

(II)

wherein R^3, R^4, R^5, R^6 R^7, R^8, R^9 and R^{10} are independently X or, $-CX_3$;

X is halogen;

n is an integer of at least 1;

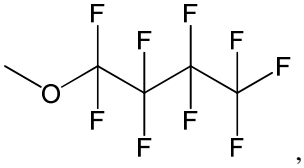
m, p and q are independently 0 or an integer of at least 1; and

represents where formula (II) attaches to formula (I).

In an aspect, there is provided a composition comprising:

a dimethyl carbonate; and

a compound selected from the group consisting of:



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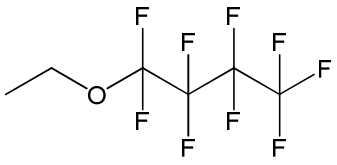

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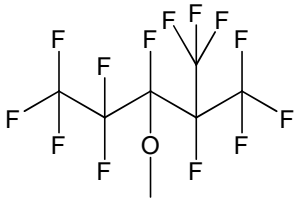

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Advantageously, the composition comprises a compound having formula (I). The compound having formula (I) is a hydrofluoroether. Fluorinated solvents derived from hydrofluoroethers, hydrofluoro olefins, and perfluoro ketones are recently considered to be environmentally benign and are therefore recommended to be used for above purposes.

Further advantageously, hydrofluoroethers of formula (I) are considered to be non-VOC, environmentally benign solvents. Advantageously, it may be used in many applications in precision cleaning, formulations, aerosols and as a solvent for lubricants. More advantageously, it forms azeotropic compositions with various hydrocarbon, alcoholic and chlorinated solvents, whereby the azeotrope increases the solvency of the hydrofluoroethers. The hydrofluorether of formula (I) may be a Novec™ hydrofluoroether.

Advantageously, the composition comprises dialkyl carbonate or a cyclic carbonate. Dialkyl carbonates such as dimethyl carbonate has recently been recognised as a VOC exempted solvent by the United States Environmental Protection Agency (US EPA) due to favourable environmental properties. It has been recommended as an alternative to hazardous Methyl Ethyl Ketone (MEK) and amine-based solvents. Advantageously, dialkyl carbonates such as dimethyl

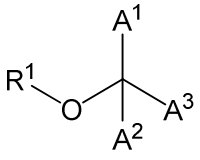
carbonate exhibits good solvency both in terms of polarity and hydrogen-bonding, which makes it a more versatile solvent. Moreover, it is an aprotic solvent having low odour, low skin irritation and a 200 ppm exposure limit.

Advantageously, the composition comprising a hydrofluoroether and a dialkyl carbonate or cyclic carbonate may be an azeotrope.

There is provided a method for synthesizing a composition comprising:

a dialkyl carbonate or a cyclic carbonate; and

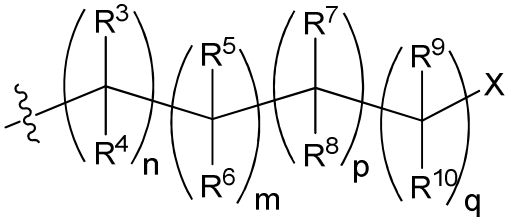
a compound having the following formula (I):


(I),

the method comprising the step of contacting the dialkyl carbonate with the compound having formula (I),

wherein R^1 is selected from the group consisting of alkyl, alkenyl and alkynyl; and

A^1, A^2 and A^3 are independently X or have the following formula (II):


(II)

wherein R^3, R^4, R^5, R^6, R^7, R^8, R^9 and R^{10} are independently X or, $-CX_3$;

X is halogen;

n is an integer of at least 1;

