposing taxogen 2 to telogen 4, can include $R_F(R_T)_nQ$ and/or $R_{Cl}(R_T)_nH$. The R_T group can include at least

one C-2 group having a pendant -CF₃ group, such as $\begin{array}{c} -\text{CH}_2-\text{CH}- \\ | \\ \text{CF}_3 \end{array}$ and/or $\begin{array}{c} -\text{CF}_2-\text{CH}- \\ | \\ \text{CF}_3 \end{array}$. Exemplary products include $\begin{array}{c} \text{Q}(\text{R}_1-\text{CH})_n\text{R}_\text{F} \\ | \\ \text{CF}_3 \end{array}$, $\begin{array}{c} \text{R}_\text{F}(\text{R}_1-\text{CH})\text{Q} \\ | \\ \text{CF}_3 \end{array}$,

and/or one or both of $\begin{array}{c} \text{R}_\text{F}(\text{R}_1-\text{CH})_n\text{Q} \\ | \\ \text{CF}_3 \end{array}$ and $\begin{array}{c} \text{R}_\text{F}(\text{CH}_2-\text{CH})_n\text{Q} \\ | \\ \text{CF}_3 \end{array}$ and/or

$\begin{array}{c} \text{R}_\text{F}(\text{CF}_2-\text{CH})_n\text{Q} \\ | \\ \text{CF}_3 \end{array}$, with R₁ including at least one carbon atom, such as -

5 CH₂- and/or -CF₂-, for example. R_T can also include -CH₂-CF₂-; -CH₂-(CH₂CF(CF₃)₂)CH-; and/or -CH₂-CH₂-. In exemplary embodiments, n can be at least 1 and in other embodiments n can be at least 2 and the product can include one or more of

$\begin{array}{c} \text{R}_\text{F}(\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH})\text{Q} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, $\begin{array}{c} \text{R}_\text{F}(\text{CH}_2-\text{CH}-\text{CH}-\text{CH}_2)\text{Q} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, $\begin{array}{c} \text{R}_\text{Cl}(\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH})\text{H} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$,

10 $\begin{array}{c} \text{R}_\text{Cl}(\text{CH}_2-\text{CH}-\text{CH}-\text{CH}_2)\text{H} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, $\begin{array}{c} \text{R}_\text{F}(\text{CF}_2-\text{CH}-\text{CF}_2-\text{CH})\text{Q} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, $\begin{array}{c} \text{R}_\text{F}(\text{CF}_2-\text{CH}-\text{CH}-\text{CF}_2)\text{Q} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$,

$\begin{array}{c} \text{R}_\text{Cl}(\text{CF}_2-\text{CH}-\text{CF}_2-\text{CH})\text{H} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, and/or $\begin{array}{c} \text{R}_\text{Cl}(\text{CF}_2-\text{CH}-\text{CH}-\text{CF}_2)\text{H} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, for example.

According to other implementations n can be 3 or even at least 4. In exemplary embodiments, n can be at least 1 and in other embodiments n can be at least 2 and the product can include one or

15 more of $\begin{array}{c} \text{R}_\text{F}(\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH})\text{Q}_\text{g} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, $\begin{array}{c} \text{R}_\text{F}(\text{CH}_2-\text{CH}-\text{CH}-\text{CH}_2)\text{Q}_\text{g} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$,

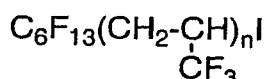
$\begin{array}{c} \text{R}_\text{Cl}(\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH})\text{H} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, and/or $\begin{array}{c} \text{R}_\text{Cl}(\text{CH}_2-\text{CH}-\text{CH}-\text{CH}_2)\text{Z} \\ | \quad | \\ \text{CF}_3 \quad \text{CF}_3 \end{array}$, Z being H, Br, and/or Cl, for example.

In an exemplary embodiment, the taxogen trifluoropropene can be exposed to the telogen (CF₃)₂CFI to form the telomer

(CF₃)₂CF(CH₂-CH)_nI

20 $\begin{array}{c} \text{CF}_3 \\ | \end{array}$, and, by way of another example, trifluoropropene

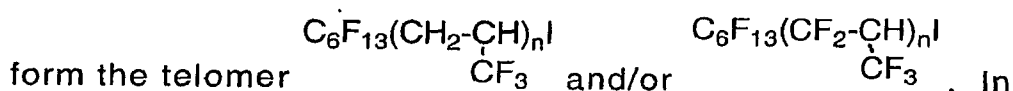
can be exposed to the telogen $C_6F_{13}I$ to form the telomer



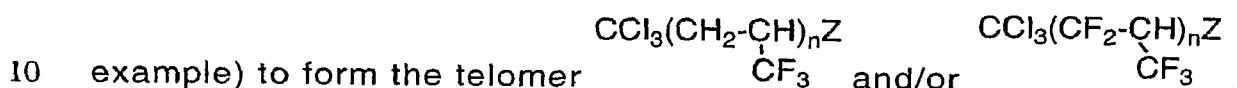
In an exemplary embodiment, the taxogen trifluoropropene can be exposed to the telogen $(CF_3)_2CFI$ to form the telomer



5 CF_3 and/or CF_3 , and, by way of another example, trifluoropropene can be exposed to the telogen $C_6F_{13}I$ to

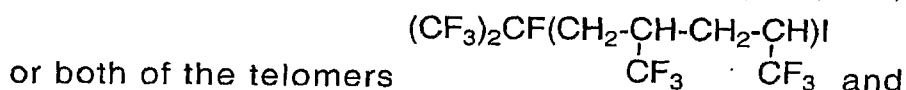


accordance with another embodiment, the taxogen trifluoropropene can also be exposed to the telogen CCl_3Z , ($Z=H$, Br , and/or Cl , for



Products having n being at least 2 can be formed when utilizing an excess of the taxogen as compared to the telogen. For example, at least a 2:1 mole ratio of the taxogen to the telogen can be utilized to obtain products having n being at least 2. For example and by way of

15 example only, at least two moles of the taxogen trifluoropropene can be exposed to at least one mole of the telogen $(CF_3)_2CFI$ to form one



telomer 9 can include those compounds shown in Table 4 below. As

20 exemplary implementations are shown in Table 4 below, telomers can also be utilized as telogens.

Heterotelomerization can also be accomplished via cotelomerization and/or oligotelomerization. As an example, at least two different taxogens may be combined with at least one telogen to

25 facilitate the production of at least a cotelomer. As another example, telomers may be produced from a first taxogen and the product

telomer may be used in a subsequent telomerization with a second taxogen different from the first taxogen.

Table 4. Exemplary Telomers

- 5 In additional embodiments initiator 6 may be provided to reactor 8 during the exposing of the reagents. Initiator 6 can include thermal, photochemical (UV), radical, and/or metal complexes, for example, including a peroxide such as di-tert-butyl peroxide. Initiator 6 can also include catalysts, such as Cu. Initiator 6 and telogen 4 can be
- 10 provided to reactor 8 at a mole ratio of initiator 6 to taxogen 2 of from between about 0.001 to about 0.05 and/or from between about 0.01 to about 0.03, for example.

- According to exemplary embodiments, various initiators 6 and telogens 4 can be used to telomerize taxogen 2 as referenced in
- 15 Table 5 below. Telomerizations utilizing photochemical and/or metal-complex initiators 6 can be carried out in batch conditions using Carius tube reactors 8. Telomerizations utilizing thermal and/or peroxide initiators 6 can be carried out in 160 and/or 500 cm³ Hastelloy reactors 8.

An embodiment of the disclosure provides R_F -surfactant compositions that include the R_F portions described above.

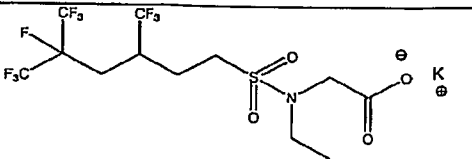
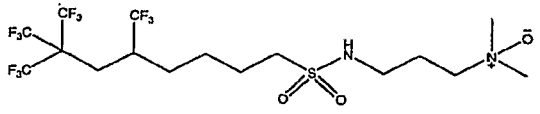
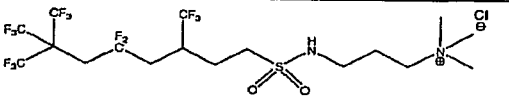
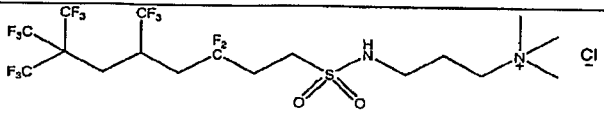
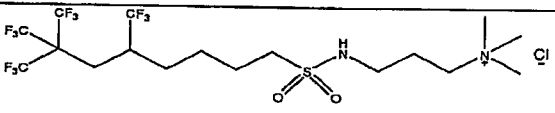
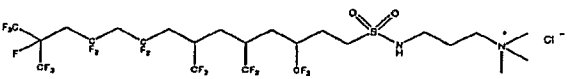
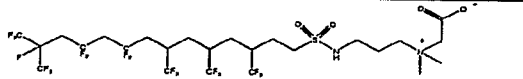
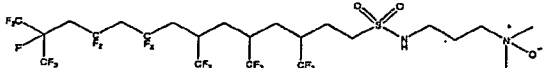
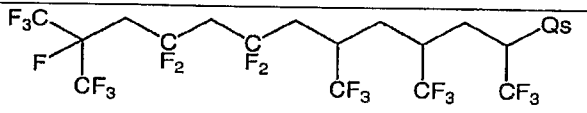
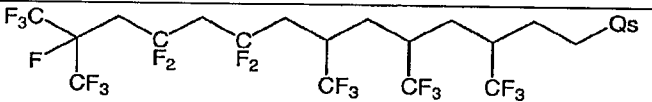
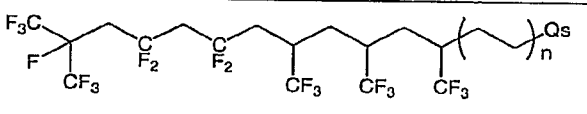
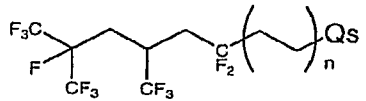
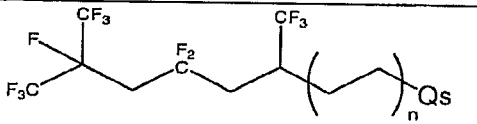
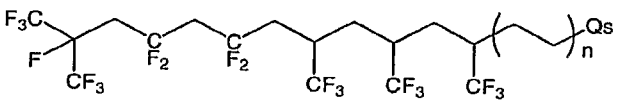
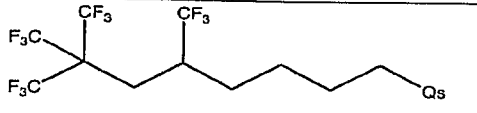
Exemplary

R_F -surfactant compositions can be referred to as R_F - Q_S . According to
5 exemplary embodiments the R_F portion can at least partially include an $R_F(R_T)_n$ portion as described above. The $R_F(R_T)_n$ portion of the surfactant can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion can be incorporated to provide additional carbon between the R_F and/or
10 $R_F(R_T)_n$ portions and the Q_S portion of the surfactant. Exemplary R_S portions include $-\text{CH}_2\text{-CH}_2-$. As an example, the surfactant composition can comprise $R_F(R_T)_nQ_S$. The R_F group can comprise at least one $-\text{CF}_3$ group. The R_T group can comprise $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$, with n being at least one. The Q_S group can be at least one atom of
15 the periodic table of elements, wherein at least a portion of the R_F and R_T groups are hydrophobic relative to the Q_S group, and at least a portion of the Q_S group is hydrophilic relative to the R_F and R_T groups.

In a system having at least two parts, R_F can have a greater affinity for a first part of the system than Q_S , and Q_S can have a
20 greater affinity for a second part of the system than R_F . The system can include liquid/liquid systems, liquid/gas systems, liquid/solid systems, and/or gas/solid systems. Liquid/liquid systems, for example, can include systems having at least one liquid part that includes water and another liquid part that is hydrophobic relative to
25 the part that includes water. Liquid/liquid systems can also include systems of which water is not a part of the system, such as hydrocarbon liquid systems. In exemplary embodiments, R_F can be hydrophobic relative to Q_S and/or Q_S can be hydrophilic relative to R_F . R_F can be hydrophobic and Q_S can be hydrophilic, for example. The
30 hydrophobic portion can be referred to as the tail of the R_F -surfactant, and the hydrophilic portion can be referred to as the head of the R_F -surfactant. The R_F -surfactants can include those surfactants having a tail or hydrophobic portion containing fluorine. The R_F -surfactant tail

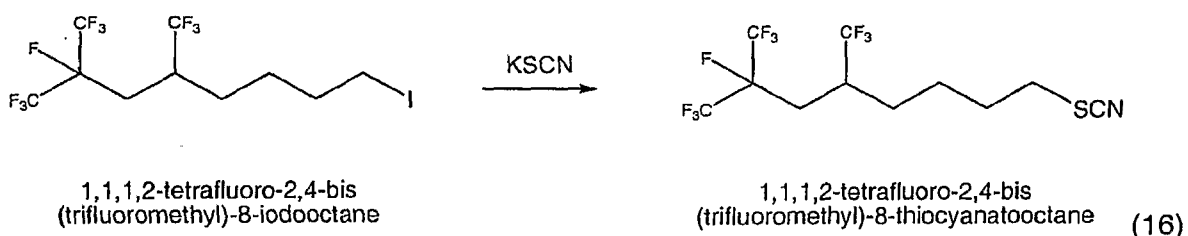
or hydrophobic portion can be referred to as an R_F portion, and the R_F -surfactant head or hydrophilic portion can be referred to as a Q_S portion. The R_F -surfactants can be produced from RF -intermediates utilizing the methods and systems detailed in published International Patent applications: PCT/US05/03429, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005; PCT/US05/02617, entitled Compositions, Halogenated Compositions, Chemical Production and Telomerization Processes, filed January 28th, 2005; PCT/US05/03433, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005; PCT/US05/03137, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005; and PCT/US05/03138, entitled Production Processes and Systems, Compositions, Surfactants, Monomer Units, Metal Complexes, Phosphate Esters, Glycols, Aqueous Film Forming Foams, and Foam Stabilizers, filed January 28th, 2005. Exemplary R_F -surfactants include those in Table 5 below.

Table 5. R_F-Surfactants

Where LC/MS can be used to identify compounds, Table 6 of
 5 LC/MS parameters, below, can be used.

Table 6. LC-MS Parameters	
Column Type:	Phenomonex Luna C18 column, 5 micrometer
Column Size:	2 x 50 mm
Column Temp:	25 °C
Gradient Pump	Agilent 1100 Quat Pump G1311A
Detector:	Agilent Diode Array Detector G13115B
Detector Wavelength:	250 nm (referenced against 360 nm)
Mass Detector:	Agilent 1100 MSD G1946C
Source:	Electrospray Positive Ion
Fragmentor:	80
Software	ChemStation Rev A.08.03
Conc:	Ca 100 ppm
Injector: Rheodyne	10 microliter
Elution Type:	Gradient
Flow Rate:	0.3mL/min
Mobile Phase:	A: Water (JT Baker HPLC grade) w/ 0.05% HCO ₂ H B: Acetonitrile w/ 0.05% HCO ₂ H
Gradient Conditions:	90:10 A:B increase to 100% B in 6 min and then hold for 4 min at 100% B

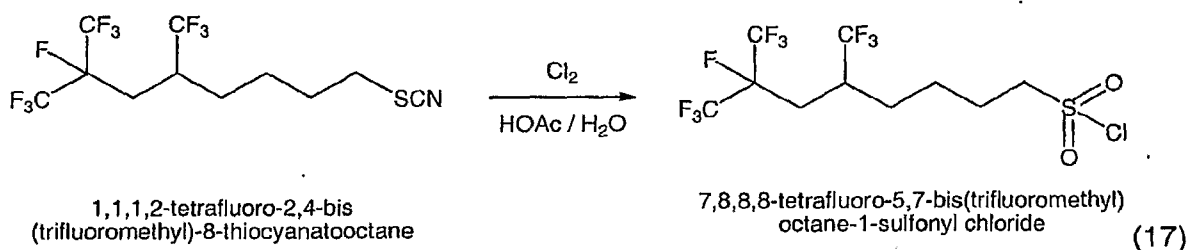


5 According to scheme (16) above, in a flask that can be equipped with an agitator, thermocouple and a reflux condenser, 30 grams (67 mmol) of 1,1,1,2-tetrafluoro-2,4-bis(trifluoromethyl)-8-iodooctane (see, e.g. Published International Patent Applications), 35 ml of absolute ethanol, 9.8 grams of potassium thiocyanate (KSCN) and 1.4 ml of

10 glacial acetic acid (HOAc) can be placed to form a mixture. The mixture can be heated to reflux (about 84.7 C) and maintained for

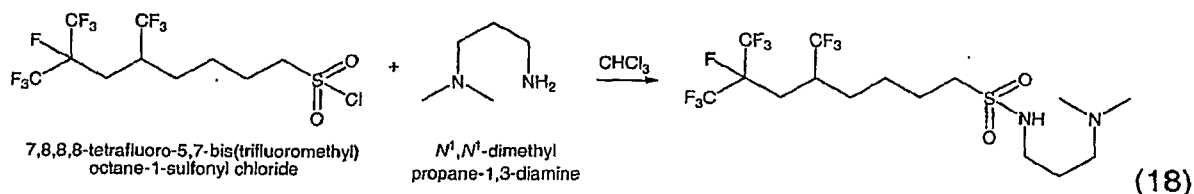
overnight while stirring. The mixture can be observed as a light yellow slurry and can be concentrated in vacuo to afford a viscous yellow slurry. The slurry can be extracted with 300 mL of diethyl ether, (decanted twice) and filtered to afford a wet cake and a filtrate.

