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(54) **Titre : DEMOUSSAGE DE LIQUIDES IONIQUES**
(54) **Title: DEFOAMING OF IONIC LIQUIDS**

(57) **Abrégé/Abstract:**

The invention relates to the defoaming of ionic liquids and also to compositions comprising at least one ionic liquid and at least one antifoam and, if appropriate, a solvent and/or further auxiliaries or additives.



Abstract:

The invention relates to the defoaming of ionic liquids
and also to compositions comprising at least one ionic
5 liquid and at least one antifoam and, if appropriate, a
solvent and/or further auxiliaries or additives.

E v o n i k G o l d s c h m i d t GmbH, Essen

Defoaming of ionic liquids

Prior Art:

Ionic liquids are used and have been proposed for numerous applications in which gases, in particular air or nitrogen and other industrial gases, and also, for example, steam are introduced under shear. This results in foam formation which in many cases has adverse effects on the application (e.g. material wear due to increased friction).

Object of the Invention:

It is therefore an object of the invention to defoam ionic liquids effectively and thus make them universally and lastingly useable in applications in which gas can be introduced under shear.

These are, in particular, applications in which the ionic liquids are used as lubricating or hydraulic fluid and the optionally dissolved gases introduced lead to a decrease, in any case worsening, of the (lubricating) properties inherent in the process.

Systems in which ionic liquids themselves are used only in small amounts, e.g. in coatings or pastes/surface coatings, are expressly excluded since here foam formation is not caused by the ionic liquid.

- 2 -

Ionic liquids are salts in general which melt at low temperatures ($< 100^{\circ}\text{C}$) and represent a new class of liquids which are made up exclusively of ions. In contrast to classical salt melts, which are high-melting, highly viscous and very corrosive media, ionic liquids are liquid and have a relatively low viscosity even at low temperatures (K.R. Seddon J. Chem. Technol. Biotechnol. 1997, 68, 351-356). They also differ, in particular, from water since they have a completely ionic structure.

It has now surprisingly been found that antifoams which are used for avoiding and destroying foam in aqueous systems solve the problem.

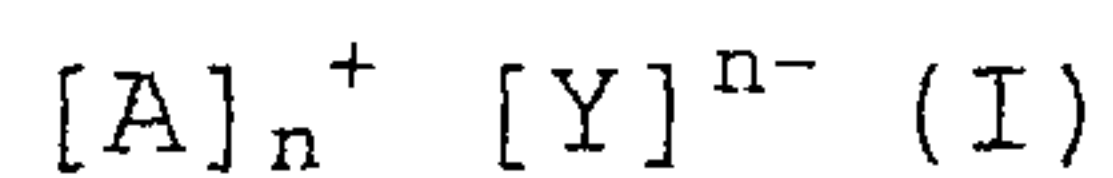
This is particularly surprising since water is not a liquid having pronounced ionic character. All the more surprising was the discovery that particularly antifoams which have been developed for defoaming of surfactant-stabilized aqueous (non-ionic) systems also have a good antifoaming effect in water-free (or low-water) high-grade ionic liquids and thus achieve the object of the invention.

The present invention provides a method of defoaming a composition containing at least 80% by weight of one or more ionic liquids, the composition being free of ketone residues, ketone-aldehyde resins, and/or urea-aldehyde resins and/or their hydrogenated derivatives, the method comprising:

adding a polyether siloxane antifoam to said composition.

- 2a -

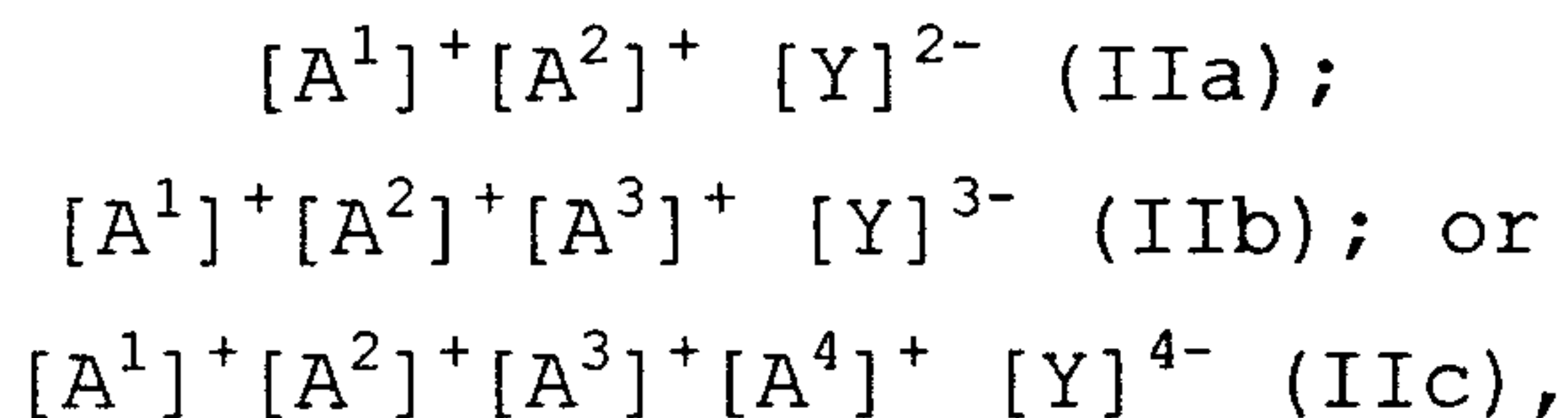
For the purposes of the present invention, ionic liquids are salts of the general formulae I, II, or III:



5

where n is 1, 2, 3 or 4, $[A]^+$ is a quaternary ammonium cation, an oxonium cation, a sulphonium cation or a phosphonium cation and $[Y]^{n-}$ is a monovalent, divalent, trivalent or tetravalent anion; or

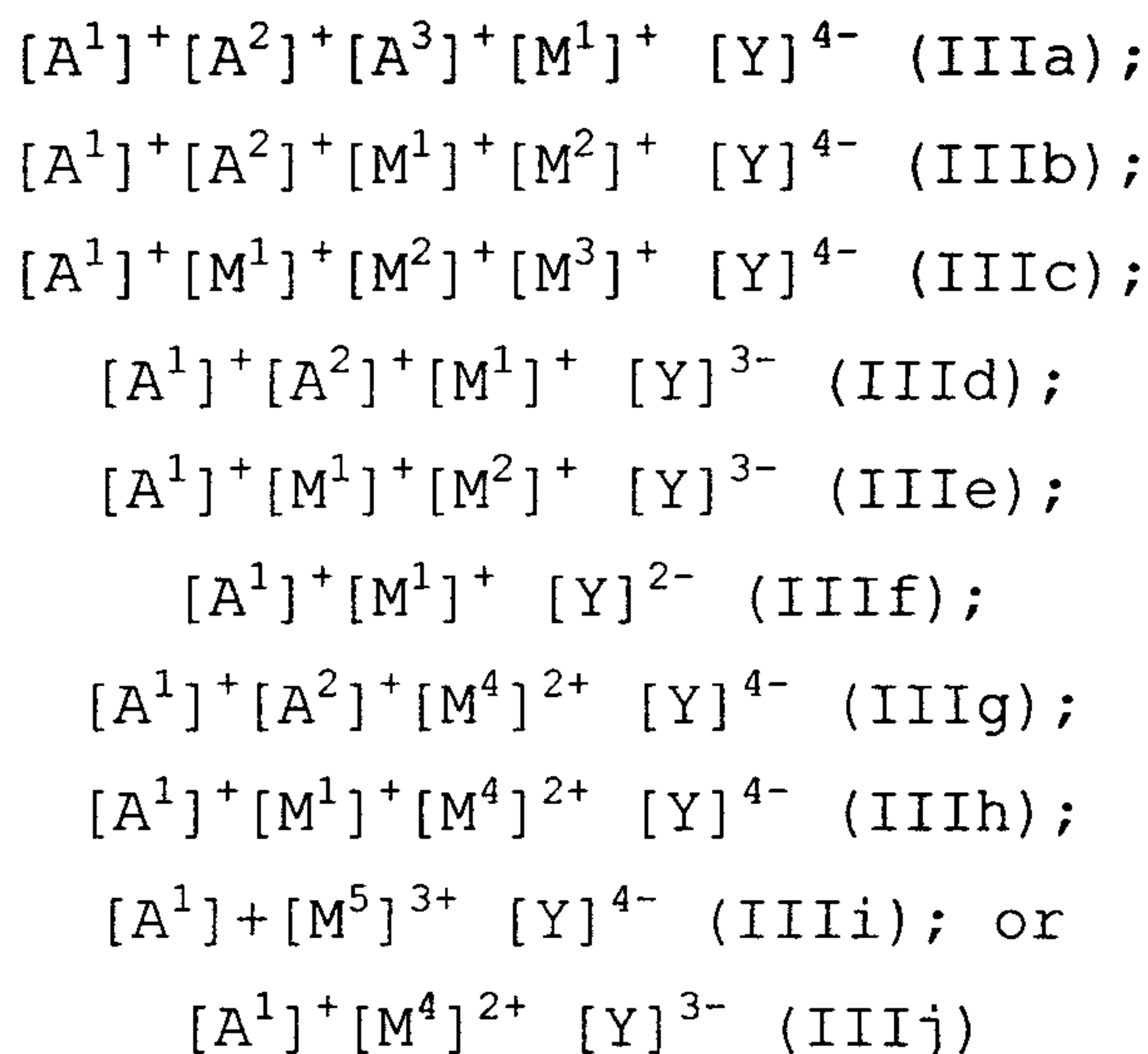
10 mixed salts of the general formulae (II)