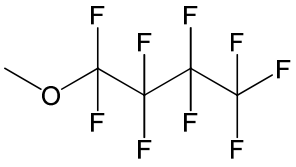
m, p and q are independently 0 or an integer of at least 1; and

~~~ represents where formula (II) attaches to formula (I),

In another aspect, there is provided a method for synthesizing a composition comprising:

a dimethyl carbonate; and

a compound selected from the group consisting of: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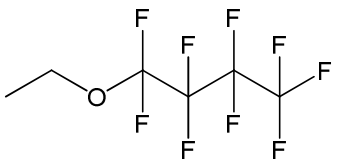
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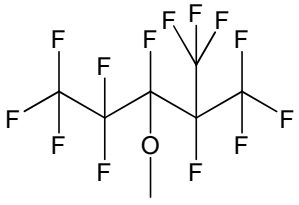
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the method comprising the step of contacting the dimethyl carbonate with the compound selected from the group consisting of:
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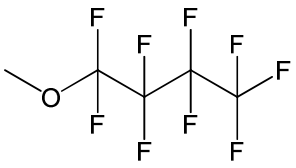

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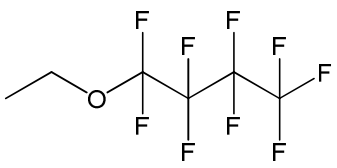

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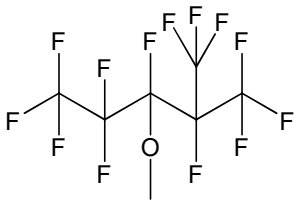

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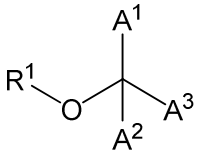
There is provided the use of a composition comprising:

a dialkyl carbonate or a cyclic carbonate; and

a compound having the following formula (I):

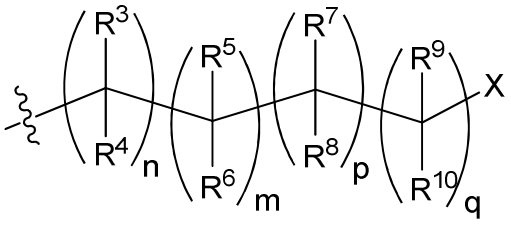


(I),

as a solvent,

wherein R^1 is selected from the group consisting of alkyl, alkenyl and alkynyl; and

A^1, A^2 and A^3 are independently X or have the following formula (II):



(II)

wherein R^3, R^4, R^5, R^6 R^7, R^8, R^9 and R^{10} are independently X or, $-CX_3$;

X is halogen;

n is an integer of at least 1;

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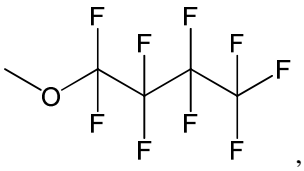
In another aspect, there is provided the use of a composition comprising:

a dimethyl carbonate; and

a compound selected from the group consisting of:



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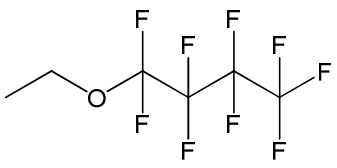

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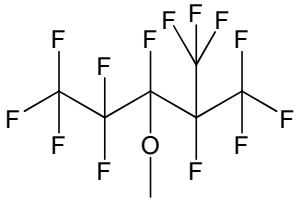

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Advantageously, the solvent may be an azeotrope.

Definitions

The following words and terms used herein shall have the meaning indicated:

"Alkyl" as a group or part of a group refers to a straight or branched aliphatic hydrocarbon group, preferably a C_1–C_{50} alkyl, preferably a C_1–C_{12} alkyl, more preferably a C_1-C_{10} alkyl, most preferably C_1-C_6 unless otherwise noted. Examples of suitable straight and branched C_1-C_6 alkyl substituents include methyl, ethyl, n-propyl, 2-propyl, n-butyl, sec-butyl, t-butyl, hexyl, and the like. The group may be a terminal group or a bridging group.

"Alkenyl" as a group or part of a group denotes an aliphatic hydrocarbon group containing at least one carbon-carbon double bond and which may be straight or branched preferably having 2-12 carbon atoms, more preferably 2-10 carbon atoms, most preferably 2-6 carbon atoms, in the normal chain. The group may contain a plurality of double bonds in the normal chain and the orientation about each is independently E or Z. Exemplary alkenyl groups include, but are
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not limited to, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl and nonenyl. The group may be a terminal group or a bridging group.