- 5 The wet cake can be washed with three 100 mL portions of diethyl ether wherein the collected washings can be combined with the filtrate and concentrated in vacuo to afford 25.28 grams (99.5 % yield) of the 1,1,1,2-tetrafluoro-2,4-bis(trifluoromethyl)-8-thiocyanatooctane product that can be observed as a light yellow oil. The product
10 structure can be confirmed by NMR and/or chromatographic analysis.

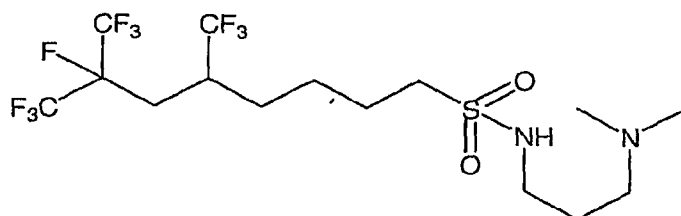


- 15 With reference to scheme (17) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, and a chlorine gas dispersion tube, 25.2 grams (66.4 mmol) of 1,1,1,2-tetrafluoro-2,4-bis(trifluoromethyl)-8-thiocyanatooctane (refer to scheme (15) above) and 40 ml of glacial acetic acid (HOAc) can be
20 placed to form a mixture and can be heated to about 60°C. The heated mixture can be sparged via a dispersion tube with chlorine gas (Cl₂) to form a reaction mixture for overnight. The reaction mixture can be cooled to about 10°C and 50 ml of water added drop-wise. The reaction mixture can be warmed to RT and 200 ml of CHCl₃ and
25 100 ml of water added to form a multiphase mixture from which an organic phase can be separated from an aqueous phase. The aqueous phase can be collected and extracted with 200 ml of CHCl₃. The organic phases can be collected, combined and washed with three 300 ml portions of water and 300 ml of brine and then dried over

Na₂SO₄, filtered and concentrated in vacuo to afford 26.26 grams (95.3 % yield) of the 7,8,8,8-tetrafluoro-5,7-bis(trifluoromethyl)octane-1-sulfonyl chloride product that can be observed as a cloudy colorless oil. The product structure can be confirmed by NMR and/or chromatographic analysis.

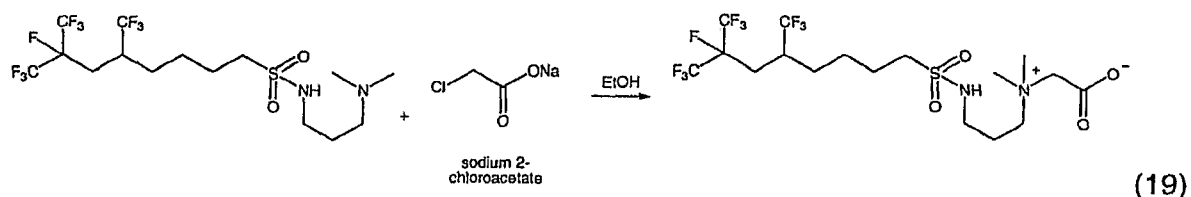


In accordance with scheme (18) above, in a flask that can be equipped with an agitator, thermocouple and a dry-ice / acetone bath, 17.80 grams (174.5 mmol) of *N,N'*-dimethylpropane-1, 3-diamine in 150 ml of CHCl₃ can be placed to form a mixture. To the mixture, 26.20 grams (62.3 mmol) of 7,8,8,8-tetrafluoro-5,7-bis(trifluoromethyl)octane-1-sulfonyl chloride (refer to scheme (16) above) and 150 ml of CHCl₃ can be added drop-wise over a 40 minute period to form a reaction mixture while maintaining the reaction temperature at between about 0°C and -5°C. The reaction mixture can be allowed to warm to and maintained at RT while stirring for over the weekend. The reaction mixture can be washed by adding 300 ml of water, two 300 ml portions of bicarbonate, 300 ml of water, and 300 ml of brine wherein each step can be observed to afford a multiphase mixture from which an organic phase can be separated from an aqueous phase and the organic phase can be transferred to the next step. The washed organic phase can be dried over Na₂SO₄, filtered and concentrated in vacuo to afford 30.23 grams (99.8 % yield) of the

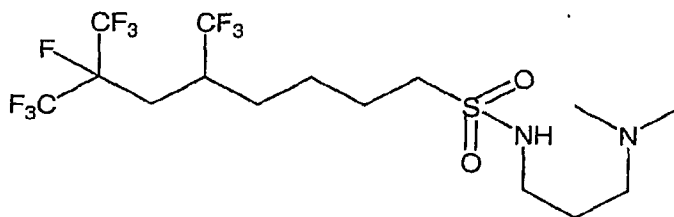


product that can be

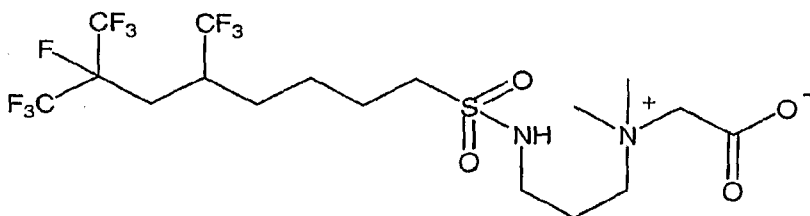
observed as a light yellow liquid. The product structure can be confirmed by NMR and/or chromatographic analysis.



- 5 Referring to scheme (19) above, in a flask that can be equipped with an agitator, thermocouple and an addition funnel, A mixture of

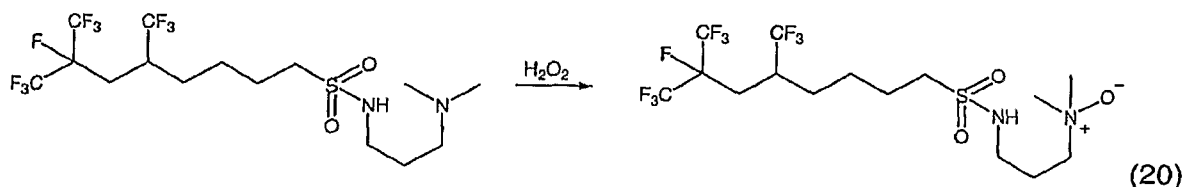


- 10.0 grams (20.6 mmol) of
 (refer to scheme (18) above), 50 ml of absolute ethanol (EtOH) and
 2.40 grams (20.6 mmol) sodium chloroacetate can be placed to form a
 10 mixture. The mixture can be heated to reflux (about 79°C) and stirred
 for a period of time to afford what can be observed as a thin white
 slurry. The slurry can be filtered and the filtrate concentrated in
 vacuo, dried at 45°C under high vacuum to afford 11.29 grams of the

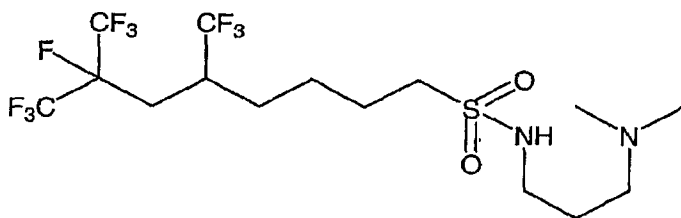


product that can be

- 15 observed as a light yellow crunchy solid. The product structure can
 be confirmed by NMR and/or chromatographic analysis.

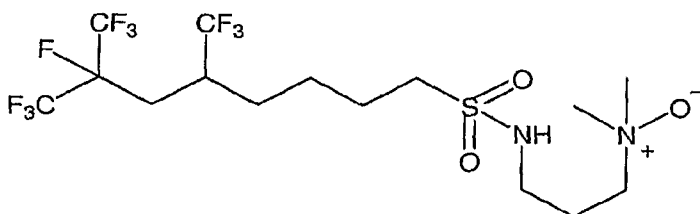


Referring to scheme (20) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, and an addition funnel, 10.0 grams (20.6 mmol) of



(refer to scheme (18) above),

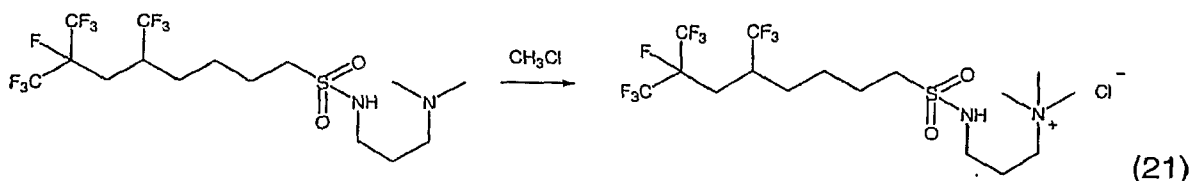
- 5 20 ml of absolute ethanol (EtOH) and 3 ml of water can be placed to form a mixture. To the mixture, at RT, 9.6 ml of a 50 % (wt/wt) H₂O₂ in water can be added drop-wise over a 5 minute period to form a reaction mixture. The reaction mixture can be heated to 35°C and maintained for overnight. The reaction mixture can be treated portion-
- 10 wise with 6 grams of decolorizing carbon (neutral) over a 2 hour period at 35°C to form a slurry and heated to 50°C and maintained stirring for overnight. A sample of the slurry can be collected and filtered and tested negative with KI/Starch paper for any unquenched peroxide. The remainder of the slurry can be filtered through celite
- 15 and stripped of EtOH on a rotary evaporator. Trace EtOH can be removed by co-stripping three times with CHCl₃ to afford a concentrate. The concentrate can be concentrated in vacuo (2 hour under high vacuum at 45°C) to afford 10.03 grams (97.4 % yield) of



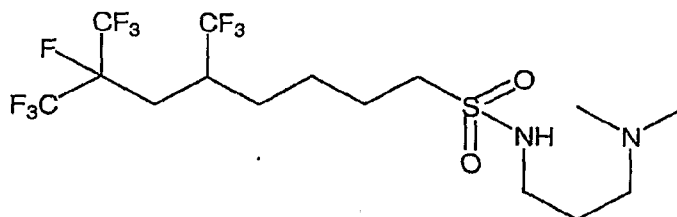
the

product that can be

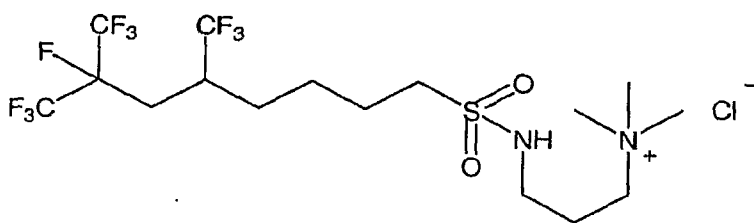
- 20 observed as an off-white crunchy solid. The product structure can be confirmed by NMR and/or chromatographic analysis.



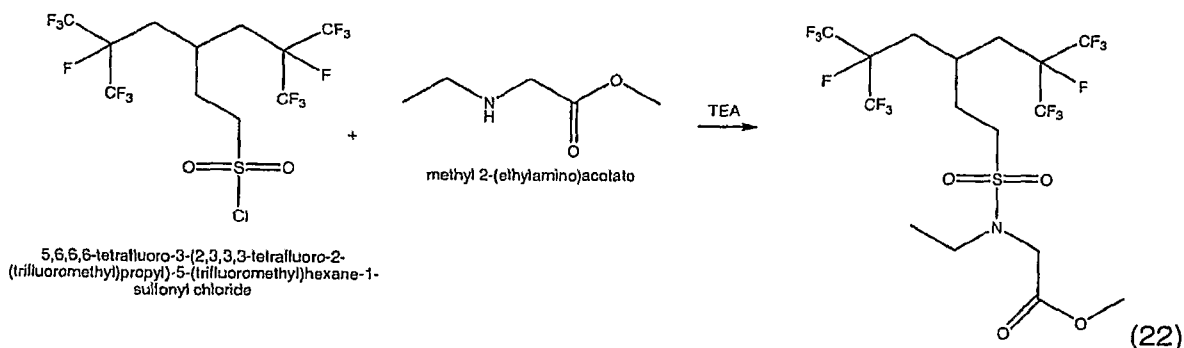
In conformity with scheme (21) above, in a sealable tube that can be equipped with an agitator and a thermocouple, 10.0 grams



(20.6 mmol) of (refer to scheme (18) above), 2.1 grams (41.1 mmol) of chloromethane in 25 mL of methyl-tert-butyl ether (MTBE) can be placed to form a mixture and heated to 55°C for an extended period of time. Stirring can be halted, the bottle cooled below about 0°C, vented, and the mixture concentrated in vacuo to afford 9.81 grams (88.9 % yield) of the

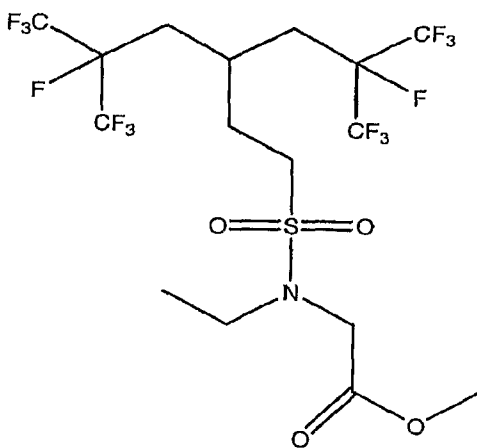


product that can be observed as a white waxy solid. The product structure can be confirmed by NMR and/or chromatographic analysis.

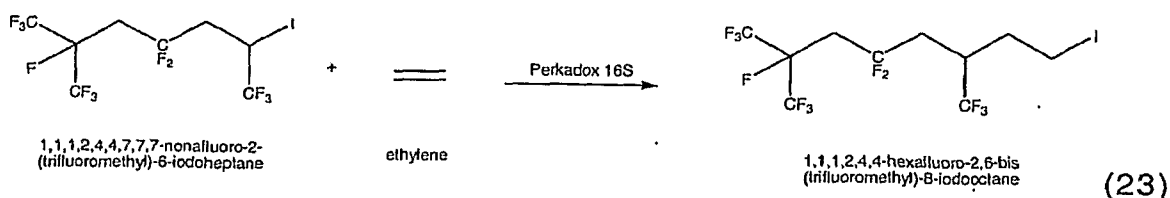


Referring to scheme (22) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, and an addition funnel, 5 grams (0.01 mole) of 5,6,6,6-tetrafluoro-3-(2,3,3,3-tetrafluoro-2-(trifluoromethyl)propyl)-5-(trifluoromethyl)hexane-1-sulfonyl chloride (see; e.g. International Patent Applications), 1.2

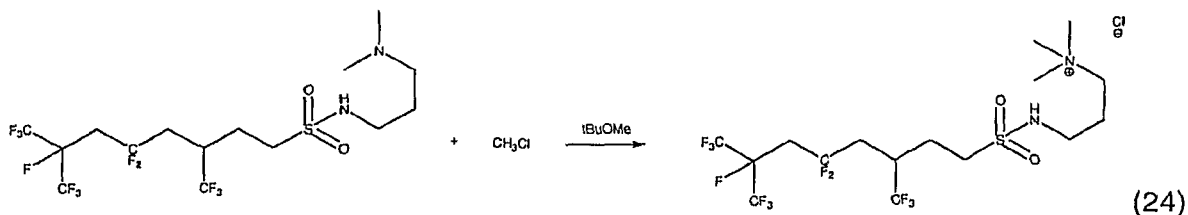
grams (0.01 mole) of methyl 2-(ethylamino)acetate and 10 mL of chloroform can be placed to form a mixture and chilled to 0°C. To the mixture, 3 mL of triethylamine (TEA) and 10 mL of chloroform can be added drop wise to form a reaction mixture. The peak temperature during addition can be about 3.9°C. The reaction mixture can be allowed to warm to room temperature while stirring and maintained for overnight. To the reaction mixture, 20 mL of chloroform can be added and washed with two 25 mL portions a saturated solution NaHCO₃ in water, two 25 mL portions of water and 25 mL of a saturated NaCl solution in water to form multiphase mixtures from which an organic phase can be separated from an aqueous phase. The organic phase can be collected, dried and concentrated to form a concentrate. To the concentrate, 25 mL of chloroform can be added to form a diluant. To the diluant, 25 mL of a 5 % (wt/wt) solution of HCl in water can be added to afford an acidified diluant. To the acidified diluant, 25 mL of a 1N solution of NaOH can be added to form a neutral multiphase mixture from which an organic phase can be separated from an aqueous phase. The organic phase can be dried and concentrated to



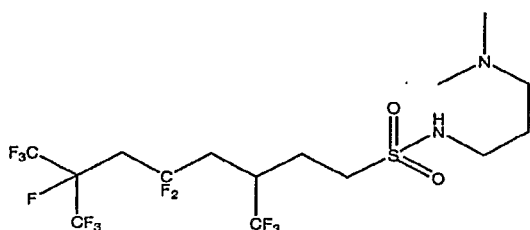
afford 3.45 grams of the product that can be observed as a yellow oil (59.5 % yd.). The product structure can be confirmed by NMR and/or chromatographic analysis.



In reference to scheme (23) above, in a 60 mL reactor that can be equipped with an agitator, ethane delivery apparatus and a thermocouple, 23.0 grams (50.4 mmol) of 1,1,1,2,4,4,7,7,7-nonafluoro-2-(trifluoromethyl)-6-iodoheptane (see, e.g. Published Patent Applications) and 0.95 grams (2.5 mmol) of di-(*t*-butylcyclohexyl) peroxydicarbamate (Akzo Nobel – Perkadox 16S) can be placed to form a mixture. The reactor can be sealed and heated to about 50°C while stirring. To the reactor, ethylene can be added in a continuous fashion to afford and maintain a reactor pressure of about 260 psig to form a reaction mixture. After about 2 hours, the ethylene feed and heating can be discontinued, the reaction cooled to about 10°C, the agitation stopped and the reactor vented and opened. To the reaction mixture, 1.0 gram of Perkadox 16S can be added and heating continued for 3 hours. To the reaction mixture, 0.9 gram of Perkadox 16S can be added, the reactor heated to about 50°C, pressurized with ethylene to about 260 psig and maintained for about 5 hours. To the reaction mixture, additional Perkadox 16S can be added and the above reaction conditions established and maintained for overnight. The reaction mixture can be collected and placed on a Kugelrohr distillation apparatus to afford 26.05 grams of the 1,1,1,2,4,4-hexafluoro-2,6-bis (trifluoromethyl)-8-iodooctane product. The product structure can be confirmed by NMR and/or chromatographic analysis.