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where $[A^1]^+$, $[A^2]^+$, $[A^3]^+$ and $[A^4]^+$ are selected independently from the groups mentioned for $[A]^+$ and $[Y]^{n-}$ is as defined in formula (I); or mixed salts of the general formulae (III)

10



15

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where $[A^1]^+$, $[A^2]^+$ and $[A^3]^+$ are selected independently from the groups mentioned for $[A]^+$, $[Y]^{n-}$ is as defined for formula I and $[M^1]^+$, $[M^2]^+$, $[M^3]^+$ are monovalent metal cations, $[M^4]^{2+}$ is a divalent metal cation and $[M^5]^{3+}$ is a trivalent metal cation; or mixtures of all formulae (I)-(III) which are free of ketone resins, ketone-aldehyde resins and/or urea-aldehyde resins and/or their hydrogenated derivatives.

25

30

Ionic liquids comprise, for example, anions such as halides, carboxylates, phosphates, thiocyanates, isothiocyanates, dicyanamides, sulphates, alkylsulphates,

5 sulphonates, alkylsulphonates, tetrafluoroborate, hexafluorophosphate or bis(trifluoromethylsulphonyl)imide combined with, for example, substituted ammonium, phosphonium, pyridinium or imidazolium cations, with the abovementioned anions and cations representing a small selection from among the large number of possible anions and cations and no claim as to completeness being made and no restriction being imposed.

10 The ionic liquids used according to the invention are preferably composed of a quaternary nitrogen and/or phosphorus compound and/or sulphur compound and at least one anion and their melting point is below about + 250°C, preferably below about + 150°C, in particular below about
15 + 100°C. Furthermore, they are free of ketone resins, ketone-aldehyde resins and/or urea-aldehyde resins and/or their hydrogenated derivatives. The ionic liquids or mixtures thereof used according to the invention are particularly preferably liquid at room temperature.

20

The compositions according to the invention contain from 80 to 99.999% by weight, preferably from 90 to 99.999% by weight, in particular at least 95% by weight and particularly preferably from > 98 to 99.999% by weight,
25 of one or more ionic liquids, and from 0 to 20% by weight, preferably from 0 to 10% by weight and particularly preferably from 0 to 5% by weight, of solvents, and from 0 to 20% by weight, preferably from 0 to 10% by
30 weight and particularly preferably from 0 to 5% by weight, of auxiliaries and additives, and from 0.001 to 10% by weight, preferably from 0.001 to 5% by weight and particularly preferably from 0.05 to 1%

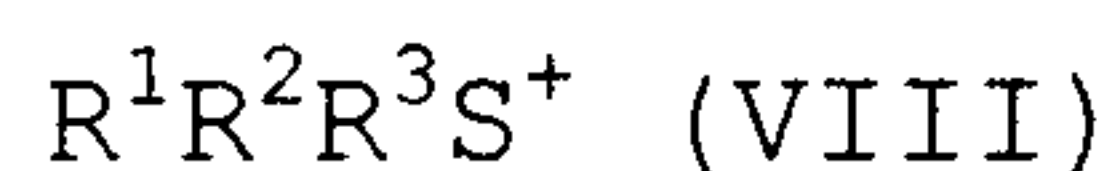
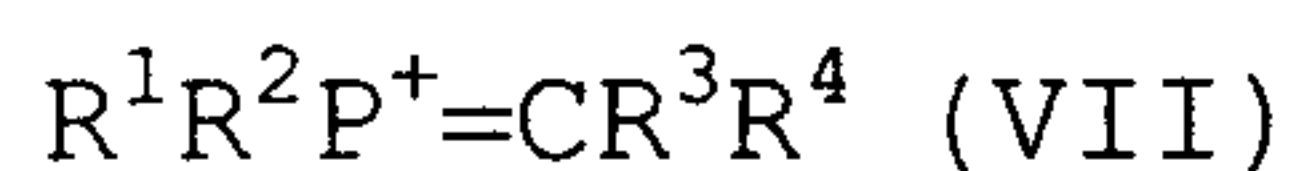
by weight, of one or more antifoams according to the invention,

where the sum of all components of the composition adds up to 100% by weight.

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The ionic liquids which are preferably used for the purposes of the invention can, for example, comprise at least one cation of the general formulae:

10



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where R^1 , R^2 , R^3 , R^4 are identical or different and are each hydrogen, a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms and may contain double bonds, a cycloaliphatic hydrocarbon radical which has from 5 to 40 carbon atoms and may contain double bonds, an aromatic hydrocarbon radical having from 6 to 40 carbon atoms, an alkylaryl radical having from 7 to 40 carbon atoms, a linear or branched aliphatic hydrocarbon radical which has from 2 to 30 carbon atoms, is interrupted by one or more heteroatoms (oxygen, NH, NR' where R' is a C_1 - C_{30} -alkyl radical which may contain double bonds, in particular $-CH_3$) and may contain double bonds, a linear or branched aliphatic hydrocarbon radical which has from 2 to 30 carbon atoms, is interrupted by one or more functions selected from the group consisting of $-O-C(O)-$, $-(O)C-O-$, $-NH-C(O)-$, $-(O)C-NH$, $-(CH_3)N-C(O)-$, $-(O)C-N(CH_3)-$, $-S(O_2)-O-$, $-O-S(O_2)-$, $-S(O_2)-NH-$, $-NH-S(O_2)-$, $-S(O_2)-N(CH_3)-$,

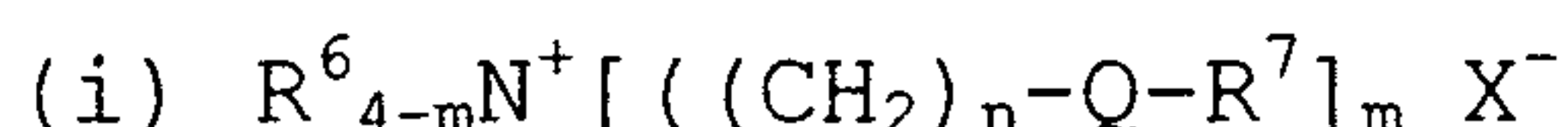
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-N(CH₃)-S(O₂)- and may contain double bonds, a linear or branched aliphatic or cycloaliphatic hydrocarbon radical which has from 1 to 30 carbon atoms, is terminally functionalized by OH, OR', NH₂, N(H)R', N(R')₂ (where R' is a C₁-C₃₀-alkyl radical which may contain double bonds) and may contain double bonds or a polyether of the formula -(R⁵-O)_n-R⁶ having a block or random structure, where R⁵ is a linear or branched hydrocarbon radical having from 2 to 4 carbon atoms, n is from 1 to 100, preferably from 2 to 60, and R⁶ is hydrogen, a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms and may contain double bonds, a cycloaliphatic hydrocarbon radical which has from 5 to 40 carbon atoms and may contain double bonds, an aromatic hydrocarbon radical having from 6 to 40 carbon atoms, an alkylaryl radical having from 7 to 40 carbon atoms or a -C(O)-R⁷ radical where R⁷ is a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms and may contain double bonds, a cycloaliphatic hydrocarbon radical which has from 5 to 40 carbon atoms and may contain double bonds, an aromatic hydrocarbon radical having from 6 to 40 carbon atoms or an alkylaryl radical having from 7 to 40 carbon atoms.