"Alkynyl" as a group or part of a group means an aliphatic hydrocarbon group containing a carbon-carbon triple bond and which may be straight or branched preferably having from 2-12 carbon atoms, more preferably 2-10 carbon atoms, more preferably 2-6 carbon atoms in the normal chain. Exemplary structures include, but are not limited to, ethynyl and propynyl. The group may be a terminal group or a bridging group.

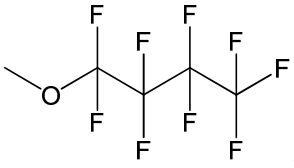
"Alkyloxy" refers to an alkyl group as defined herein that is singularly bonded to oxygen. The group may be a terminal group or a bridging group. If the group is a terminal group, it is bonded to the remainder of the molecule through the alkyl group.

Claims

1. A composition comprising:

   a dimethyl carbonate; and

   a compound selected from the group consisting of: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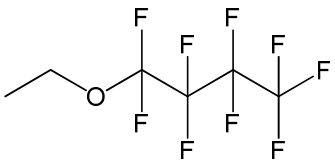
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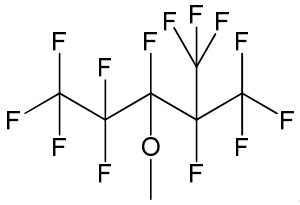
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2. The composition according to claim 1, wherein the dimethyl carbonate is present at a range of 0.1 to 15% w/w, wherein the composition has a total % w/w of 100%.

3. The composition according to claim 1 or 2, wherein the dimethyl carbonate is present at a range of 6 to 10% w/w, wherein the composition has a total %w/w of 100%.

4. The composition according to any one of the preceding claims, wherein the composition is an azeotrope.

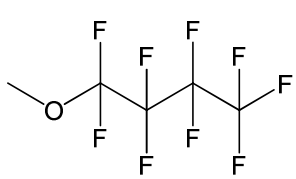
5. The composition according to any one of the preceding claims, comprising a further solvent.

6. The composition according to claim 5, wherein the further solvent is trans-1,2-dichloroethene.

7. A method for synthesizing a composition comprising:

   a dimethyl carbonate; and

   a compound selected from the group consisting of: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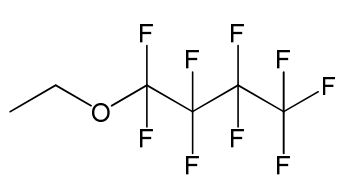
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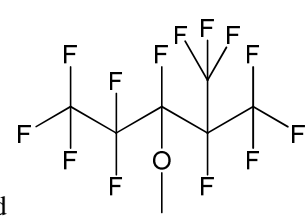
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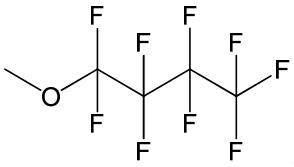
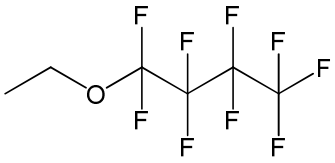
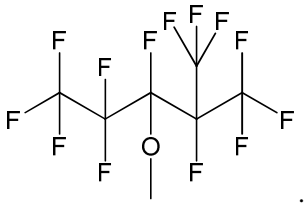
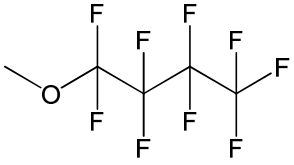
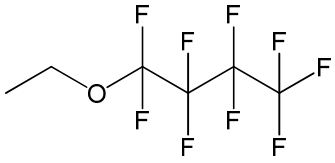
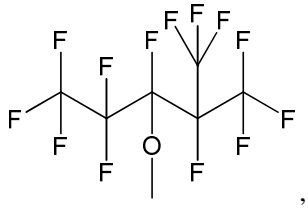
   the method comprising the step of contacting the dimethyl carbonate with the compound selected from the group consisting of:

 ,  and  .

8. The method according to claim 7, wherein the contacting step comprises refluxing the dimethyl carbonate and the compound selected from the group consisting of:

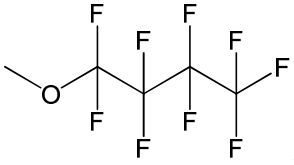
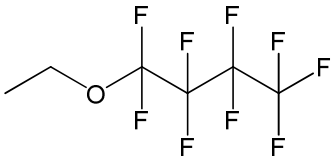
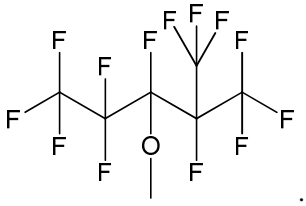
 ,  and  ,

for a duration in the range of about 15 minutes to about 45 minutes.

9. Use of a composition comprising:

a dimethyl carbonate; and

a compound selected from the group consisting of:

 ,  and  .

10. The use according to claim 9, wherein the composition is an azeotrope.

11. The use according to claim 9 or 10, wherein the composition is used as a solvent for disc lubricant.

12. The use according to claim 9 or 10, wherein the composition is used as a coating, or aerosol, or in cleaning, rinsing or drying of a substrate.