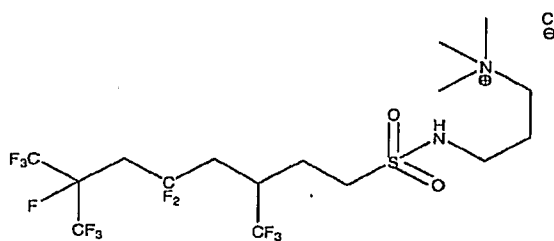


Conforming to scheme (24) above, in a sealable tube that can be equipped with an agitator, thermocouple, reflux condenser, and an addition funnel, 6.0 grams (11.5 mmol) of



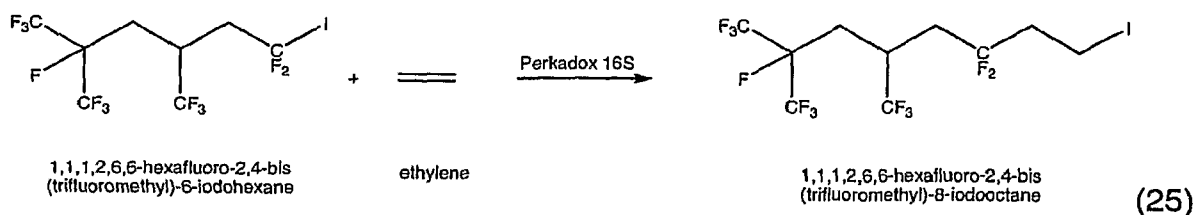
(see, e.g. Published International Patent Applications) and 1.2 grams (23 mmol) of chloromethane (CH_3Cl) in 30 mL of methyl-tert-butyl ether (tBuOMe) can be placed to form a mixture and heated to about 55°C for an extended period of time. A thick layer can be observed to have settled on the bottom of the tube restricting the stirring. The tube can be cooled and vented, and heated to regain homogeneity. The stir bar can be replaced with a different type and the contents were cooled and charged with an additional 2.9 grams of CH_3Cl . Once sealed, the heating can be resumed. A thick layer can be observed to have settled out again. The tube can be sonicated to homogenize and stirred at 55°C for overnight. The tube can be cooled below about 0°C and vented where the contents of the tube can be observed as a multiphase mixture wherein a liquid phase can be separated from a clear orange tar. The liquid phase can be discarded and ether added and the contents heated and sonicated to dissolve. The contents can be cooled to RT and the ether decanted from the tar that can be observed to have reformed (precipitated). The tar can be dissolved in dichloromethane, transferred and concentrated to afford to 5.41 grams

(90.0 % yield) of the



product that can

be observed as an orange semi-solid. The product structure can be confirmed by NMR and/or chromatographic analysis.

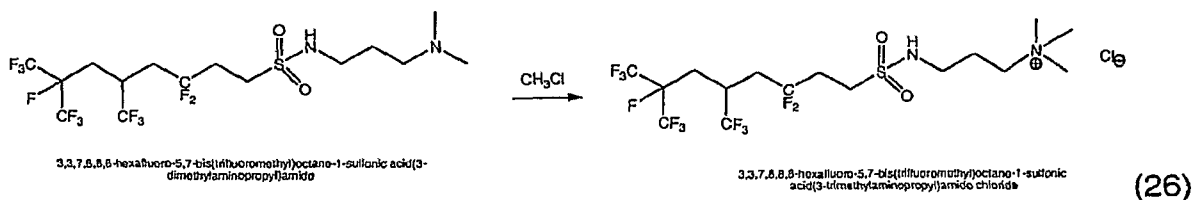


5 In reference to scheme (25) above, in a reactor that can be equipped with an agitator, thermocouple, and an ethylene addition apparatus, 23 grams (50.4 mmol) of 1,1,1,2,6,6-hexafluoro-2,4-bis(trifluoromethyl)-6-iodohexane (see, e.g. Published Patent Applications) and 0.95 grams (2.5 mmol) of di-(t-butylcyclohexyl) peroxydicarbamate (Akzo Nobel – Perkadox 16S) can be added to

10 form a mixture. The reactor can be sealed, heated to 50°C while stirring and continuously pressurized to about 260 psig with ethylene (reaction conditions) to form a reaction mixture. After 2 hours, the ethylene feed and heating can be discontinued, the reaction cooled to

15 about 10°C, the agitation can be discontinued and the reactor vented and opened. To the reaction mixture, 1.0 grams of the Perkadox 16S can be added, reaction conditions restored and maintained for over a weekend. To the reaction mixture, 0.9 grams of Perkadox 16S can be added and the reaction conditions restored and maintained for from

20 about 5 hours 24 hours wherein additional Perkadox 16S can be added. The reaction mixture can be collected and placed on a Kugelrohr distillation apparatus to 26.05 grams of the 1,1,1,2,6,6-hexafluoro-2,4-bis(trifluoromethyl)-8-iodooctane product. The product structure can be confirmed by NMR and/or chromatographic analysis.



Referring to scheme (26) above, in a sealable tube that can be equipped with an agitator and a thermocouple, 7.1 grams (13.6 mmol)

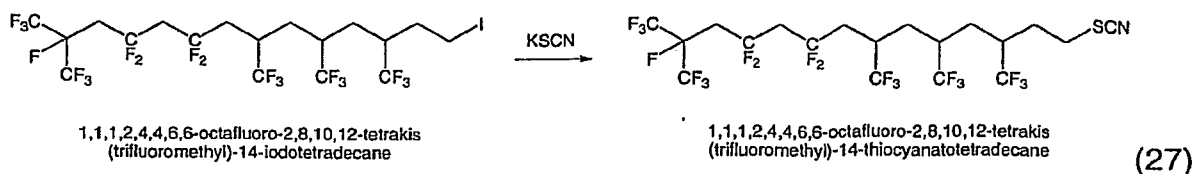
5 3,3,7,8,8,8-hexafluoro-5,7-bis(trifluoromethyl)octane-1-sulfonic acid(3-dimethylaminopropyl)amide (see, e.g. Published Patent Applications) and 1.4 grams (27.2 mmol) of chloromethane and 30 mL of methyl-tert-butyl ether can be placed to form a mixture. The mixture can be heated to 55°C and maintained for an extended period of time. A

10 thick layer can be observed to have settled on the bottom of the tube thereby restricting the stirring. The tube can be cooled and vented and heated to regain homogeneity. The agitator can be replaced with a different type and the contents cooled and charged with an additional 3.1 grams of CH₃Cl. The tube can be sealed and the

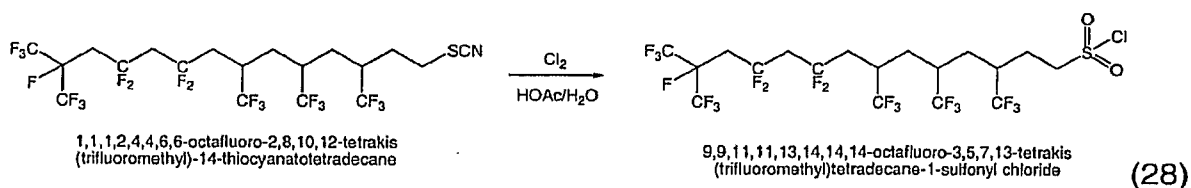
15 heating resumed. A layer can be observed to have settled out again. The tube can be sonicated to homogenize and stirred at 55°C for overnight to form a multiphase mixture from which a liquid phase can be separated from a tar phase. The tube can be cooled to below about 0°C, vented and the liquid decanted from the tar. To the tar,

20 ether can be added and the contents heated and sonicated to dissolve. The mixture can be cooled to RT and the liquid decanted from the tar that can be observed to have reformed. The tar can be dissolved in dichloromethane, transferred and concentrated to afford 7.0 grams (90.0 % yield) of the 3,3,7,8,8,8-hexafluoro-5,7-

25 bis(trifluoromethyl)octane-1-sulfonic acid(3-trimethylaminopropyl)amido chloride product that can be observed as an orange semi-solid. The product structure can be confirmed by NMR and/or chromatographic analysis.

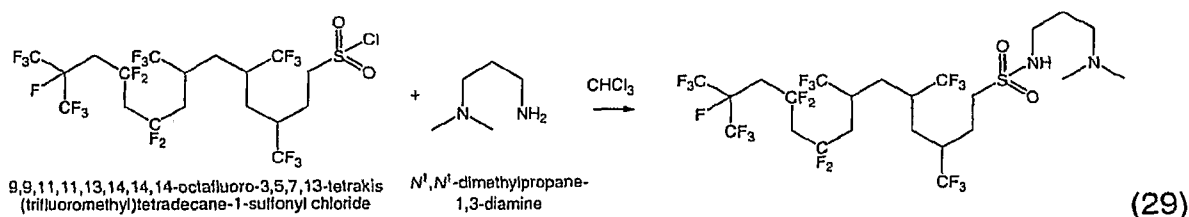


According to scheme (27) above, in a flask that can be equipped with an agitator, thermocouple and a reflux condenser, 20 grams (27 mmol) of 1,1,1,2,4,4,6,6-octafluoro-2,8,10,12-tetrakis(trifluoromethyl)-14-iodotetradecane (see, e.g. Published Patent Applications), 20 ml of absolute ethanol, 3.9 grams (40.5 mmol) of potassium thiocyanate (KSCN) and 0.5 ml of glacial acetic acid (HOAc) can be placed to form a mixture. The mixture can be heated to reflux (84.7 C) and maintained stirring for overnight. The mixture can be concentrated in vacuo to afford what can be observed as a thick yellow slurry. The slurry can be extracted with 300 ml of diethyl ether and decanted twice and filtered to afford a wet cake and a filtrate. The wet cake can be washed with three 100 ml portions of diethyl ether and the filtrates combined. The combined filtrates can be concentrated in vacuo to afford 17.12 grams (94.6 % yield) of the 1,1,1,2,4,4,6,6-octafluoro-2,8,10,12-tetrakis(trifluoromethyl)-14-thiocyanatotetradecane product that can be observed as a light yellow oil. The product structure can be confirmed by NMR and/or chromatographic analysis.



Referring to scheme (28) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, and a dispersion
25 tube, A yellow solution of 17.1 grams (25.5 mmol) of 1,1,1,2,4,4,6,6-octafluoro-2,8,10,12-tetrakis(trifluoromethyl)-14-

thiocyanatotetradecane (refer to scheme (23) above) and 30 ml of HOAc can be placed to form a mixture. The mixture can be heated to about 60°C and sparged via the dispersion tube with chlorine gas (Cl₂) for overnight. The flow of chlorine can be observed to have stopped overnight, causing the reaction material to back up into the trap. A portion of the mixture, what can be observed as a white liquid, can remain in the flask and can still be in contact with the thermocouple. Chlorination can be continued for about two overnight periods to afford what can be observed as a slurry. The slurry can be cooled to about 10°C and about 40 ml of water can be added drop wise to form a reaction mixture. The reaction mixture can be warmed to room temperature (RT) and diluted with about 200 ml of chloroform (CHCl₃) and about 100 ml of water to form a multiphase mixture from which an organic phase can be separated from an aqueous phase. The aqueous phase can be extracted with 200 ml of CHCl₃ and the organic phases combined. The combined extracts can be washed with three 300 mL portions of water and the organic phase collected. The organic phase can be washed with 300 ml of brine and dried over Na₂SO₄, filtered and concentrated in vacuo to afford 16.52 grams (91.0% yield) of the 9,9,11,11,13,14,14,14-octafluoro-3,5,7,13-tetrakis(trifluoromethyl)tetradecane-1-sulfonyl chloride that can be observed as a cloudy colorless oil. The product structure can be confirmed by NMR and/or chromatographic analysis.



In reference to scheme (29) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, addition funnel and a dry-ice / acetone bath, 16.5 grams (23.1 mmol) of

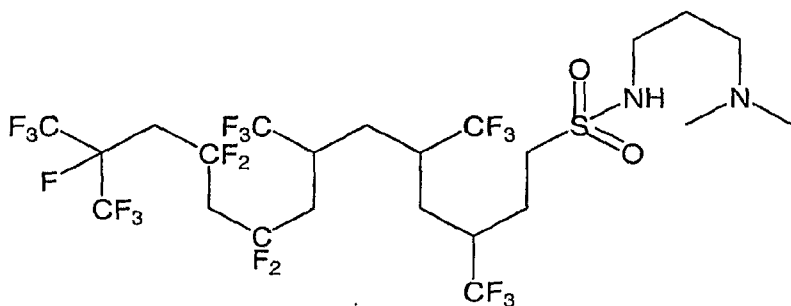
9,9,11,11,13,14,14,14-octafluoro-3,5,7,13-

tetrakis(trifluoromethyl)tetradecane-1-sulfonyl chloride (refer to scheme (24) above) and 50 mL of CHCl_3 can be placed to form a mixture. In the addition funnel, 6.60 grams (64.9 mmol) of 3-

dimethylaminopropylamine and 50 ml of CHCl_3 can be added to form an addition mixture. To the mixture, the addition mixture can be added drop-wise over a 30 minute period to form a reaction mixture while maintaining the temperature at between about 0°C and -5°C .

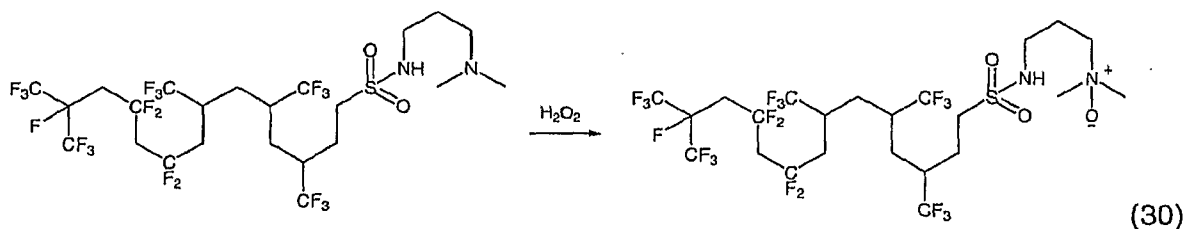
The reaction mixture can be allowed to warm to room temperature

(RT) and stir overnight. The reaction mixture can be washed with one 200 ml portion of water, two 200 ml portions of a saturated solution of bicarbonate and one 200 ml portion of brine wherein each step can be observed to form a multiphase mixture from which an organic phase can be separated from an aqueous phase. The organic phase can be collected and dried over Na_2SO_4 , filtered and concentrated in vacuo to afford 39.30 grams (95.9 % yield) of the

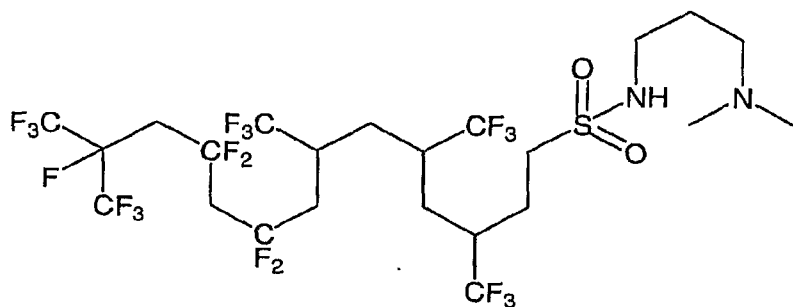


product that can be

observed as a light yellow liquid. The product structure can be confirmed by NMR and/or chromatographic analysis.



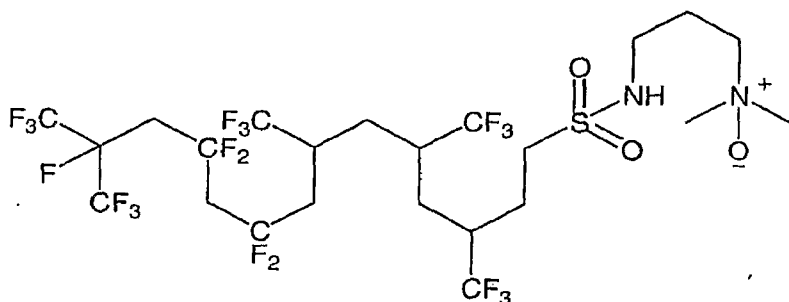
According to scheme (30) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, and an addition funnel, 5.80 grams of



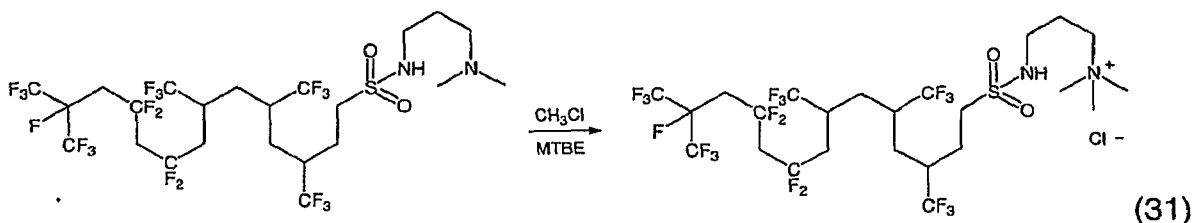
(refer to scheme (26))

- 5 above), 15 ml of absolute ethanol and 1.1 ml of water at RT can be placed to form a mixture. To the mixture, 3.5 ml of 50 % H_2O_2 can be added drop-wise over a 1 minute period to form a reaction mixture. The reaction mixture can be heated to 35°C and maintained for over the weekend. The reaction mixture can be treated portion-wise with 5
 10 grams of decolorizing carbon (neutral) over a 1 hour period at 35°C to form a slurry. The slurry can be heated to about 50°C and maintained for overnight while stirring.