Preference is given to quaternary ammonium salts of alkoxylated fatty acids, also referred to as alkanolamine ester quats, characterized by the general formula of the type R¹R²R³R⁴N⁺ A⁻ (IV) where R¹ is an alkyl radical having from 1 to 20 carbon atoms, R² is an alkyl radical having from 1 to 4 carbon atoms, R³ is a (CH₂CHRO)_n-H radical where n is from 1 to 200 and R is H or CH₃, R⁴ is an alkyl radical having from 1 to 4 carbon atoms or a

$(\text{CH}_2\text{CHRO})_n\text{-H}$ radical where n is from 1 to 200 and R is H or CH_3 and A^- is a monovalent anion.

Among these compounds, preference is given to substances
5 of the formula



where: each radical R^6 is independently an alkyl group or
10 hydroxyalkyl group having from 1 to 6 carbon atoms or a benzyl group, preferably a methyl group; each radical R^7 is independently hydrogen, a linear or branched alkyl group having from 11 to 22 carbon atoms, a linear or branched alkenyl group having from 11 to 22 carbon atoms,
15 with the proviso that at least one radical R^7 is not hydrogen;

Q is selected independently from the groups of the formulae $-\text{O}-\text{C}(=\text{O})-$, $-\text{C}(=\text{O})\text{O}-$, $-\text{NR}^8-\text{C}(=\text{O})-$, $-\text{C}(=\text{O})-\text{NR}^8-$, $-\text{O}-\text{C}(=\text{O})-\text{O}-$, $-\text{CHR}^9-\text{O}-\text{C}(=\text{O})-$ or $-\text{CH}(\text{OCOR}^7)-\text{CH}_2-\text{O}-\text{C}(=\text{O})-$, where
20 R^8 is hydrogen, methyl, ethyl, propyl or butyl and R^9 is hydrogen or methyl, and Q is preferably $-\text{O}-\text{C}(=\text{O})-$ or $-\text{NH}-\text{C}(=\text{O})-$; m is from 1 to 4 and preferably 2 or 3; n is from 1 to 4 and preferably 2; and X is an anion compatible with plasticizers, e.g. chloride, bromide,
25 methylsulphate, ethylsulphate, sulphate or nitrate, preferably chloride or methylsulphate. The quaternary ammonium compounds can contain mixtures of compounds having different groups R^7 which are not hydrogen and whose valency ranges from 1 to m . Such mixtures
30 preferably have an average of from 1.2 to 2.5 groups R^7 which are not hydrogen. The proportion of groups R^7 which are not hydrogen is preferably from 1.4 to 2.0 and more preferably from 1.6 to 1.9.

The preferred quaternary ammonium compounds are the compounds of the type:

- 5 (ii) $R^6N^+[CH_2CHR^9OH-][CH_2CHR^9OC(O)R^7]_2 X^-$
(iii) $R^6N^+[CH_2CHR^9OC(O)R^7]_2 X^-$
(iv) $R^6N^+[CH_2CHR^9OH-][CH_2CH_2NHC(O)R^7]_2 X^-$,

where R^6 , R^7 and X are as defined above for formula (i),
10 with the proviso that R^7 is not hydrogen.

The fragment $-C(O)R^7$ is preferably a fatty acyl group. Fatty acyl groups are derived from the natural sources of triglycerides, preferably tallow, vegetable oils, partially hydrogenated tallow and partially hydrogenated
15 vegetable oils. Useable sources of triglycerides are soybean oil, tallow, partially hydrogenated tallow, palm oil, palm kernels, rapeseeds, lard, coconut, rape, safflower oil, maize, rice and tall oil and mixtures of these components.

20

A person skilled in the art will know that the composition of the fatty acid-containing compounds is subject to some natural fluctuations depending on conditions from harvest to harvest or on the multiplicity
25 of sources of vegetable oil. The R^7 groups are usually mixtures of linear and branched carbon chains of saturated and unsaturated aliphatic fatty acids. The proportion of unsaturated groups R^7 in such mixtures is preferably at least 10%, particularly preferably at least
30 25% and very particularly preferably from 40% to 70%. The proportion of multiply unsaturated groups R^7 in such mixtures is less than 10%, preferably less than 5% and particularly preferably less than 3%. If necessary, a

partial hydrogenation can be carried out to increase the saturated character and thus improve the stability (e.g. odour, colour, etc.) of the end product. The content of unsaturated material, expressed by the iodine number, should be in the range from 5 to 150 and preferably in the range from 5 to 50. The ratio of cis and trans isomers of the double bonds in the unsaturated groups R⁷ is preferably greater than 1:1 and particularly preferably in the range from 4:1 to 50:1.

10

Preferred examples of compounds of formula (i) are:

N,N-di(tallowyloxyethyl)-N,N-dimethylammonium chloride;

N,N-di(canolyloxyethyl)-N,N-dimethylammonium chloride;

N,N-di(tallowyloxyethyl)-N-methyl,N-(2-

15 hydroxyethyl)ammonium methylsulphate;

N,N-di(canolyloxyethyl)-N-methyl,N-(2-hydroxyethyl)

ammonium methylsulphate;

N,N-di(tallowylamidoethyl)-N-methyl,N-(2-hydroxyethyl)

ammonium methylsulphate;

20 N,N-di(2-tallowyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

N,N-di(2-canolyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

25 N,N-di(2-tallowyloxyethylcarbonyloxyethyl)-N,N-dimethylammonium chloride;

N,N-di(2-canolyloxyethylcarbonyloxyethyl)-N,N-dimethylammonium chloride;

N-(2-tallowyloxy-2-ethyl)-N-(2-tallowyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

30 N-(2-canolyloxy-2-ethyl)-N-(2-canolyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

N,N,N-tri(tallowyloxyethyl)-N-methylammonium chloride;

N,N,N-tri(canolyloxyethyl)-N-methylammonium chloride;