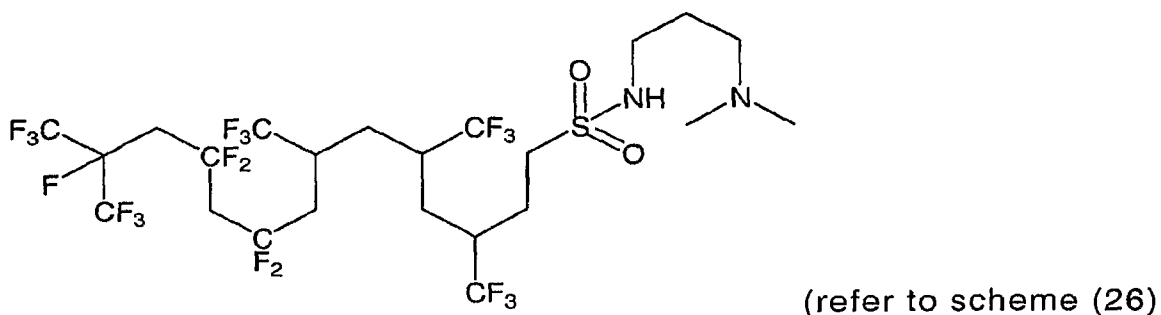
A sample of the slurry can be filtered and the filtrate tested negative for the presence of peroxides. The remainder of the slurry
 15 can be filtered through celite to afford a filtrate. The filtrate can be concentrated in vacuo to afford the



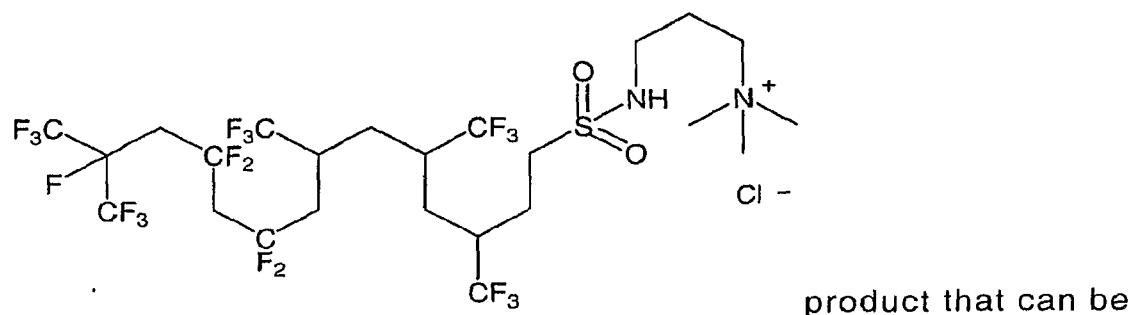
product that can be observed as an off-white crunchy solid. The product structure can be confirmed by NMR and/or chromatographic analysis.



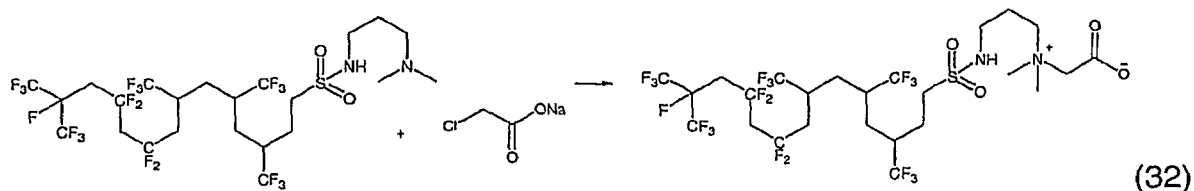
In accordance with scheme (31) above, in a sealable tube that can be equipped with an agitator, 5.50 grams (7.1 mmol) of



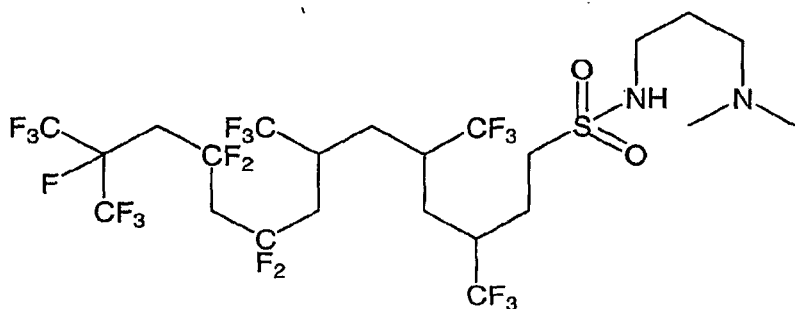
- 5 above), 2.2 grams of chloromethane in 20 mL of methyl-tert-butyl ether (MTBE) can be placed to form a mixture and heated to about 55°C for an extended period of time. Stirring can be halted and the mixture cooled to below about 0°C and the tube vented. The mixture can be concentrated in vacuo to afford the



observed as a white waxy solid. The product structure can be confirmed by NMR and/or chromatographic analysis.

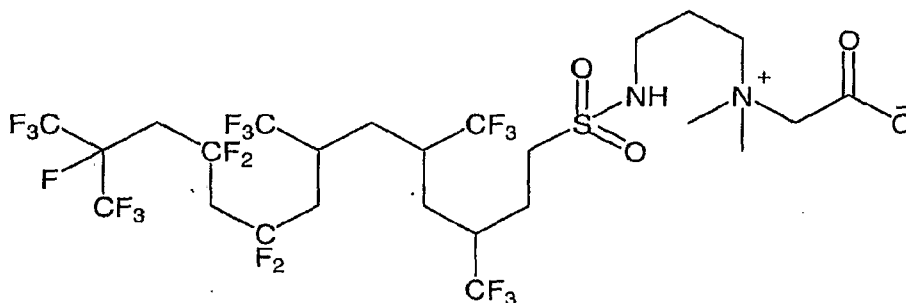


In accordance with scheme (32) above, in a flask that can be equipped with an agitator, thermocouple, reflux condenser, and an addition funnel, 5.50 grams (7.1 mmol) of



(refer to scheme (26)

- 5 above), 20 mL of absolute ethanol and 0.90 grams (7.1 mmol) of sodium chloroacetate can be placed to form a mixture. The mixture can be heated to reflux (about 79°C) and stirred for a period of about 6.5 days. The reaction mixture can be observed as a thin white slurry and can be filtered to afford a filtrate. The filtrate can be
 10 concentrated in vacuo and dried at 45° C under high vacuum to afford 11.03 grams of the



product that

can be observed as a light yellow crunchy solid. The product structure can be confirmed by NMR and/or chromatographic analysis.

- 15 According to another embodiment, a mercaptan R_F -intermediate may also be produced by reacting a iodine R_F -intermediate with thiourea to make the isothiuronium salt and treating the isothiuronium salt with sodium hydroxide to give the mercaptan R_F -intermediate plus sodium iodide, as described in U.S. patent 3,544,663 herein
 20 incorporated by reference.

In an exemplary aspect of the disclosure, the mercaptan R_F -intermediate may be attached to a Qs portion such as group 2-

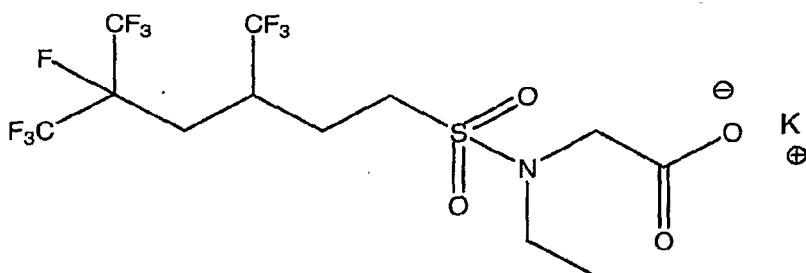
acrylamido-2-methyl-1 propane sulfonic acid available from Lubrizol as AMPS 2403, as generally described in U.S. patent 4,000,188 herein incorporated by reference.

Aminoxides of the R_F -surfactants can be produced according to processes that include those generally described in U.S. patent 4,983,769, herein incorporated by reference. Accordingly, sulfoamidoamines can be combined with ethanol and water and 70% (wt/wt) hydrogen peroxide and heated to at least 35°C for 24 hours. Activated carbon can be added and the mixture and refluxed for about 2 hours. The reaction mixture can be filtered and the filtrate evaporated to dryness to provide the amine oxide of the R_F -surfactant.

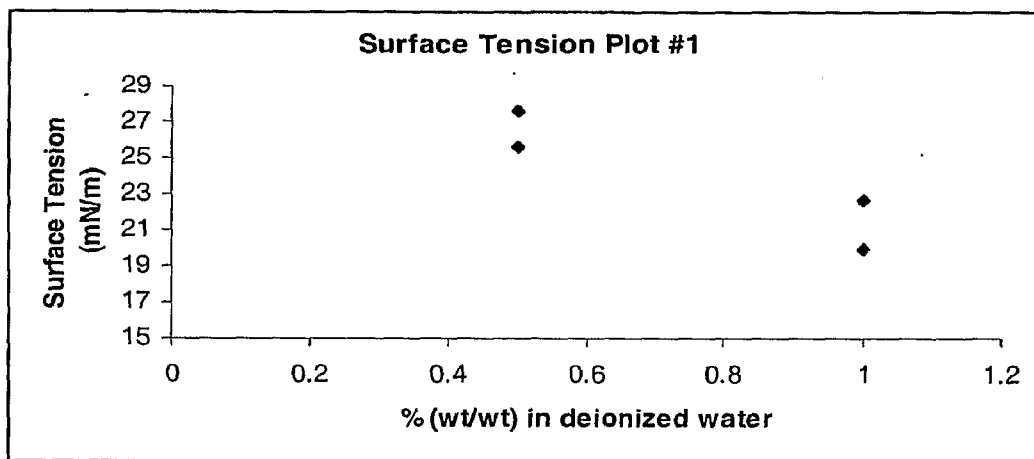
In accordance with another embodiment of the disclosure, processes are provided that can be used to alter the surface tension of a part of a system having at least two parts. The system can include liquid/solid systems, liquid/gas systems, gas/solid systems, and/or liquid/liquid systems. In an exemplary embodiment, the liquid/liquid systems can have one part that includes water and another part that includes a liquid that is relatively hydrophobic when compared to water. According to another example, the liquid/liquid system can contain one part that is relatively hydrophobic when compared to water and/or relatively hydrophobic when compared to another part of the system. R_F -surfactants can be used to alter the surface tension of a part of the system, for example, by adding the R_F -surfactant to the system.

R_F -surfactants may be used as relatively pure solutions or as mixtures with other components. For example, and by way of example only, the R_F -surfactants can be added to a system and the surface tension of the system determined by the Wilhelmy plate method and/or using the Kruss Tensiometer method.

As another example, the surface tensions of

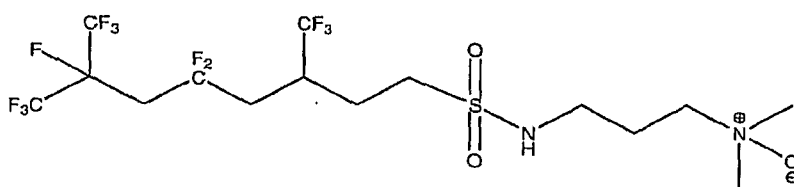


at various concentrations can be determined and the data as indicated in Plot # 1 below.



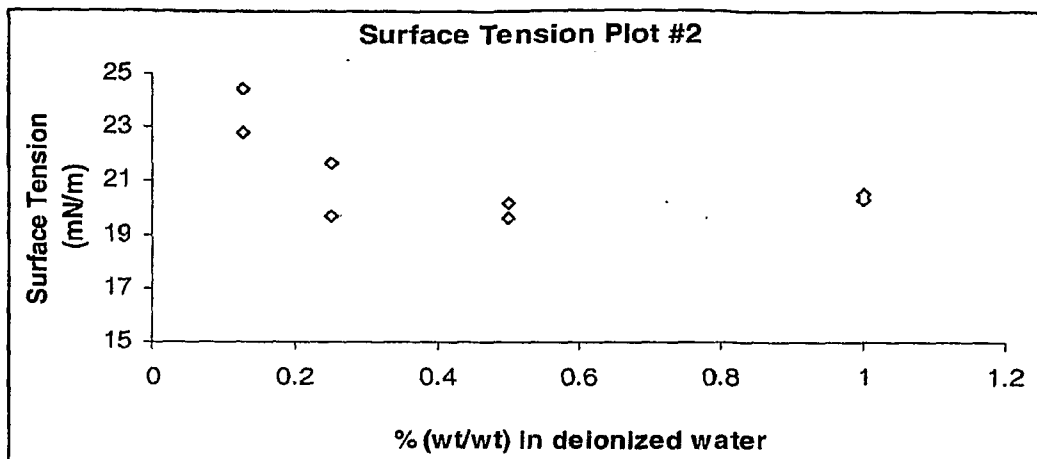
5

As another example, the surface tensions of

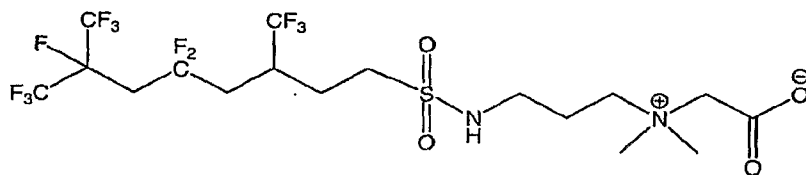


at various concentrations can be determined and the data as indicated in Plot # 2 below.

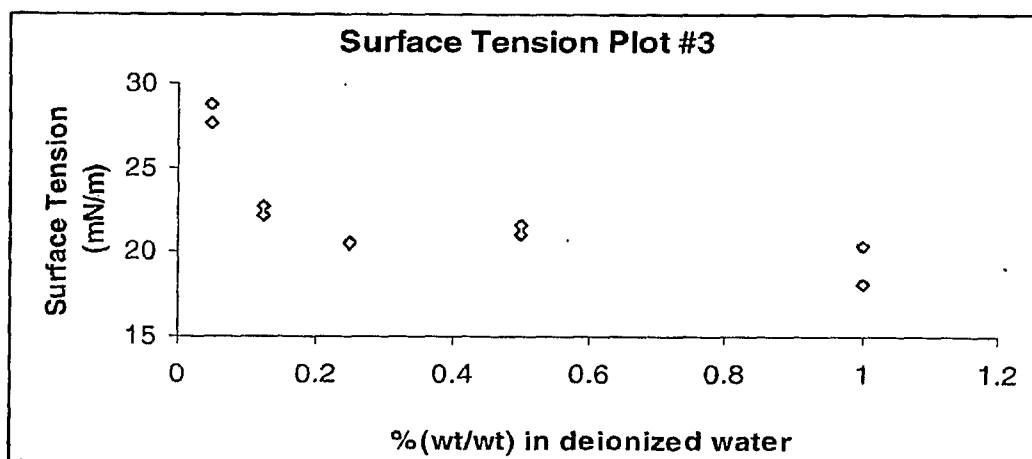
10



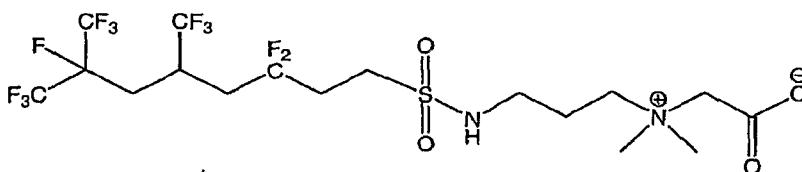
As another example, the surface tensions of



at various concentrations can be determined and the data as indicated in Plot # 3 below.

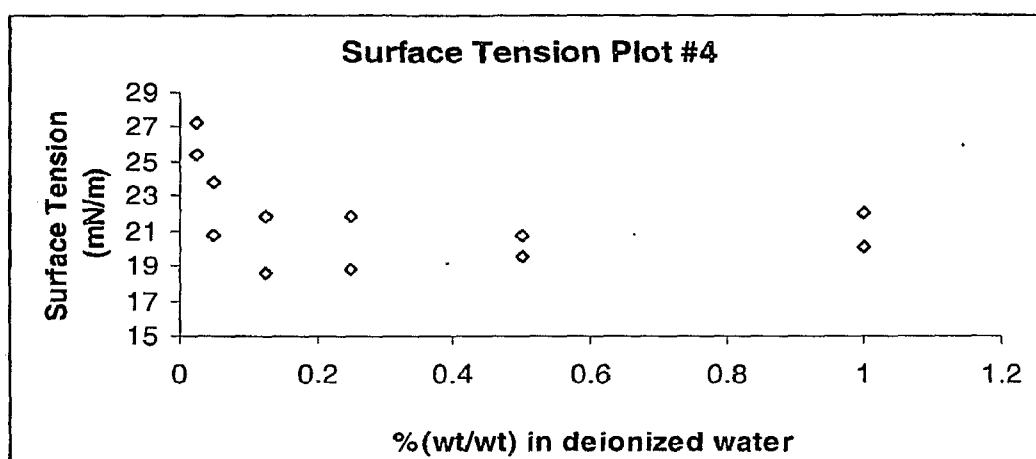


As another example, the surface tensions of

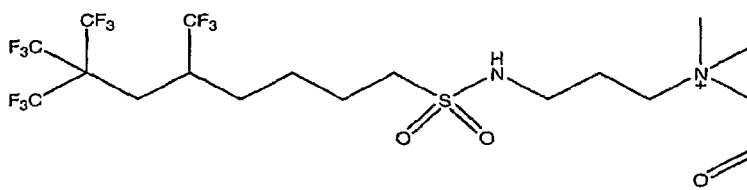


concentrations can be determined and the data as indicated in Plot # 4 below.

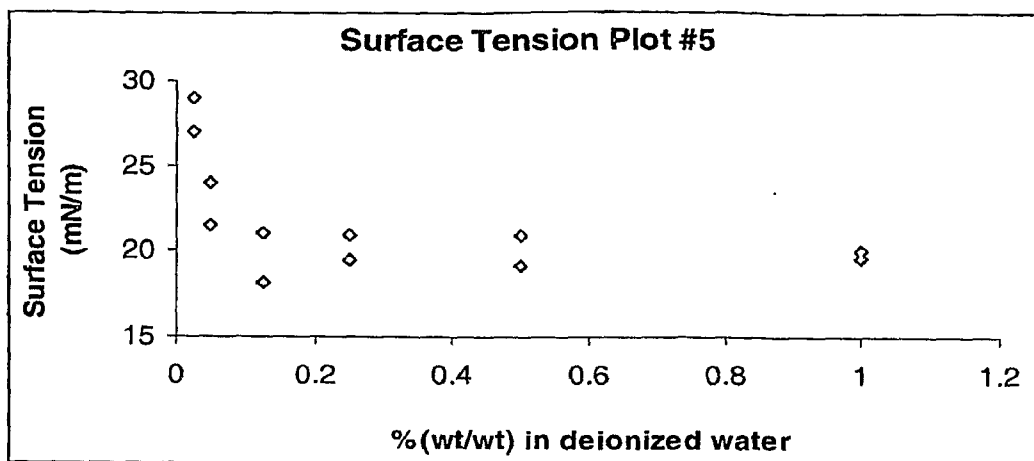
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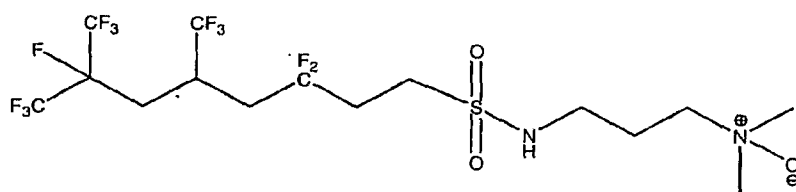
As another example, the surface tensions of



10 concentrations can be determined and the data as indicated in Plot #
5 below.

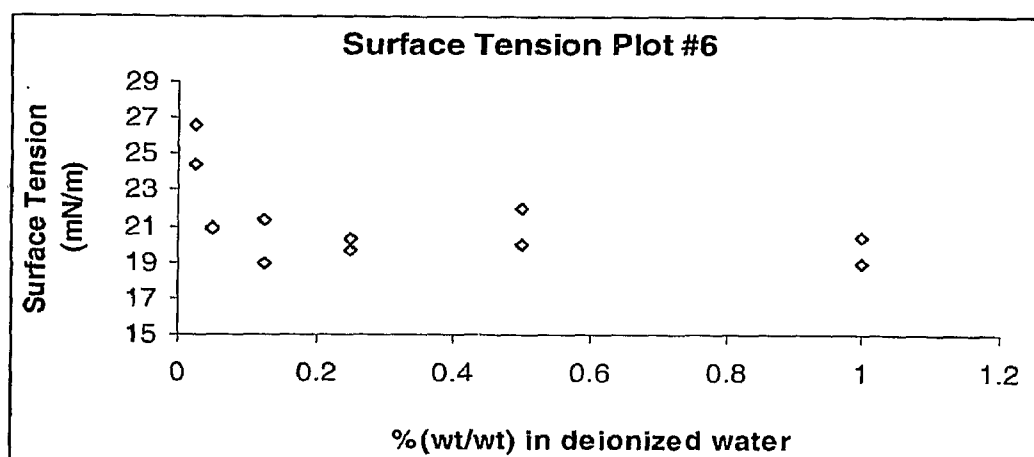


As another example, the surface tensions of

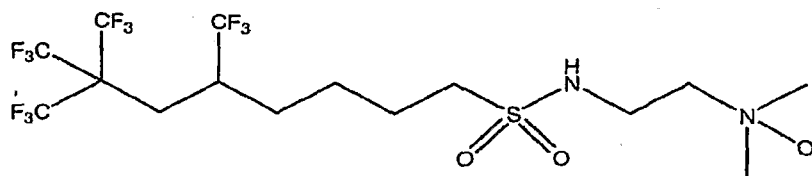


at various

concentrations can be determined and the data as indicated in Plot # 6 below.



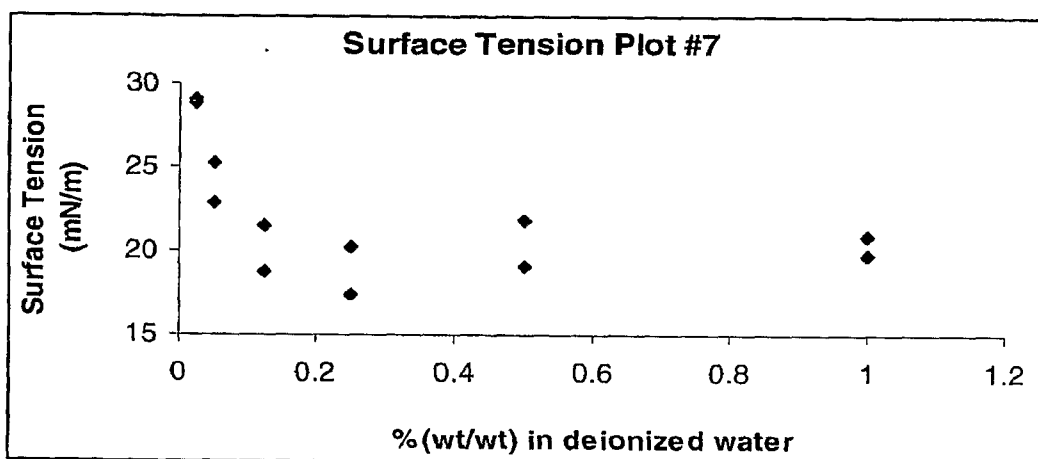
As another example, the surface tensions of



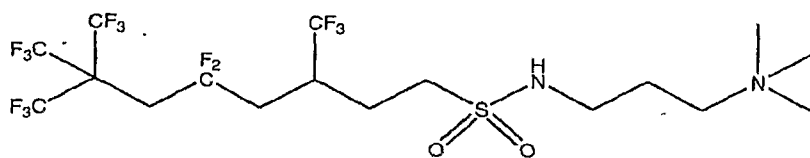
at various

concentrations can be determined and the data as indicated in Plot # 7 below.

5



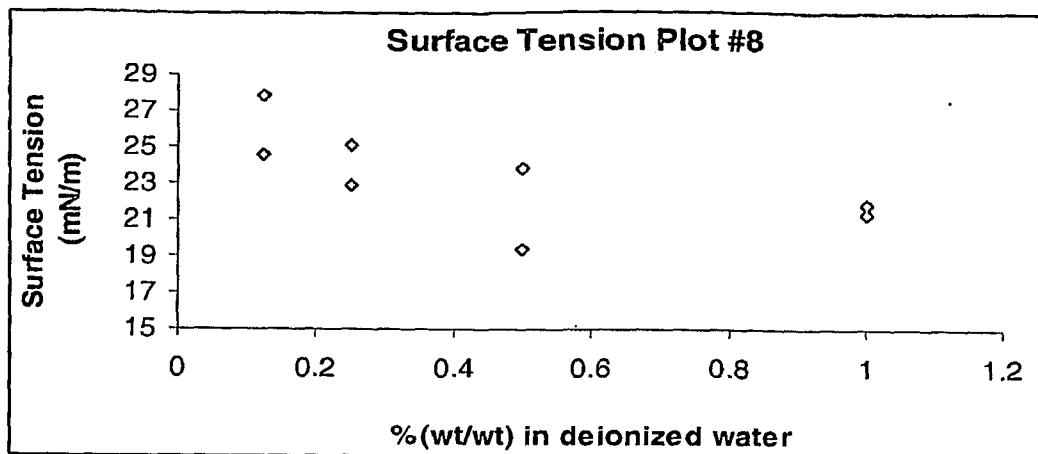
As another example, the surface tensions of



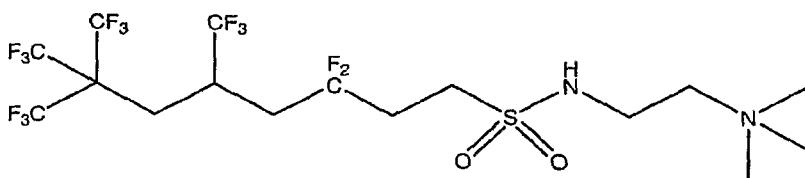
at various

concentrations can be determined and the data as indicated in Plot # 8 below.

10

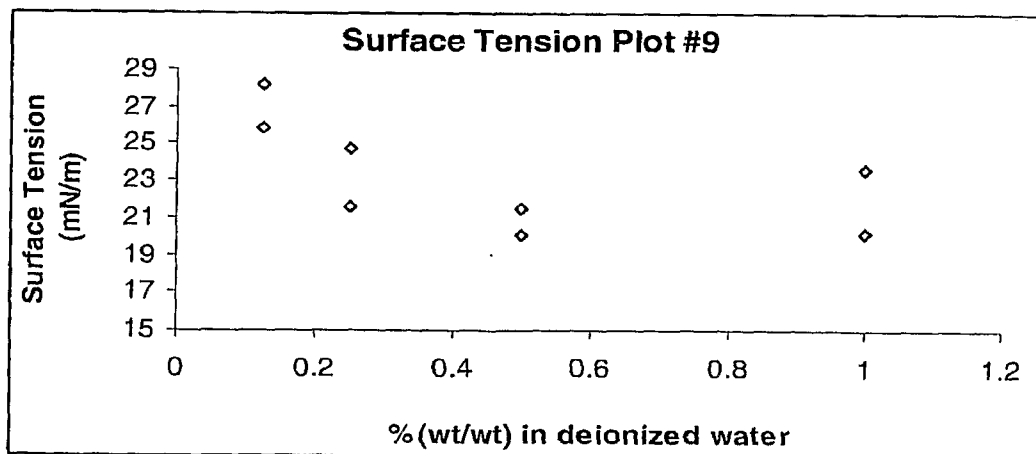


As another example, the surface tensions of

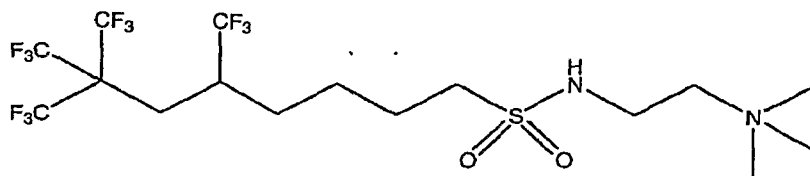


at various

concentrations can be determined and the data as indicated in Plot # 9 below.



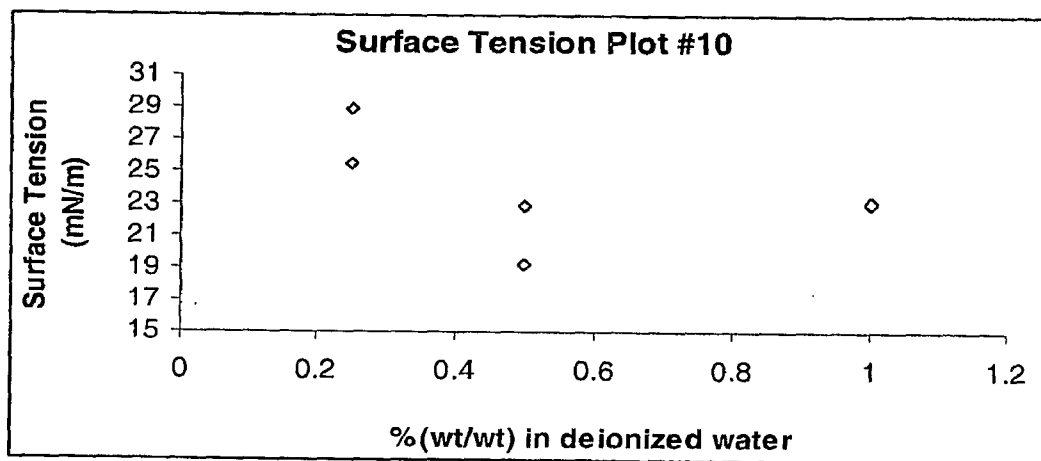
As another example, the surface tensions of



at various

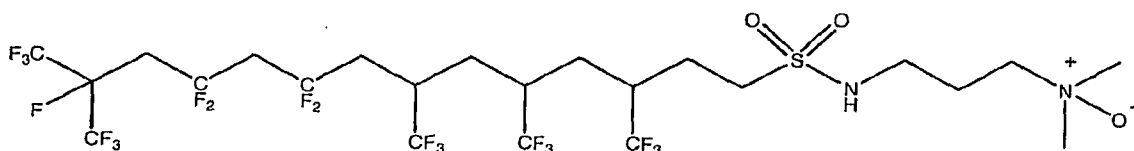
concentrations can be determined and the data as indicated in Plot # 10 below.

5



10

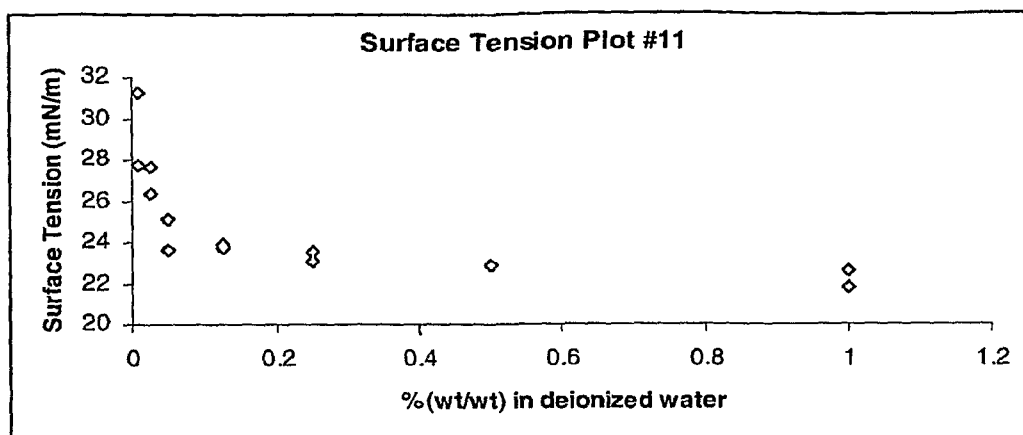
As another example, the surface tensions of



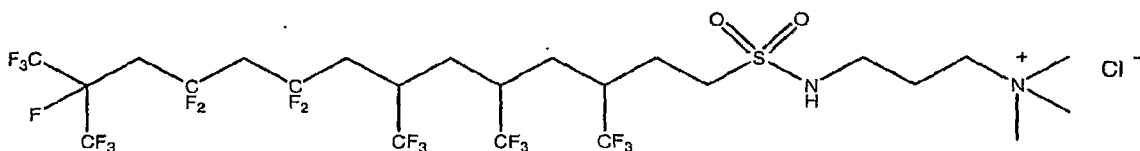
at various concentrations can be determined and the data as indicated in

Plot # 11 below.

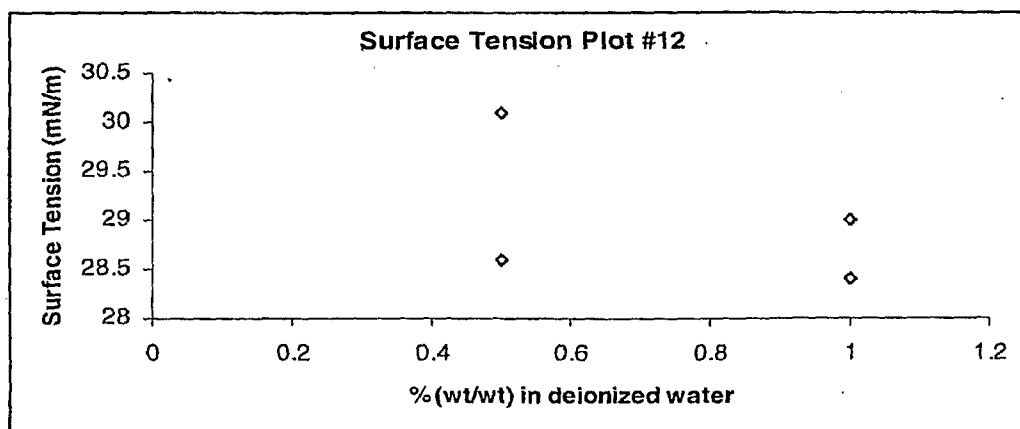
15



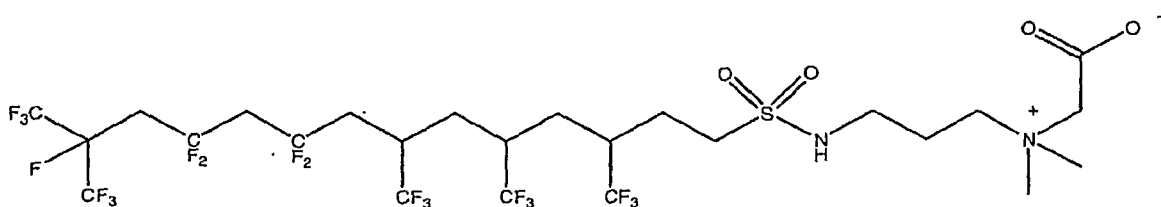
As another example, the surface tensions of



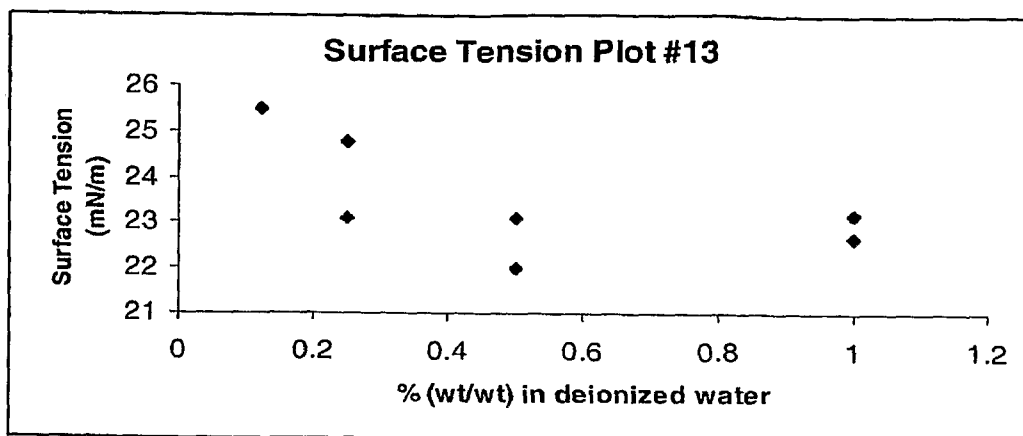
5 at various concentrations can be determined and the data as indicated
in Plot # 12 below.