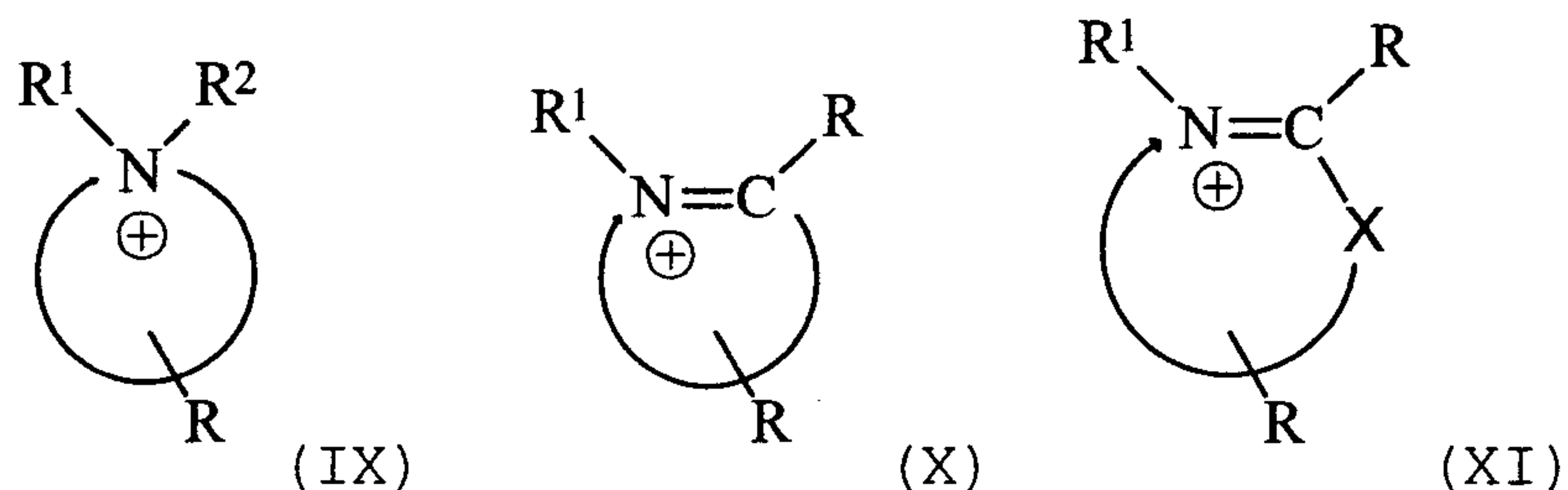
1,2-ditallowyloxy-3-N,N,N-trimethylammoniopropyl
chloride; and

1,2-dicanolyloxy-3-N,N,N-trimethylammoniopropyl chloride.

5 Further preferred quaternary ammonium salts are
ditallowdimethylammonium chloride, ditallowdimethyl-
ammonium methylsulphate, the dimethylammonium chloride of
di(hydrogenated tallow)distearyldimethylammonium chloride
and dibehenyldimethylammonium chloride.

10

Further possible cations are ions derived from saturated
or unsaturated cyclic compounds and from aromatic
compounds having, in each case, at least one trivalent
nitrogen atom in a 4- to 10-membered, preferably 5- or 6-
15 membered, heterocyclic ring which may be substituted.
Such cations can be described in simplified form (i.e.
without indication of precise position and number of the
double bonds in the molecule) by the general formulae
(IX), (X) and (XI) below, where the heterocyclic rings
20 may also contain a plurality of heteroatoms.



R¹ and R² are as defined above,

25 R is hydrogen, a linear or branched aliphatic
hydrocarbon radical which has from 1 to 30 carbon atoms
and may contain double bonds, a cycloaliphatic
hydrocarbon radical which has from 5 to 40 carbon atoms
and may contain double bonds, an aromatic hydrocarbon

radical having from 6 to 40 carbon atoms or an alkylaryl radical having from 7 to 40 carbon atoms, X is an oxygen atom, a sulphur atom or a substituted nitrogen atom ($X = O, S, NR^1$).

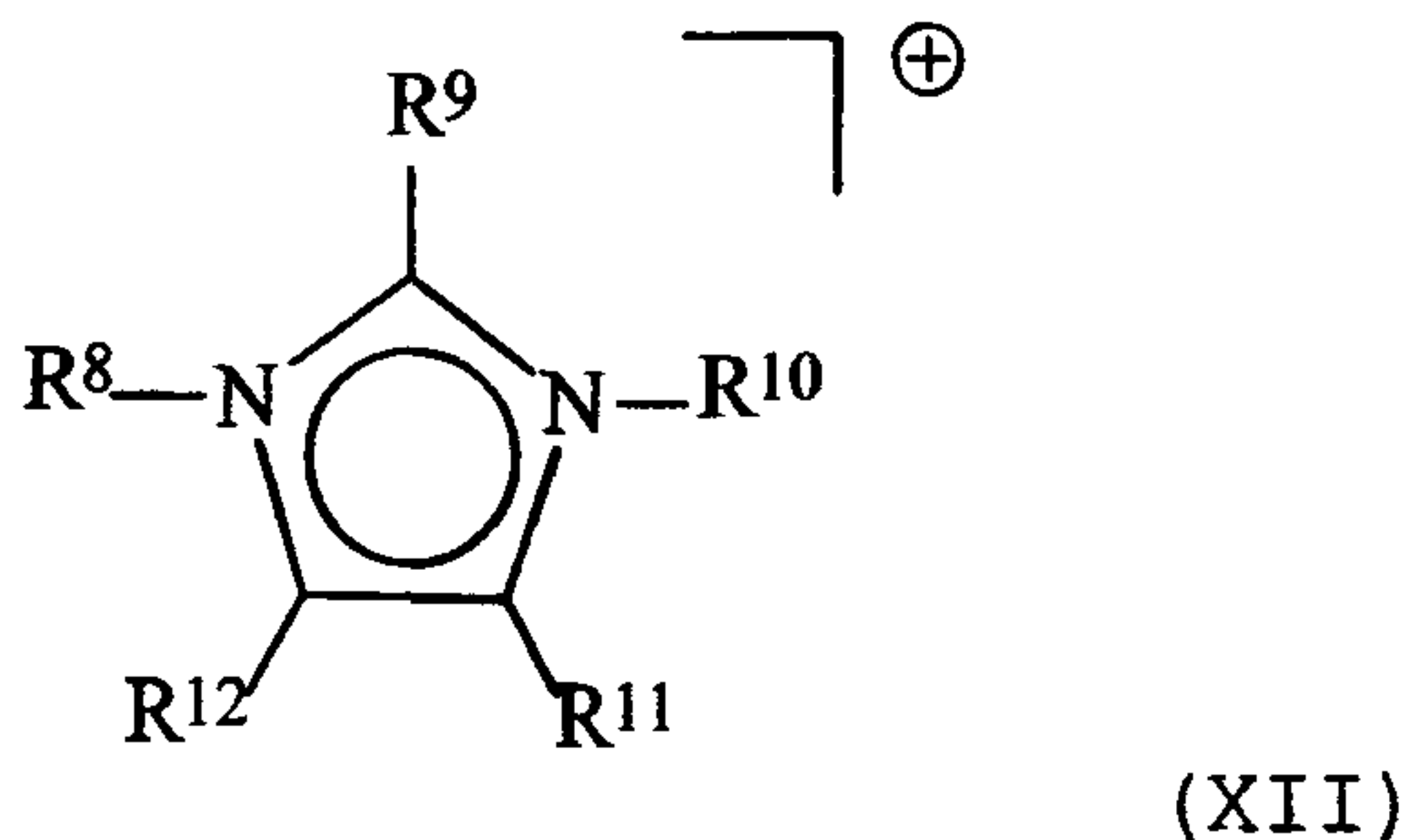
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Examples of cyclic nitrogen compounds of the abovementioned type are pyrrolidine, dihydropyrrole, pyrrole, imidazoline, oxazoline, oxazole, thiazoline, thiazole, isoxazole, isothiazole, indole, carbazole, piperidine, pyridine, the isomeric picolines and lutidines, quinoline and isoquinoline. The cyclic nitrogen compounds of the general formulae (IX), (X) and (XI) can be unsubstituted ($R = H$) or monosubstituted or multiply substituted by the radical R, where in the case of multiple substitution by R, the individual radicals R may be different.

Further possible cations are ions derived from saturated acyclic compounds, saturated or unsaturated cyclic compounds and from aromatic compounds having, in each case, more than one trivalent nitrogen atom in a 4- to 10-membered, preferably 5- or 6-membered, heterocyclic ring. These compounds can be substituted both on the carbon atoms and on the nitrogen atoms. They can also be fused with substituted or unsubstituted benzene rings and/or cyclohexane rings to form polycyclic structures. Examples of such compounds are pyrazole, 3,5-dimethylpyrazole, imidazole, benzimidazole, N-methylimidazole, dihydropyrazole, pyrazolidine, pyridazine, pyrimidine, pyrazine, 2,3-, 2,5- and 2,6-dimethylpyrazine, cimoline, phthalazine, quinazoline, phenazine and piperazine. Cations derived from imidazole

and its alkyl and phenyl derivatives have been found to be particularly useful as constituents of ionic liquids.

Further possible cations are ions which contain two
5 nitrogen atoms and have the general formula (XII)



where R^8 , R^9 , R^{10} , R^{11} , R^{12} are identical or different and are each hydrogen, a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms and may contain double bonds, a cycloaliphatic hydrocarbon radical which has from 5 to 40 carbon atoms and may contain double bonds, an aromatic hydrocarbon radical having from 6 to 40 carbon atoms, an alkylaryl radical having from 7 to 40 carbon atoms, a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms, is interrupted by one or more heteroatoms (oxygen, NH, NR' where R' is a C_1 - C_{30} -alkyl radical which may contain double bonds) and may contain double bonds, a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms, is interrupted by one or more functions selected from the group consisting of $-O-C(O)-$, $-(O)C-O-$, $-NH-C(O)-$, $-(O)C-NH$, $-(CH_3)N-C(O)-$, $-(O)C-N(CH_3)-$, $-S(O_2)-O-$, $-O-S(O_2)-$, $-S(O_2)-NH-$, $-NH-S(O_2)-$, $-S(O_2)-N(CH_3)-$, $-N(CH_3)-S(O_2)-$ and may contain double bonds, a linear or branched aliphatic or cycloaliphatic hydrocarbon radical which has from 1 to 30 carbon atoms, is terminally functionalized by OH, OR' , NH_2 , $N(H)R'$, $N(R')_2$, where R'

is a C₁-C₃₀-alkyl radical which may contain double bonds, and may contain double bonds or a polyether of the formula $-(R^5-O)_n-R^6$ having a block or random structure, where R⁵ is a hydrocarbon radical containing from 2 to 5 carbon atoms, n is from 1 to 100 and R⁶ is hydrogen, a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms and may contain double bonds, a cycloaliphatic hydrocarbon radical which has from 5 to 40 carbon atoms and may contain double bonds, an aromatic hydrocarbon radical having from 6 to 40 carbons, an alkylaryl radical having from 7 to 40 carbon atoms or a -C(O)-R⁷ radical where R⁷ is a linear or branched aliphatic hydrocarbon radical which has from 1 to 30 carbon atoms and may contain double bonds, a cycloaliphatic hydrocarbon radical which has from 5 to 40 carbon atoms and may contain double bonds, an aromatic hydrocarbon radical having from 6 to 40 carbon atoms, an alkylaryl radical having from 7 to 40 carbon atoms.

Very particularly preferred imidazolium ions (XII) are 1-methylimidazolium, 1-ethylimidazolium, 1-(1-butyl)imidazolium, 1-(1-octyl)imidazolium, 1-(1-dodecyl)imidazolium, 1-(1-tetradecyl)imidazolium, 1-(1-hexadecyl)imidazolium, 1,3-dimethylimidazolium, 1-ethyl-3-methylimidazolium, 1-(1-butyl)-3-methylimidazolium, 1-(1-butyl)-3-ethylimidazolium, 1-(1-hexyl)-3-methylimidazolium, 1-(1-hexyl)-3-ethylimidazolium, 1-(1-hexyl)-3-butylimidazolium, 1-(1-octyl)-3-methylimidazolium, 1-(1-octyl)-3-ethylimidazolium, 1-(1-octyl)-3-butylimidazolium, 1-(1-dodecyl)-3-methylimidazolium, 1-(1-dodecyl)-3-ethylimidazolium, 1-(1-dodecyl)-3-butylimidazolium, 1-(1-dodecyl)-3-octylimidazolium, 1-(1-tetradecyl)-3-methylimidazolium,

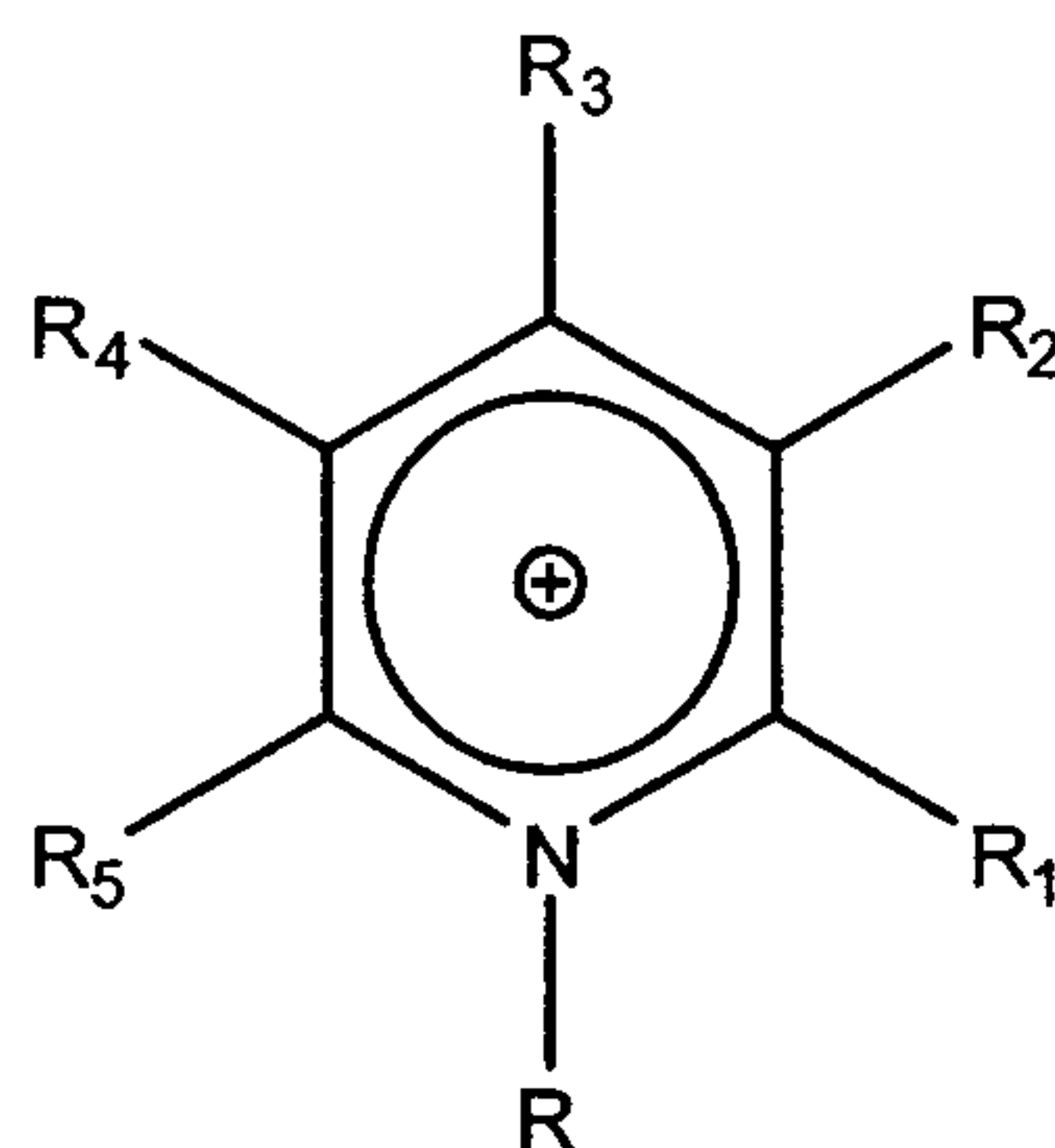
1-(1-tetradecyl)-3-ethylimidazolium, 1-(1-tetradecyl)-3-butylimidazolium, 1-(1-tetradecyl)-3-octylimidazolium, 1-(1-hexadecyl)-3-methylimidazolium, 1-(1-hexadecyl)-3-ethylimidazolium, 1-(1-hexadecyl)-3-butylimidazolium, 1-(1-hexadecyl)-3-octylimidazolium, 1,2-dimethylimidazolium, 1,2,3-trimethylimidazolium, 1-ethyl-2,3-dimethylimidazolium, 1-(1-butyl)-2,3-dimethylimidazolium, 1-(1-hexyl)-2,3-dimethylimidazolium, 1-(1-octyl)-2,3-dimethylimidazolium, 1,4-dimethylimidazolium, 1,3,4-trimethylimidazolium, 1,4-dimethyl-3-ethylimidazolium, 3-butylimidazolium, 1,4-dimethyl-3-octylimidazolium, 1,4,5-trimethylimidazolium, 1,3,4,5-tetramethylimidazolium, 1,4,5-trimethyl-3-ethylimidazolium, 1,4,5-trimethyl-3-butylimidazolium and 1,4,5-trimethyl-3-octylimidazolium.