As another example, the surface tensions of



at various concentrations can be determined and the data as indicated in Plot # 13 below.



R_F -surfactants described above may be incorporated into
5 detergents, emulsifiers, paints, adhesives, inks, wetting agents,
foamers, and/or defoamers, for example.

R_F -surfactants can be incorporated into AFFF formulations and
these formulations can be used as fire-fighting foams, to prevent,
and/or extinguish combustion. An exemplary use of AFFFs that
10 include an R_F -surfactant includes the addition of the AFFF to high
pressure misting systems, the misting systems being used to prevent
and/or extinguish combustion. AFFF formulations can be provided to
a substrate, for example. The substrate can include liquid and/or
solid compositions. The AFFF formulations can also be dispersed into
15 an atmosphere including gaseous atmospheres, such air to prevent
and/or extinguish combustion.

The formulations can include other components such as water
soluble solvents. These solvents may facilitate the solubilization of
the R_F -surfactants and other surfactants. These solvents can also act
20 as foam stabilizers and/or freeze protection agents. Exemplary
solvents can include ethylene glycol, diethylene glycol, glycerol, ethyl
Cellusolve[®], butyl Carbitol[®], Dowanol DPM[®], Dowanol TPM[®], Dowanol
PTB[®], propylene glycol, and/or hexylene glycol. Additional

components to the formulation, such as polymeric stabilizers and thickeners, can be incorporated into the formulation to enhance the foam stability property of a foam produced from aeration of the aqueous solution of the formulation. Exemplary polymeric stabilizers and thickeners include partially hydrolyzed protein, starches, polyvinyl resins such as polyvinyl alcohol, polyacrylamides, carboxyvinyl polymers, and/or poly(oxyethylene)glycol. Polysaccharide resins, such as xanthan gum, can be included in the formulation as a foam stabilizer in formulations for use in preventing or extinguishing polar solvent combustion, such as alcohol, ketone, and/or ether combustion, for example. The formulation can also include a buffer to regulate the pH of the formulation, for example, tris(2-hydroxyethyl) amine or sodium acetate, and a corrosion inhibitor such as toluotriazole or sodium nitrite may be included. Water soluble electrolytes such as magnesium sulphate may be included and can improve film-spreading characteristics of the formulation.

The R_F-surfactants can also be useful in formulations that include other surfactants such as alkyl sulfate, alkylethersulfates, alphaolefinsulfonates, alkyl sulfobetaines, alkyl polyglycerides, alkylamidopropylbetaines, alkylimidazolinedicarboxylates, 2-alkylthiopropionamido-2 methyl-propanesulfonic acid sodium salt, alkyliminodipropinates, alkylsulfonates, ethoxylated alkylphenols, dialkylsulfosuccinates, and/or alkyltrimethyl ammonium chloride.

A variation of AFFF, ARAFFF, an acronym for Alcohol Resistant Aqueous Film Forming Foam(s), can be used to extinguish hydrocarbon fires in much the same manner that AFFF foams are used and may also be used to extinguish fires involving water soluble solvents such as acetone and isopropanol which conventional AFFF foams will not extinguish.

ARAFFF formulations can contain the same ingredients as conventional AFFF formulations plus a polysaccharide such as xanthan gum and, in some formulations, a polymeric foam stabilizer.

Polymeric foam stabilizers are offered by DuPont® and Dynax®, Inc. An exemplary DuPont product, Forafac® 1268, is a water soluble acrylic polymer. An exemplary Dynax product, DX5011®, is an ethyleneimine polymer. Xanthan gum is offered by several suppliers,
5 including Kelco CP (Kelzan) and Rhodia North America (Rhodopol).

Polysaccharide alone can be sufficient to make ARAFFF formulations alcohol resistant, but the amount required produces a foam concentrate that can be quite viscous. The use of a polymeric foam stabilizer can permit a reduction in the amount of polysaccharide
10 required to give useful alcohol resistance.

Because of the possibility of microbial attack on polysaccharide solutions, ARAFFF concentrates can contain an effective amount of a biocide such as Kathon CG ICP, manufactured by Rohm & Haas. Many other biocides such as Acticide, Nipacide and Dowicil can also
15 be effective.

Some ARAFFF formulations can be designed to be proportioned at different percentages depending on whether the substrate to be extinguished is a hydrocarbon or an alcohol type substrate, for example. Alcohol type can include any fuel having a hydroxyl group.

20 Exemplary ARAFFF formulations utilizing the R_F surfactants can be provided and/or formulated in accordance with the methods described in the Published International Applications. Foam stabilizers, such as R_F -stabilizers that include R_F groups described above, for example, can be prepared. R_F -stabilizers can include R_F -
25 Q_{FS} compositions. Example foam stabilizer compositions can include $R_F(R_T)_nQ_{FS}$. The R_F group can comprise at least one $-CF_3$ group. The R_T group can comprise $-CF_2CH_2CH(CF_3)-$, with n being at least 1. The Q_{FS} group can be at least one atom of the periodic table of elements, wherein at least a portion of the R_F and R_T groups are
30 hydrophobic relative to the Q_{FS} group, and at least a portion of the Q_{FS} group is hydrophilic relative to the R_F and R_T groups.

According to exemplary embodiments the R_F portion can at least partially include an $R_F(R_T)_n$ portion as described above. The $R_F(R_T)_n$ portion of the surfactant can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion can be incorporated to provide additional carbon between the R_F and/or $R_F(R_T)_n$ portions and the Q_{FS} portion of the surfactant. Exemplary R_S portions include $-\text{CH}_2-\text{CH}_2-Q_{FS}$ can include portions that have a greater hydrophilic character than R_F . Exemplary Q_{FS} portions include the Q_S portions described herein as well as those having polyalkoxylated amines. Exemplary R_F -Foam Stabilizers include, but are not limited to those in Table 7 below.

Table 7. Exemplary R_F -Foam Stabilizers

R_F -metal complexes such as R_F-Q_{MC} incorporating the R_F portions are also provided. The R_F portions can be incorporated as acid halides or carboxylic acids, for example, with the acid halide including, but not limited to, acid fluorides, for example. According to exemplary embodiments the R_F portion can at least partially include an $R_F(R_T)_n$ portion as described above. The $R_F(R_T)_n$ portion of the complex can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion can be incorporated to provide additional carbon between the R_F and/or $R_F(R_T)_n$ portions and the Q_{MC} portion of the complex. Exemplary R_S

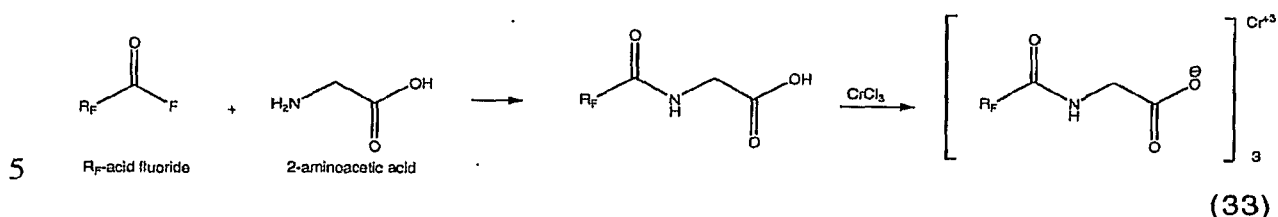
portions include $-\text{CH}_2-\text{CH}_2-$. R_F -metal complexes can include R_F -intermediates and, as such, Q_g can be interchangeable with Q_MC . Q_MC can include the portion of a ligand of a metal complex that is coordinated with the complexed metal, for example. Metal complexes are provided that can include $\text{R}_\text{F}(\text{R}_\text{T})_n\text{Q}_\text{MC}$. The R_F group can include at least one $-\text{CF}_3$ group. The R_T group can include $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$, with n being at least 1. The Q_MC group can include a charged group configured to complex one or more metal ions. Exemplary R_F -metal complexes include, but are not limited to, those in Table 8 below.

10

Table 8. Exemplary R_F -Metal Complexes	

R_F -metal complexes such as $\text{R}_\text{F}-\text{Q}_\text{MC}$ incorporating the R_F portions are also provided. The R_F portions can be incorporated as acid halides or carboxylic acids, for example, with the acid halide including, but not limited to, acid fluorides, for example. According to exemplary embodiments the R_F portion can at least partially include an $\text{R}_\text{F}(\text{R}_\text{T})_n$ portion as described above. The $\text{R}_\text{F}(\text{R}_\text{T})_n$ portion of the complex can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion can be incorporated to provide additional carbon between the R_F and/or $\text{R}_\text{F}(\text{R}_\text{T})_n$ portions and the Q_MC portion of the complex. Exemplary R_S portions include $-\text{CH}_2-\text{CH}_2-$. R_F -metal complexes can include R_F -intermediates and, as such, Q_g can be interchangeable with Q_MC . Q_MC

can include the portion of a ligand of a metal complex that is coordinated with the complexed metal, for example. Exemplary R_F -metal complexes can be prepared by way of the following exemplary synthetic steps.



An acid fluoride R_F -intermediate can be reacted with an amino acid such as glycine (2-aminoacetic acid) to produce an amido-carboxylic acid. The amido-carboxylic acid can be reacted with chromic chloride in an alcohol such as methanol and/or isopropanol to produce an exemplary R_F -metal complex such as a R_F chrome complex. Exemplary acid R_F -intermediates for use in preparation of

15 R_F -metal complexes can include ethylene carboxylic acid R_F -intermediates and/or mixtures of ethylene carboxylic acid R_F -intermediates and carboxylic acid R_F -intermediates. Exemplary preparations can be performed in accordance with U.S. Patents 3,351,643, 3,574,518, 3,907,576, 6,525,127 and 6,294,107, herein

20 incorporated by reference. R_F -metal complexes can include a ligand having a R_F portion and a Q_{MC} portion associated with the metal of the complex. In exemplary embodiments the Q_{MC} portion can have a greater affinity for the metal complex than the R_F portion. R_F -metal complexes can be used to treat substrates such as paper, leather,

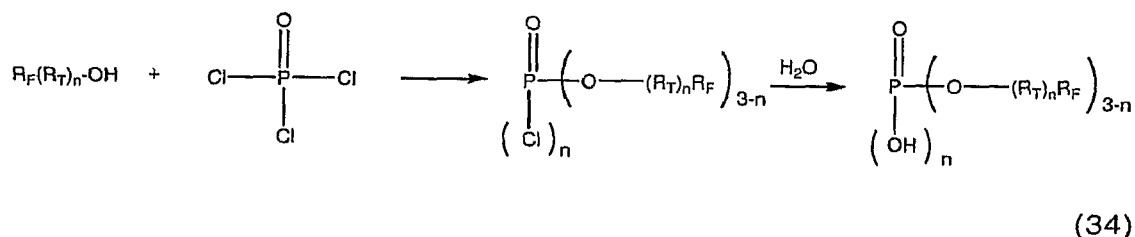
25 textiles, yarns, fabrics, glass, ceramics, and/or metals. In some cases, treating substrates with the complexes can render the substrates less permeable to water and/or oil. The above described chrome complex solutions can be applied as a surface treatment of a variety of materials including, but not limited to, leather by the

employment of the methods described in US 3,351,643 and US 3,948,887, herein incorporated by reference.

An embodiment of the present invention also provides for incorporation of the R_F portions into phosphate ester which, in exemplary embodiments, can be used to treat substrates and/or as dispersing agents during the preparation of polymers. Exemplary R_F -phosphate esters include R_F - Q_{PE} , with the Q_{PE} portion being the phosphate portion of the R_F -composition. According to exemplary to embodiments the R_F portion can at least partially include an $R_F(R_T)_n$ portion as described above. The $R_F(R_T)_n$ portion of the ester can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion can be incorporated to provide additional carbon between the R_F and/or $R_F(R_T)_n$ portions and the Q_{PE} portion of the ester. Exemplary R_S portions include $-\text{CH}_2\text{CH}_2-$. Phosphate esters are provided that can include $R_F(R_T)_nQ_{PE}$. The R_F group can include at least two $-\text{CF}_3$ groups. The R_T group can include a group having at least two carbons, with n being at least 1. The Q_{PE} group can be a portion of a phosphate ester. R_F -phosphate esters, include, but are not limited to, those in Table 9 below.

Table 9. Exemplary R_F -Phosphate Esters

R_F -phosphate esters can be used as dispersing agents in the preparation of polymers or they can be diluted and used to treat substrate materials in aqueous bathes, for example, by ordinary means such as padding, dipping, impregnating, spraying, etc. These composition can be incorporated into or used to treat such materials as textile fabric, textile yarns, leather, paper, plastic, sheeting, wood, ceramic clays, as well as, manufactured articles of apparel, wallpaper, paper bags, cardboard boxes, porous earthenware, etc. U.S. Patent 3,112,241 describes methods for treating materials using phosphate esters and is herein incorporated by reference. R_F -phosphoric acid ester can be used to treat substrates such as wood pulp products, including paper products such as packaging products including food packaging products.



According to scheme (34) above, benzene, pyridine and phosphorous oxychloride ($POCl_3$) can be combined to form mixture A. Mixture A can be chilled to about 7°C, from about 0°C to about 15°C, and/or about 2°C. To mixture A, a mixture of $R_F(R_T)_n-OH$, pyridine and benzene can be added to form a reaction mixture. The reaction mixture can be allowed to warm to room temperature and heated to reflux and maintained for about one hour to afford a product mixture that can comprise the mono ($n = 2$), bis ($n=1$) and tris ($n=0$) R_F -phosphate esters. To the product mixture, water can be added to provide a product mixture that can comprise the acid esters of the above acid chlorides.

An embodiment includes the R_F portions incorporated into glycols, such as R_F -glycols, including R_F-Q_H , with Q_H representing the

ether portion of the glycol after conjugation or, as hydroxyl functionality before conjugation as the ether. According to exemplary embodiments the R_F portion can at least partially include an $R_F(R_T)_n$ portion as described above. The $R_F(R_T)_n$ portion of the glycol can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion can be incorporated to provide additional carbon between the R_F and/or $R_F(R_T)_n$ portions and the Q_H portion of the glycol. Exemplary R_S portions include $-\text{CH}_2-\text{CH}_2-$. Glycols are provided that can include $R_F(R_T)_nQ_H$. The R_F group can include at least one $-\text{CF}_3$ group. The R_T group can include $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$, with n being at least 1. The Q_H group can be a portion of a glycol chain backbone. Exemplary R_F -glycols include, but are not limited to, those in Table 10 below.

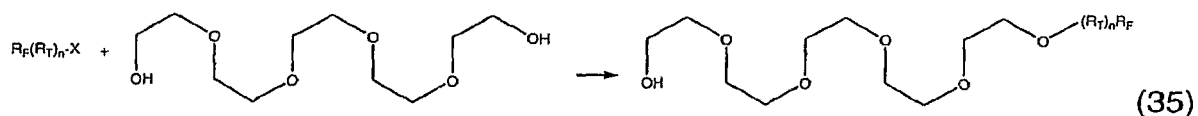
Table 10. Exemplary R_F -Glycols

R_F -glycols can be incorporated into polymers such as urethanes including polyurethane elastomers, films and coatings, for example. R_F -glycols can be converted to phosphoric acids or phosphate esters of those glycols as well. Referring to scheme 35 below, R_F portions can be incorporated into glycols.

Methods for preparing glycols are described in U.S. Patent 4,898,981, U.S. Patent 5,491,261, U.S. Patent 5,091,550, U.S. Patent 5,132,445, and Dupau, et. al., Adv. Synth. Catal. 2002. 344. No. 3&4,

Procedure B, all of which are herein incorporated by reference. For example, and by way of example only, an RF-intermediate ($QG=SH$) can be reacted with a sulfide diol or 2,6 diox-aspiro (3,3) heptane to produce exemplary R_F -glycols ($Q_H=H_2CH_2CSH_2CH_2-$). The RF-glycol can be used directly or indirectly to prepare a R_F condensation product such as polyesters, polyureas, polycarbonates and polyurethanes. The glycol functionality can be incorporated into block polymers using RF-glycols. U.S. Patent 5,491,261 discloses several other glycols that can benefit from the RF portion of the present invention and is herein incorporated by reference.

R_F -glycols may be converted to phosphoric acid functionality or phosphate esters (not shown). U.S. Patent 5,091,550, 5,132,445, 4,898,981 and 5,491,261 all disclose methods of preparing diols and converting diols to phosphate esters and are herein incorporated by reference. In an exemplary implementation, the diols can be converted to phosphoric acids or phosphate esters by reacting diols in the presence of phosphoric acid. These compositions can be incorporated into compounds which can act as oil and/or grease proofing for paper, as well as, soil release agents for textile fibers.

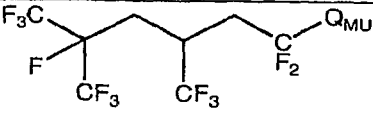
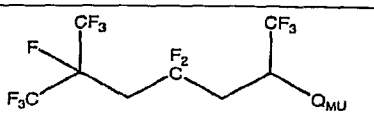
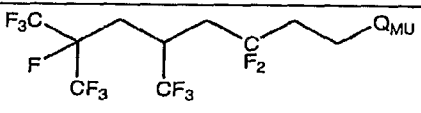
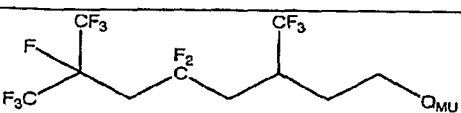
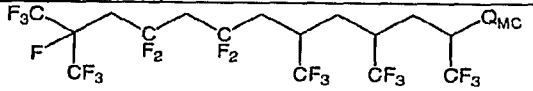
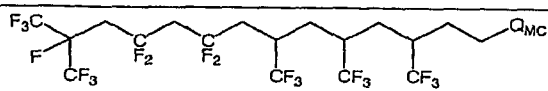


According to scheme (35) above, pentaethylene glycol and anhydrous tetrahydrofuran (THF) can be combined to form a first mixture. The mixture can be cooled to about 0°C in an acetone/ice bath. To the first mixture, sodium bis(trimethylsilyl)amide in THF can be added to form a second mixture. The second mixture can be stirred at about 0°C for about 15 minutes. To the second mixture, the $R_F(R_T)_n-X$, wherein X is a halogen, and THF can be added drop-wise to form a reaction mixture. The reaction mixture can be allowed to warm to room temperature and maintained for about two hours. The

reaction mixture can be heated to about 40°C and maintained for overnight. The reaction mixture can be allowed to cool to room temperature and a 5 % (wt/wt) solution of HCl can be added to form a multiphase mixture having a pH of about 7, from which an organic phase can be separated from an aqueous phase. The organic layer can be concentrated in vacuo to afford the R_F-glycol. The product structure can be confirmed by NMR and/or chromatographic analysis.

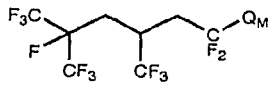
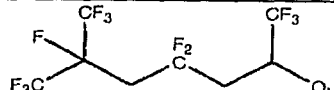
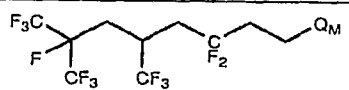
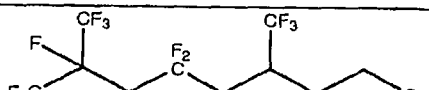
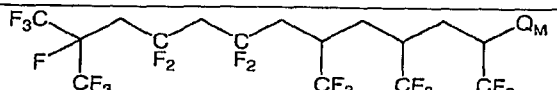
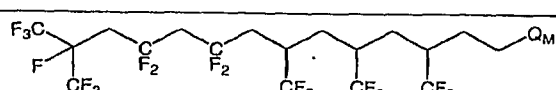
According to another embodiment of the present invention, oligomers, polymers, copolymers, acrylics, and/or resins, for example, can be prepared that include an R_F-monomer unit, such as R_F-Q_{MU}. The monomer unit portion, Q_{MU}, can be a single unit within a complex of units and the monomer unit need not repeat within the complex. In an exemplary embodiment, the monomer unit can be a single unit within the complex or it may be one of many identical units linked together, such as a homopolymer, for example. The complex can also include block polymers and/or polyurethane resins. The R_F of the unit can include a pendant group of the monomer unit. The monomer unit may be associated with a complex, perhaps even bonded to the complex, for example, and Q_{MU} can include the portion of the monomer unit that is associated with the complex. The complex may be coated onto a substrate or it may be chemically bonded to the substrate. For example, a preparation of R_F-intermediates can be provided to the substrate and groups such as hydroxyl groups common to substrates like cotton, may provide sites that allow the R_F-intermediate to chemically bond to the substrate when forming part of, or being associated with a complex. In an exemplary embodiment, Q_{MU} can represent the acrylate functionality of an acrylic and R_F can be a pendant group from the acrylics chain and/or backbone. Polymers comprising R_F(R_T)_nQ_{MU} are provided. The R_F group can include at least one -CF₃ group. The R_T group can include -CF₂CH₂CH(CF₃)-, with n being at least 1. The Q_{MU} group can be a portion of a polymer chain backbone. Exemplary R_F-monomer units include but are not limited to those in Table 11 below.

Table 11. Exemplary R_F -Monomer Units

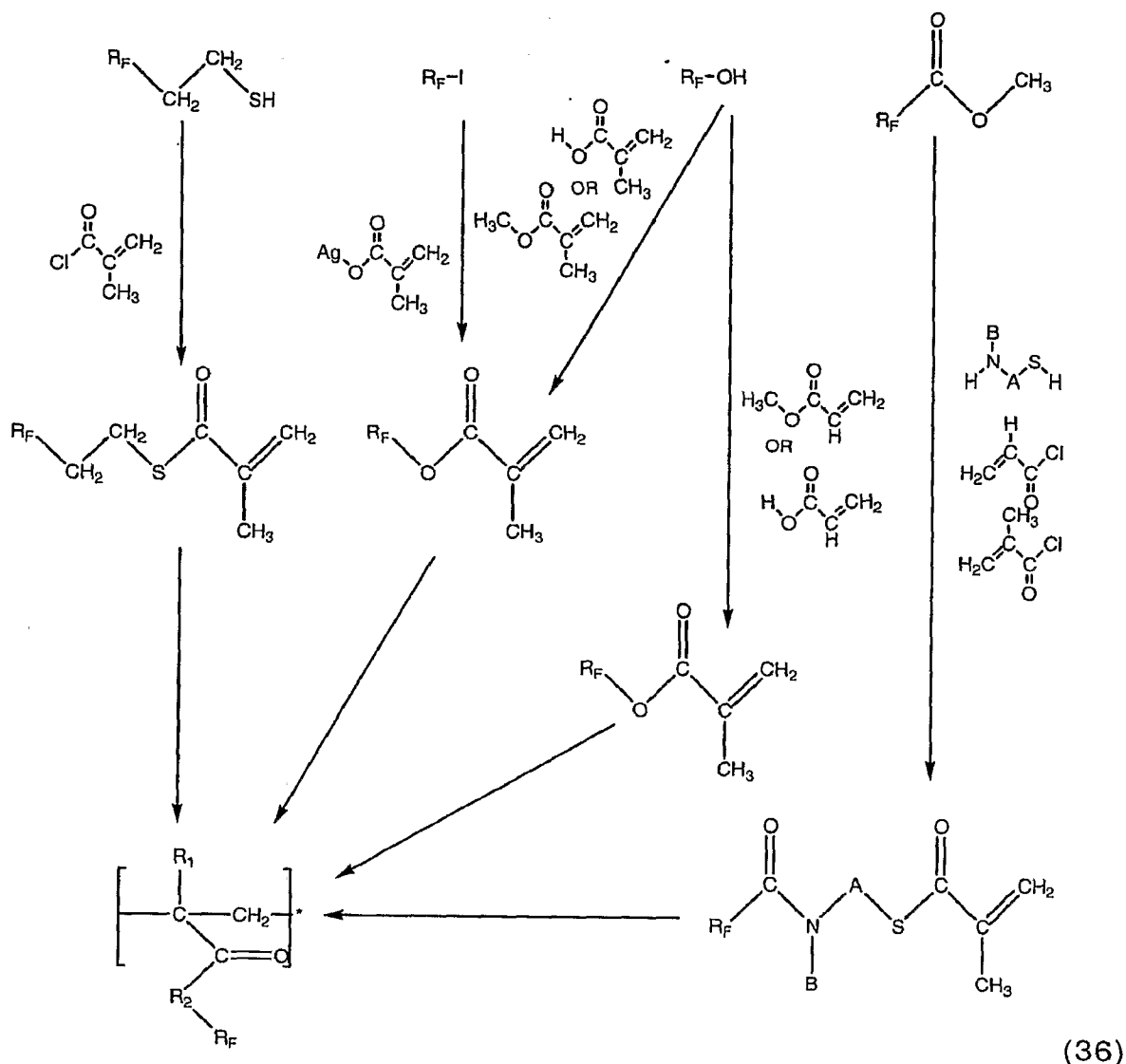
	
	
	

- In exemplary embodiments oligomers containing a R_F -monomer unit can be prepared from R_F -monomers. R_F -monomers can include R_F -intermediates above, but may contain functionality that allows for their conjugation with another monomer, but not necessarily the same R_F -monomer. The monomers can include $R_F(R_T)_nQ_M$. The R_F group can include at least one $-CF_3$ group. The R_T group can include $-CF_2CH_2CH(CF_3)-$, with n being at least 1. The Q_M group can be at least one atom of the periodic table of elements. Exemplary R_F -monomers include, but are not limited to those in Table 12 below.

Table 12. Exemplary R_F -Monomer Units

- Referring to scheme (36) below, multiple reactions sequences are shown for the preparation of R_F -monomers having the R_F group.



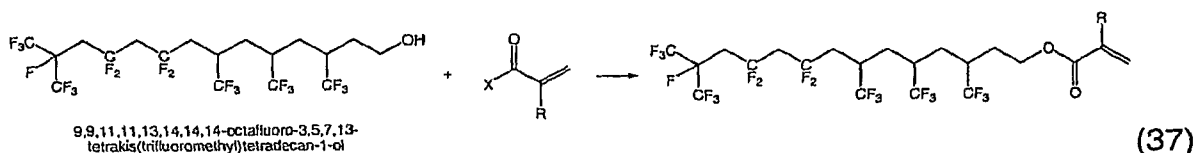
U.S. Patents 3,491,169, 3,282,905, 3,497,575, 3,544,663, 6,566,470, 4,147,851, 4,366,299, 4,439,329, and 5,439,998 all relate to the use and preparation of acrylic emulsion polymers that can benefit from the R_F groups and, are herein incorporated by reference.

5 Thiol R_F -intermediates, iodine R_F -intermediates, hydroxyl R_F -intermediates, and/or acetate R_F -intermediates can be converted to R_F -monomers according to scheme (35) above, and these R_F -monomers can be used to prepare a composition containing an R_F -monomer unit.

10

For example, and by way of example only, the R_F portion can be incorporated into a R_F -monomer as described in U.S. Patent

6,566,470 represented as $R_F-W-X-C(=O)-C(R_1)=CH_2$, with the R_F portion as described above. W can be an alkylene with 1 to 15 carbons, hydroxyalkylene with 3 to 15 carbons, $-(C_nH_{2n})(OC_mH_{2m})_q-$, $-SO_2NR_2-(C_nH_{2n})-$, or $-CONR_2-(C_nH_{2n})-$, with n being 1 to 12, m being
 5 2 to 4, q being 1 to 10, and R_1 being an alkyl group with 1 to 4 carbon atoms, for example, X being O, S and/or N(R_2), where R_2 is as R_1 .



According to scheme (37) and procedures set forth in the published international applications, R_F -acrylates can be prepared
 10 wherein $R = CH_3$ or H and X is a halogen. The resulting acrylates can be homopolymerized and/or copolymerized according to the general procedures listed in the published international applications. For example and by way of example only, solutions of R_F -monomers can be provided to a substrate and allowed to complex, for example, via
 15 evaporating the solvent of the solution to form a complex that includes a R_F -monomer unit, providing these solutions to a substrate such as glass, nylon, and/or cotton and allowing the R_F -monomer to become part of a complex, such as coating the substrate.

The surface energy of the complex can be determined using the
 20 standard Fowkes method using diiodomethane and water as probe liquids, and the Zisman method of surface energy analysis using octane, decane, tetradecane, and hexadecane as probe liquids. Contact angle of drops of Zisman probe liquids, as well as the Fowkes probes, can be determined using a Kruss Drop Shape Analysis
 25 System.

R_F -monomers can be incorporated with other monomers and then incorporated into the construction of paper materials or used to treat paper materials. R_F -monomers can also be used to prepare polymer solutions. Polymeric solutions can be diluted to a percentage.

aqueous or non-aqueous solution and then applied to substrates to be treated, such as paper plates.

R_F -monomers can also be incorporated into copolymers with comonomers such as the dialkyl amino alkyl acrylate or methacrylate or acrylamide or methacrylamide monomer and its amine salt quaternary ammonium or amine oxide form, as described in U.S. Patent 4,147,851, herein incorporated by reference. The general formula for R_F -monomers can be $R_FqO_2CC(R)=CH_2$, with R being H or CH_3 , q being an alkylene of 1 to 15 carbon atoms, hydroxyalkylene of 3 to 15 carbon atoms, or $C_nH_{2n}(OC_qH_{2q})_m-$, $-SO_2NR_1(C_nH_{2n})-$, or $-CONR_1(C_nH_{2n})-$, n being 1 to 15, q being 2 to 4, and m being 1 to 15. Monomers used to form copolymers with acrylates and the R_F -monomers include those having amine functionality. These copolymers can be diluted in a solution and applied or incorporated directly into or on substrates to be treated, such as paper.

R_F -monomers can also be used to form acrylate polymers or other acrylate monomers consistent with those described in U.S. Patent 4,366,299, herein incorporated by reference. As described, R_F -monomers can be incorporated into paper products or applied thereon.

R_F -monomers, acrylates and/or acrylics, for example, can be applied to finished carpet or incorporated into the finished carpet fiber before it is woven into carpet. R_F -monomers can be applied to carpet by a normal textile finishing process known as padding, in which the carpet is passed through a bath containing the R_F -monomer and, for example, latex, water, and/or other additives such as non-rewetting surfaces. The carpet can then be passed through nip rollers to control the rate of the add-on before being dried in a tenter frame.

R_F -monomers may also be incorporated into the fiber by reacting the fiber with R_F -intermediates having isocyanate functionality, R_F -isocyanate, for example.

R_F portions can also be incorporated into materials used to treat calcitic and/or siliceous particulate materials. For example, R_F -monomers can be incorporated into a copolymer where the copolymer can either be part of a formulation to treat these materials or used by itself to treat these materials as described in U.S. Patent 6,383,569, herein incorporated by reference. The R_F -monomer can have the general formula R_F -Q-A-C(O)-C(R)=CH₂ wherein R_F is described above, R is H or CH₃, A is O, S, or N(R₁), wherein R₁ is H or an alkyl of from 1 to 4 carbon atoms, Q is alkylene of 1 to about 15 carbon atoms, hydroxyalkylene of 3 to about 15 carbon atoms, --(C_nH_{2n})(OC_qH_{2q})_m-- , -SO₂-NR₁(C_nH_{2n})--, or -CONR₁(C_nH_{2n})--, wherein R₁ is H or an alkyl of 1 to 4 carbon atoms, n is 1 to 15, q is 2 to 4, and m is 1 to 15.

R_F -compositions and mixtures containing the R_F portion can be used to treat substrates including hard surfaces like construction materials such as brick, stone, wood, concrete, ceramics, tile, glass, stucco, gypsum, drywall, particle board, and chipboard. These compositions and mixtures can be used alone or in combination with penetration assistance such as non-ionic surfactants. These compositions can be applied to the surface of calcitic and/or siliceous architectural construction material by known methods, for example, by soaking, impregnation, emersion, brushing, rolling, or spraying. The compositions can be applied to the surface to be protected by spraying. Suitable spraying equipment is commercially available. Spraying with a compressed air sprayer is an exemplary method of application to the particular substrate. U.S. Patents 6,197,382 and 5,674,961 also describe methods for applying and using polymer solutions and are herein incorporated by reference.

In an exemplary process of producing solutions having components with R_F , an R_F -intermediate having a methyl-epoxide functionality may be condensed with a monocarboxylic alkenoic acid to prepare an unsaturated R_F -ester (not shown). Exemplary methods

for producing these kinds of unsaturated esters are described in U.S. Patent 5,798,415, herein incorporated by reference. Additional esters may be prepared according to U.S. Patent 4,478,975, herein incorporated by reference. Components of these solutions can also

5 include dimethyl amino ethyl methacrylate, and these components can be applied in organic and inorganic solvents, as described in U.S. Patent 6,120,892 herein incorporated by reference.

R_F -monomers can also be combined with other monomers to produce copolymers or in solutions with amido and sulfur monomers as

10 described by U.S. Patent 5,629,372 herein incorporated by reference.

R_F -intermediates having amine functionality can also be reacted with tetrachlorophthalic anhydride using U.S. Patent 4,043,923 as an exemplary reaction scheme (not shown). U.S. Patent 4,043,923 is herein incorporated by reference. The reaction product can be mixed

15 with a carpet cleaning solution to provide soil repellency.

In exemplary embodiments urethanes containing a R_FQ_U (R_F -Urethanes) can be prepared from R_F -Intermediates. R_F -Urethanes can include R_F -intermediates above, but may contain functionality that allows for their conjugation with another R_FQ_U

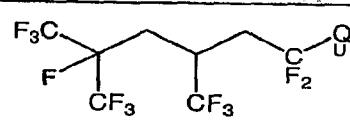
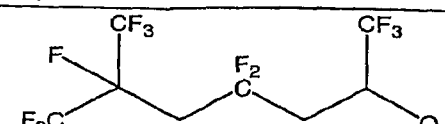
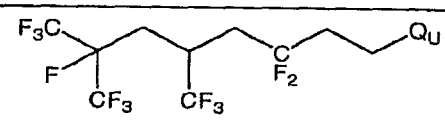
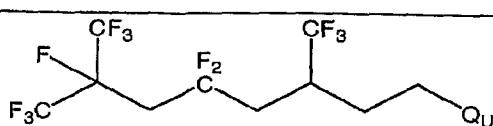
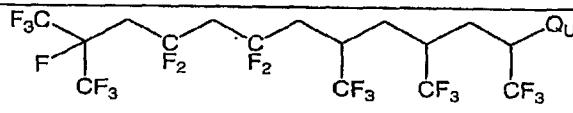
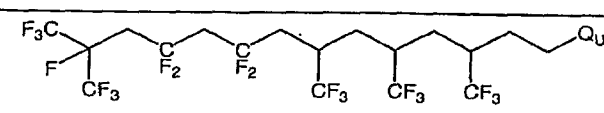
20 compounds, but not necessarily the same R_FQ_U compound. According to exemplary embodiments the R_F portion of the urethane can at least partially include an $R_F(R_T)_n$ portion as described above. The $R_F(R_T)_n$ portion of the urethane can also include the R_S portion described above. In accordance with exemplary implementations the R_S portion

25 can be incorporated to provide additional carbon between the R_F and/or $R_F(R_T)_n$ portions and the Q_U portion of the urethane.