Further possible cations are ions which form dications, trications or polycations composed of, in particular, the abovementioned cations which have been dimerized, trimerized or polymerized. These encompass dications, trications and polycations which have a polymeric backbone, for example a backbone based on siloxanes, polyethers, polyesters, polyamides or polyacrylates, in particular branched and hyperbranched polymers.

25

Further possible ionic liquids are those in which the cation $[A]^+$ is a pyridinium ion (XIIIa)

- 15 -



(XIIIa)

where

- 5 one of the radicals R_1 to R_5 is methyl, ethyl or chlorine and the remaining radicals R_1 to R_5 are each hydrogen; R_3 is dimethylamino and the remaining radicals R_1 , R_2 , R_4 and R_5 are each hydrogen; all radicals R_1 to R_5 are hydrogen;
- 10 R_2 is carboxy or carboxamide and the remaining radicals R_1 , R_2 , R_4 and R_5 are each hydrogen; or R_1 and R_2 or R_2 and R_3 are 1,4-buta-1,3-dienylene and the remaining radicals R_1 , R_2 , R_4 and R_5 are each hydrogen; and in particular one in which
- 15 R_1 to R_5 are each hydrogen; or one of the radicals R_1 to R_5 is methyl or ethyl and the remaining radicals R_1 to R_5 are each hydrogen.

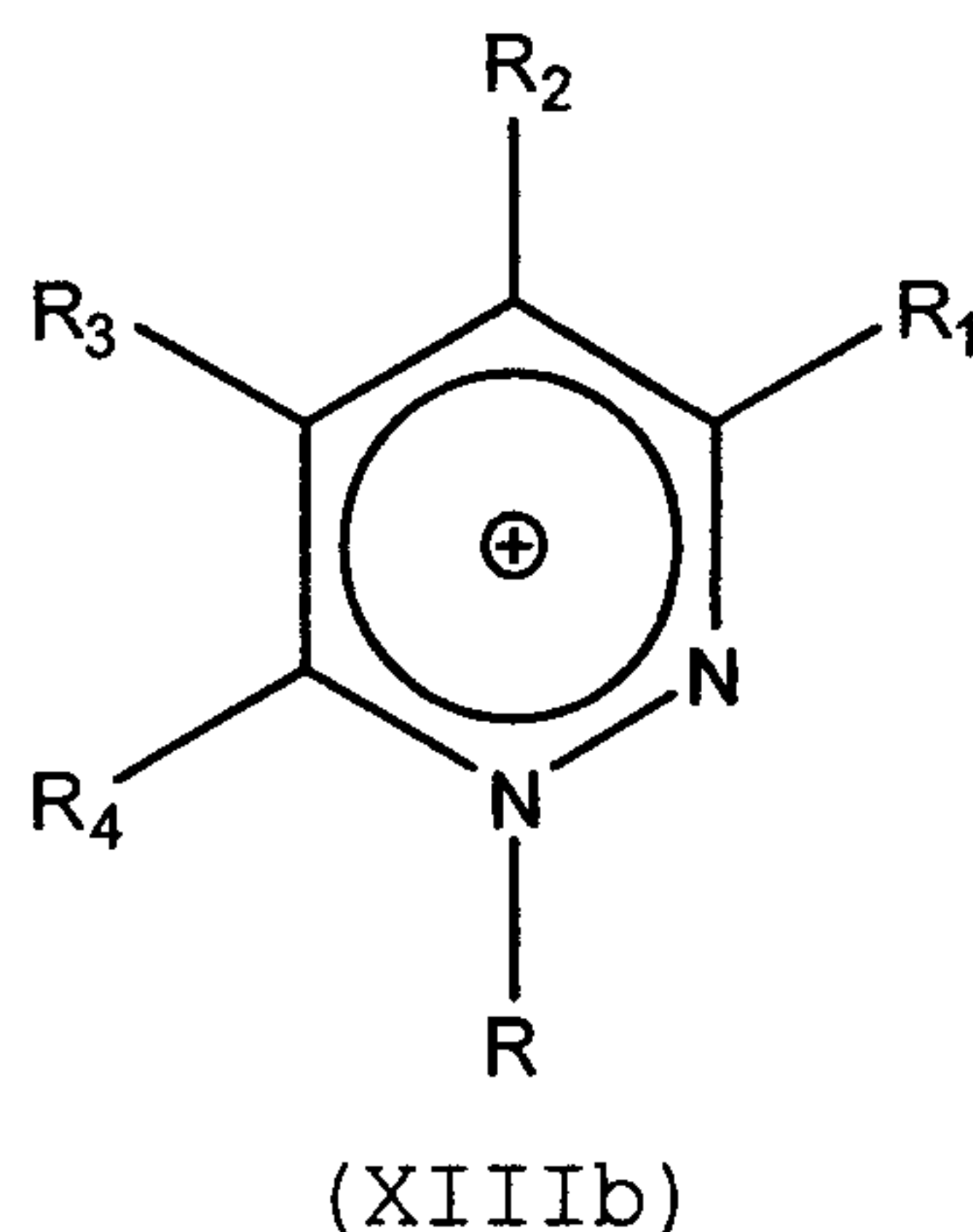
Very particularly preferred pyridinium ions (XIIIa) are

20 1-methylpyridinium, 1-ethylpyridinium, 1-(1-butyl)-pyridinium, 1-(1-hexyl)pyridinium, 1-(1-octyl)pyridinium, 1-(1-hexyl)pyridinium, 1-(1-octyl)pyridinium, 1-(1-dodecyl)pyridinium, 1-(1-tetradecyl)pyridinium, 1-(1-hexadecyl)pyridinium, 1,2-dimethylpyridinium, 1-ethyl-2-

25 methylpyridinium, 1-(1-butyl)-2-methylpyridinium, 1-(1-hexyl)-2-methylpyridinium, 1-(1-octyl)-2-methylpyridinium, 1-(1-dodecyl)-2-methylpyridinium, 1-(1-tetradecyl)-2-methylpyridinium, 1-(1-hexadecyl)-2-

methylpyridinium, 1-methyl-2-ethylpyridinium, 1,2-
 diethylpyridinium, 1-(1-butyl)-2-ethylpyridinium, 1-(1-
 hexyl)-2-ethylpyridinium, 1-(1-octyl)-2-ethylpyridinium,
 1-(1-dodecyl)-2-ethylpyridinium, 1-(1-tetradecyl)-2-
 5 ethylpyridinium, 1-(1-hexadecyl)-2-ethylpyridinium, 1,2-
 dimethyl-5-ethylpyridinium, 1,5-diethyl-2-methyl-
 pyridinium, 1-(1-butyl)-2-methyl-3-ethylpyridinium, 1-(1-
 hexyl)-2-methyl-3-ethylpyridinium and 1-(1-octyl)-2-
 methyl-3-ethylpyridinium, 1-(1-dodecyl)-2-methyl-3-ethyl-
 10 pyridinium, 1-(1-tetradecyl)-2-methyl-3-ethylpyridinium
 and 1-(1-hexadecyl)-2-methyl-3-ethylpyridinium.

Further possible ionic liquids are those in which the
 cation $[A]^+$ is a pyridazinium ion (XIIIb)

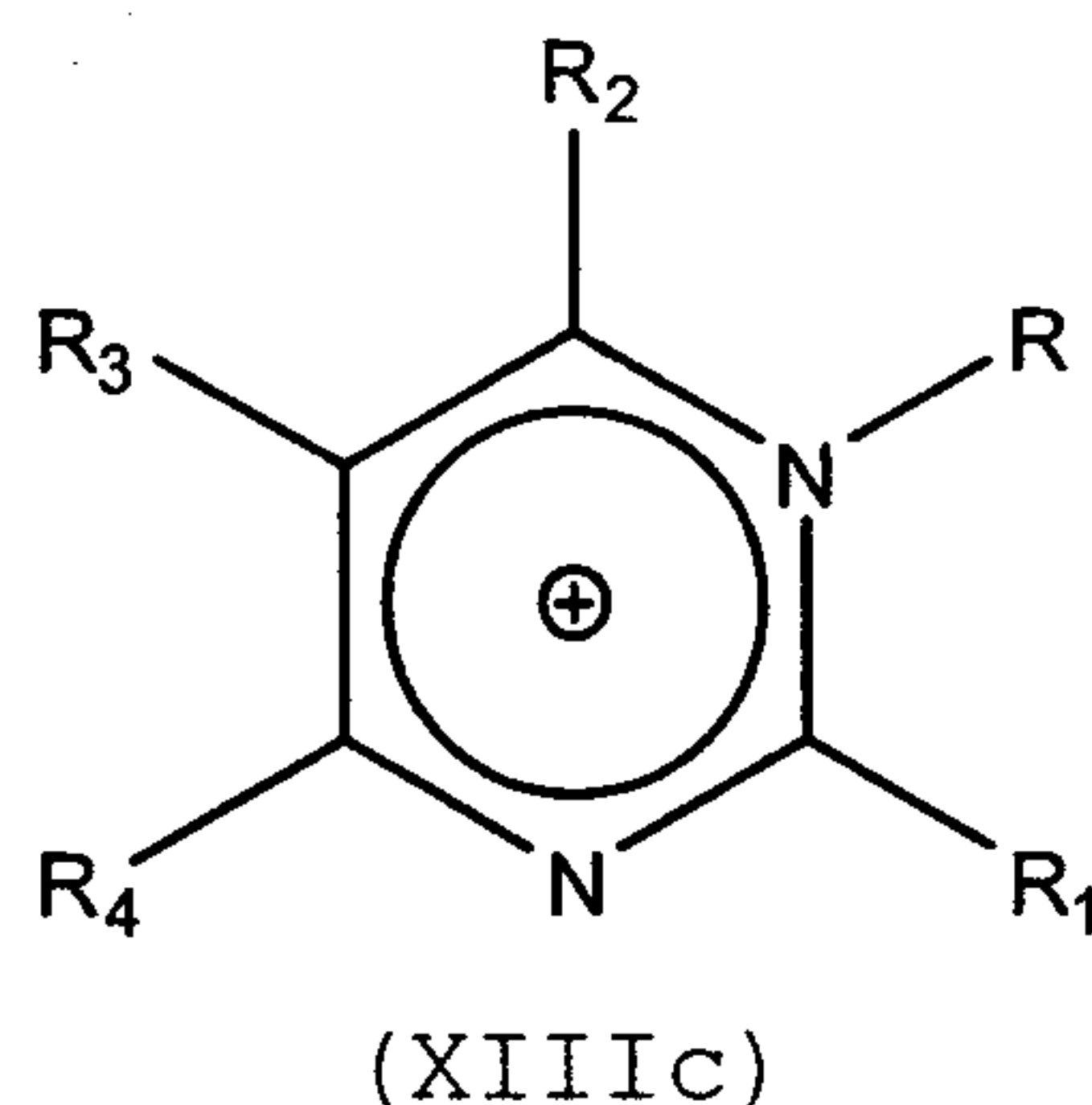


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where

20 R_1 to R_4 are each hydrogen; or
 one of the radicals R_1 to R_4 is methyl or ethyl and the
 remaining radicals R_1 to R_4 are each hydrogen.

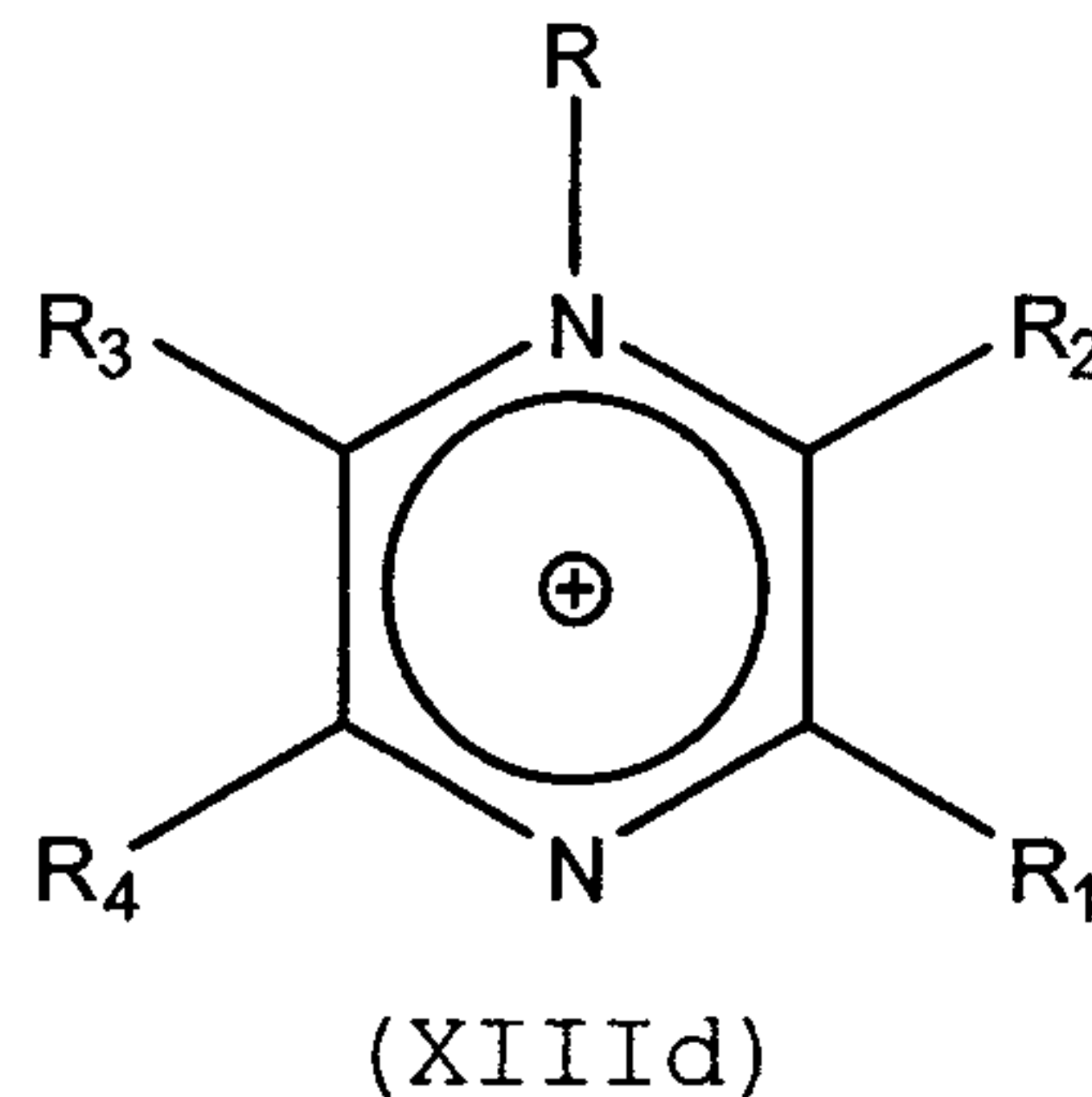
In addition, very particular preference is given to ionic
 liquids in which the cation $[A]^+$ is a pyrimidinium ion
 25 (XIIIc),



where

- 5 R_1 is hydrogen, methyl or ethyl and R_2 to R_4 are each, independently of one another, hydrogen or methyl; or
 R_1 is hydrogen, methyl or ethyl, R_2 and R_4 are each methyl and R_3 is hydrogen.