Exemplary R_S portions include $-CH_2-CH_2-$. Urethanes comprising $R_F(R_T)_nQ_U$ are provided. The R_F group can include at least one $-CF_3$ group. The R_T group can include $-CF_2CH_2CH(CF_3)-$, with n being at

30 least 1. The Q_U group can be at least one atom of the periodic table of elements. Exemplary R_F -urethanes, such as R_F-Q_u , can include, but are not limited to those listed in Table 13 below.

Table 13. Exemplary R_F -Urethanes

CLAIMS

1. A surfactant composition comprising $R_F(R_T)_nQ_S$, wherein:
the R_F group comprises at least one $-CF_3$ group;
the R_T group comprises $-CF_2CH_2CH(CF_3)-$;
5 n is at least one; and
the Q_S group is at least one atom of the periodic table of
elements, wherein at least a portion of the R_F and R_T groups are
hydrophobic relative to the Q_S group, and at least a portion of the Q_S
group is hydrophilic relative to the R_F and R_T groups.
- 10 2. The surfactant of claim 1 wherein the R_F group is one of $-C_3F_6$
or $-C_3F_7$.
3. The surfactant of claim 1 wherein the R_T group comprises
 $-CH_2CF_2CH_2CH(CF_3)-$.
4. The surfactant of claim 1 wherein the R_T group comprises
15 $-CF_2CH_2CF_2CH_2CH(CF_3)-$.
5. The surfactant of claim 1 wherein the R_T group comprises
 $-CH_2CF_2CH_2CF_2CH_2CH(CF_3)-$.
6. The surfactant of claim 1 wherein the R_T group comprises
 $-CF_2CH_2CH(CF_3)CH_2-$.
- 20 7. The surfactant of claim 1 wherein the R_T group comprises
 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)-$.
8. The surfactant of claim 1 wherein the R_T group comprises
 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2-$.
9. The surfactant of claim 1 wherein the R_T group comprises
25 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)-$.

10. A foam stabilizer composition comprising $R_F(R_T)_nQ_{FS}$, wherein:
the R_F group comprises at least one $-CF_3$ group;
the R_T group comprises $-CF_2CH_2CH(CF_3)-$;
n is at least 1; and
5 the Q_{FS} group is at least one atom of the periodic table of
elements, wherein at least a portion of the R_F and R_T groups are
hydrophobic relative to the Q_{FS} group, and at least a portion of the Q_{FS}
group is hydrophilic relative to the R_F and R_T groups.
11. The foam stabilizer of claim 10 wherein the R_F group is one of
10 $-C_3F_6$ or $-C_3F_7$.
12. The foam stabilizer of claim 10 wherein the R_T group comprises
 $-CH_2CF_2CH_2CH(CF_3)-$.
13. The foam stabilizer of claim 10 wherein the R_T group comprises
 $-CF_2CH_2CF_2CH_2CH(CF_3)-$.
- 15 14. The foam stabilizer of claim 10 wherein the R_T group comprises
 $-CH_2CF_2CH_2CF_2CH_2CH(CF_3)-$.
15. The foam stabilizer of claim 10 wherein the R_T group comprises
 $-CF_2CH_2CH(CF_3)CH_2-$.
16. The foam stabilizer of claim 10 wherein the R_T group comprises
20 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)-$.
17. The foam stabilizer of claim 10 wherein the R_T group comprises
 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2-$.
18. The foam stabilizer of claim 10 wherein the R_T group comprises
 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)-$.

19. A monomer comprising $R_F(R_T)_nQ_M$ wherein:
the R_F group comprises at least one $-CF_3$ group;
the R_T group comprises $-CF_2CH_2CH(CF_3)-$;
 n is at least 1; and
5 the Q_M group is at least one atom of the periodic table of elements.
20. The monomer of claim 19 wherein the R_F group is one of $-C_3F_6$ or $-C_3F_7$.
21. The monomer of claim 19 wherein the R_T group comprises
10 $-CH_2CF_2CH_2CH(CF_3)-$.
22. The monomer of claim 19 wherein the R_T group comprises $-CF_2CH_2CF_2CH_2CH(CF_3)-$.
23. The monomer of claim 19 wherein the R_T group comprises $-CH_2CF_2CH_2CF_2CH_2CH(CF_3)-$.
- 15 24. The monomer of claim 19 wherein the R_T group comprises $-CF_2CH_2CH(CF_3)CH_2-$.
25. The monomer of claim 19 wherein the R_T group comprises $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)-$.
26. The monomer of claim 19 wherein the R_T group comprises
20 $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2-$.
27. The monomer of claim 19 wherein the R_T group comprises $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)-$.
28. A polymer comprising $R_F(R_T)_nQ_{MU}$, wherein:
the R_F group comprises at least one $-CF_3$ group;
25 the R_T group comprises $-CF_2CH_2CH(CF_3)-$;
 n is at least 1; and
the Q_{MU} group is a portion of a polymer chain backbone.

29. The polymer of claim 28 wherein the R_F group is one of $-C_3F_6$ or $-C_3F_7$.
30. The polymer of claim 28 wherein the R_T group comprises $-CH_2CF_2CH_2CH(CF_3)-$.
- 5 31. The polymer of claim 28 wherein the R_T group comprises $-CF_2CH_2CF_2CH_2CH(CF_3)-$.
32. The polymer of claim 28 wherein the R_T group comprises $-CH_2CF_2CH_2CF_2CH_2CH(CF_3)-$.
33. The polymer of claim 28 wherein the R_T group comprises
10 $-CF_2CH_2CH(CF_3)CH_2-$.
34. The polymer of claim 28 wherein the R_T group comprises $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)-$.
35. The polymer of claim 28 wherein the R_T group comprises $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2-$.
- 15 36. The polymer of claim 28 wherein the R_T group comprises $-CF_2CH_2CH(CF_3)CH_2CH(CF_3)CH_2CH(CF_3)-$.
37. A urethane comprising $R_F(R_T)_nQ_U$, wherein:
the R_F group comprises at least one $-CF_3$ group;
the R_T group comprises $-CF_2CH_2CH(CF_3)-$;
20 n is at least 1; and
the Q_U group is at least one atom of the periodic table of elements.
38. The urethane of claim 37 wherein the R_F group is one of $-C_3F_6$ or $-C_3F_7$.
- 25 39. The urethane of claim 37 wherein the R_T group comprises $-CH_2CF_2CH_2CH(CF_3)-$.

40. The urethane of claim 37 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.
41. The urethane of claim 37 wherein the R_T group comprises $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.
- 5 42. The urethane of claim 37 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.
43. The urethane of claim 37 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.
44. The urethane of claim 37 wherein the R_T group comprises
10 $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.
45. The urethane of claim 37 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.
46. A glycol comprising $R_F(R_T)_nQ_H$, wherein:
the R_F group comprises at least one $-\text{CF}_3$ group;
15 the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$;
n is at least 1; and
the Q_H group is a portion of a glycol chain backbone.
47. The glycol of claim 46 wherein the R_F group is one of $-\text{C}_3\text{F}_6$ or $-\text{C}_3\text{F}_7$.
- 20 48. The glycol of claim 46 wherein the R_T group comprises $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.
49. The glycol of claim 46 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.
50. The glycol of claim 46 wherein the R_T group comprises
25 $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.
51. The glycol of claim 46 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.

52. The glycol of claim 46 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.

53. The glycol of claim 46 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.

5 54. The glycol of claim 46 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.

55. A metal complex comprising $R_F(R_T)_nQ_{MC}$, wherein:
the R_F group comprises at least one $-\text{CF}_3$ group;
the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$;
10 n is at least 1; and
the Q_{MC} group comprises a charged group configured to complex one or more metal ions.

56. The metal complex of claim 55 wherein the R_F group is one of $-\text{C}_3\text{F}_6$ or $-\text{C}_3\text{F}_7$.

15 57. The metal complex of claim 55 wherein the R_T group comprises $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.

58. The metal complex of claim 55 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.

59. The metal complex of claim 55 wherein the R_T group comprises
20 $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.

60. The metal complex of claim 55 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.

61. The metal complex of claim 55 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.

25 62. The metal complex of claim 55 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.

63. The metal complex of claim 55 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.

64. A phosphate ester composition comprising $R_F(R_T)_nQ_{PE}$, wherein:
the R_F group comprises at least two $-\text{CF}_3$ groups;
5 the R_T group comprises a group having at least two carbons;
 n is at least 1; and
the Q_{PE} group is a portion of a phosphate ester.

65. The phosphate ester of claim 64 wherein the R_F group is one of $-\text{C}_3\text{F}_6$ or $-\text{C}_3\text{F}_7$.

10 66. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.

67. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.

15 68. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)-$.

69. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.

70. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.

20 71. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2-$.

72. The phosphate ester of claim 64 wherein the R_T group comprises $-\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)-$.

73. A composition comprising $R_F(R_T)_nQ_g$, wherein:

the R_F group has a carbon amount greater than C5 and at least one terminal and at least one pendant $-CX_3$ group, with X being one or both of H and F;

5 the R_T group comprises $-CH_2CX_2-$;

n is greater than 1; and

the Q_g group is at least one atom of the periodic table of elements.

10 74. The composition of claim 73 wherein the R_F group has a carbon amount between C5 and C17.

75. The composition of claim 73 wherein the R_T group comprises $-CH_2CH_2-$.

76. The composition of claim 73 wherein the R_T group comprises $-CH_2CF_2-$.

15 77. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CH(CF_3)-$.

78. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2C(CF_3)HCH_2-$.

20 79. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2C(CF_3)HCH_2CF_2-$.

80. The composition of claim 73 wherein the R_F group comprises $(CF_3)_3CCH_2C(CF_3)H-$.

81. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2-$.

25 82. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2-$.

83. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2CF_2-$.

84. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2-$.

85. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)H-$.

5 86. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)HCH_2C(CF_3)H-$.

87. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)HCH_2C(CF_3)H-$.

10 88. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CFCH_2CF_2CH_2CF_2CH_2C(CF_3)HCH_2C(CF_3)HCH_2C(CF_3)H-$.

89. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CF(CH_2CF_2)_l-$, l being from 1 to 2.

90. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CF(CH_2C(CF_3)H)_m-$, m being from 1 to 3.

15 91. The composition of claim 73 wherein the R_F group comprises $(CF_3)_2CF(CH_2CF_2)_l(CH_2C(CF_3)H)_m-$, l being from 1 to 2 and m being from 1 to 3.

20 92. A telomerization process comprising exposing a taxogen to a telogen to form a telomer, the taxogen being one of or more of VDF, TFP, and ethylene, and the telogen comprises one of $C_3F_6(R_T)_nX$ or $C_3F_7(R_T)_nX$, wherein X is a halogen, R_T is one or both of $-CH_2CF_2-$ and $-CH_2C(CF_3)H-$, and n is 1 to 4.

93. The telomerization process of claim 92 wherein the taxogen is VDF and the telogen is $(CF_3)_2CFCH_2CH(CF_3)I$.

25 94. The telomerization process of claim 92 wherein the taxogen is TFP and the telogen is $(CF_3)_2CFCH_2CF_2I$.

95. The telomerization process of claim 92 wherein the taxogen is TFP and the telogen is $(\text{CF}_3)_2\text{CFCH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{I}$.

96. The telomerization process of claim 92 wherein the taxogen is TFP and the telogen is $(\text{CF}_3)_2\text{CFCH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{I}$.

5 97. The telomerization process of claim 92 wherein the taxogen is TFP and the telogen is $(\text{CF}_3)_2\text{CFCH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{I}$.

98. The telomerization process of claim 92 wherein the taxogen is ethylene and the telogen is

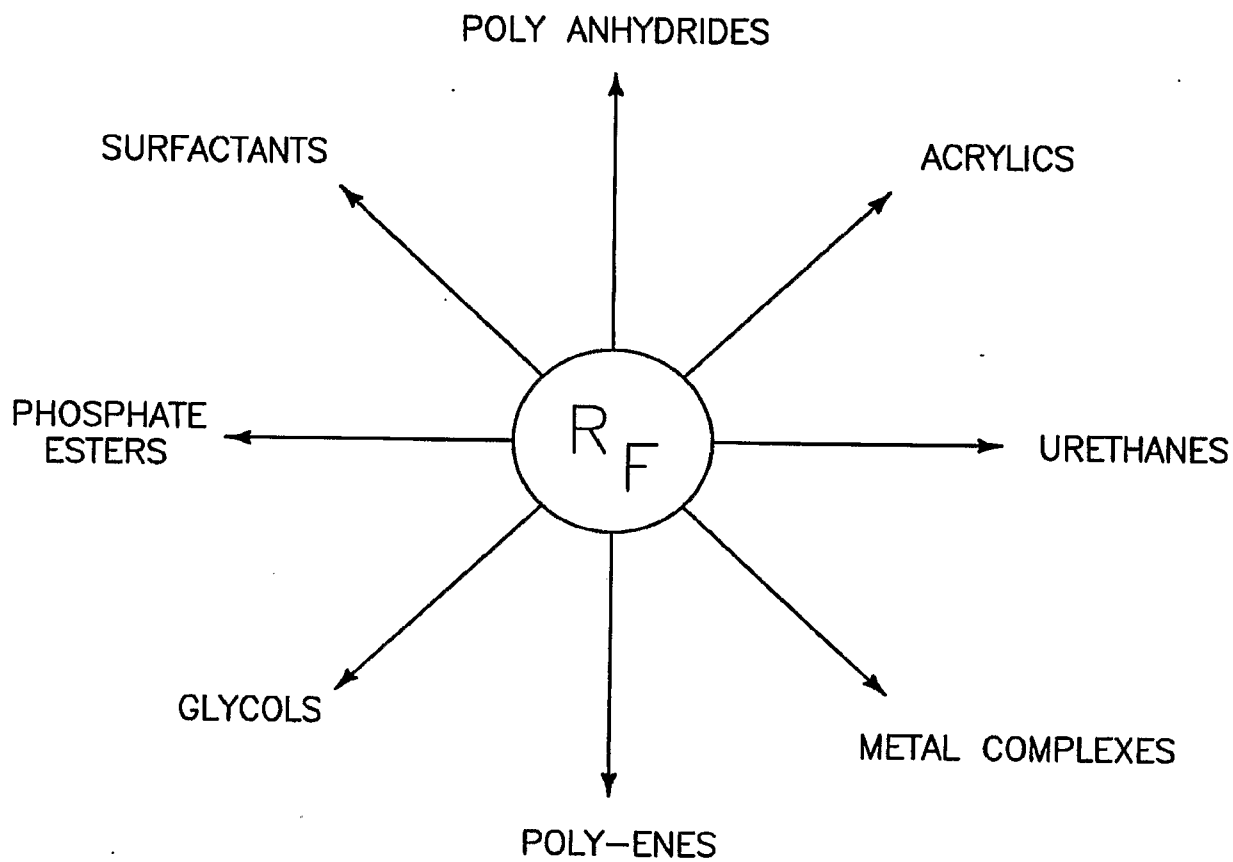
10 $(\text{CF}_3)_2\text{CFCH}_2\text{CF}_2\text{CH}_2\text{CF}_2\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{CH}_2\text{CH}(\text{CF}_3)\text{I}$.

99. The telomerization process of claim 92 wherein the taxogen is ethylene and the telogen is $(\text{CF}_3)_3\text{CCH}_2\text{CH}(\text{CF}_3)\text{I}$.

100. A telomerization process comprising exposing a taxogen to a telogen to form a telomer, the taxogen comprising an olefin having
15 greater than two carbon atoms, and the telogen comprising at least five carbon atoms and having at least two $-\text{CF}_3$ groups.

101. The telomerization process of claim 100 wherein the taxogen is one of ethylene, VDF, TFP, VDF, 4,5,5,5-tetrafluoro-4-(trifluoromethyl)pent-1-ene and/or 6,7,7,7-tetrafluoro-6-
20 (trifluoromethyl)hept-1-ene.

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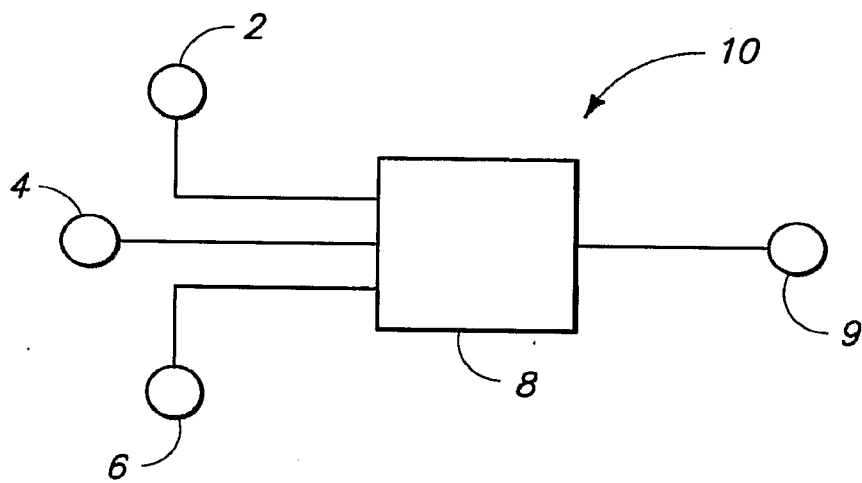


FIG. 2