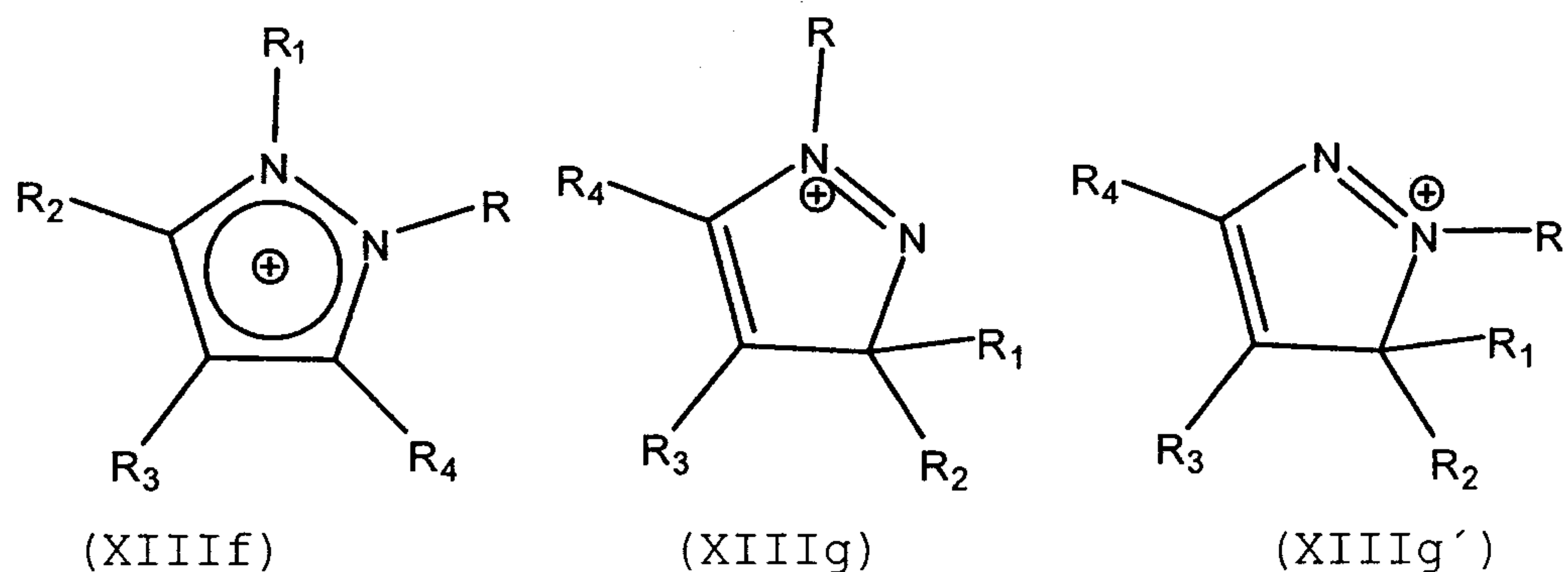
- 10 Further possible ionic liquids are those in which the cation $[A]^+$ is a pyrazinium ion (XIIIId),



- 15 where

- R_1 is hydrogen, methyl or ethyl and R_2 to R_4 are each, independently of one another, hydrogen or methyl;
 R_1 is hydrogen, methyl or ethyl, R_2 and R_4 are each methyl and R_3 is hydrogen;
 20 R_1 to R_4 are each methyl; or
 R_1 to R_4 are each methyl or hydrogen.

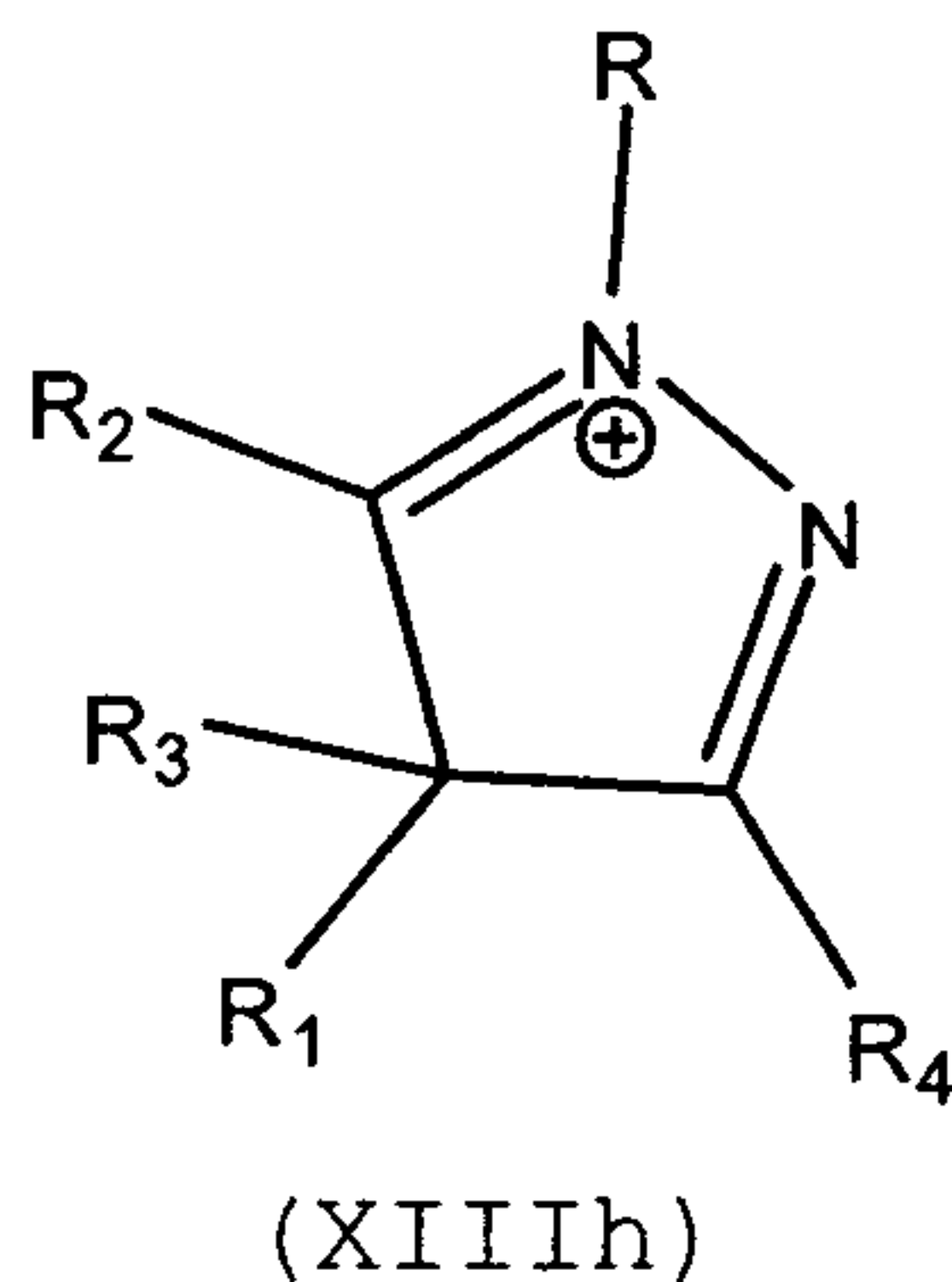
- Further possible ionic liquids are those in which the cation $[A]^+$ is a pyrazolium ion (XIIIIf), (XIIIIfg) or
 25 (XIIIIfg'),



where

- 5 R_1 is hydrogen, methyl or ethyl and R_2 to R_4 are each, independently of one another, hydrogen or methyl.

Further possible ionic liquids are those in which the cation $[A]^+$ is a pyrazolium ion (XIIIh),

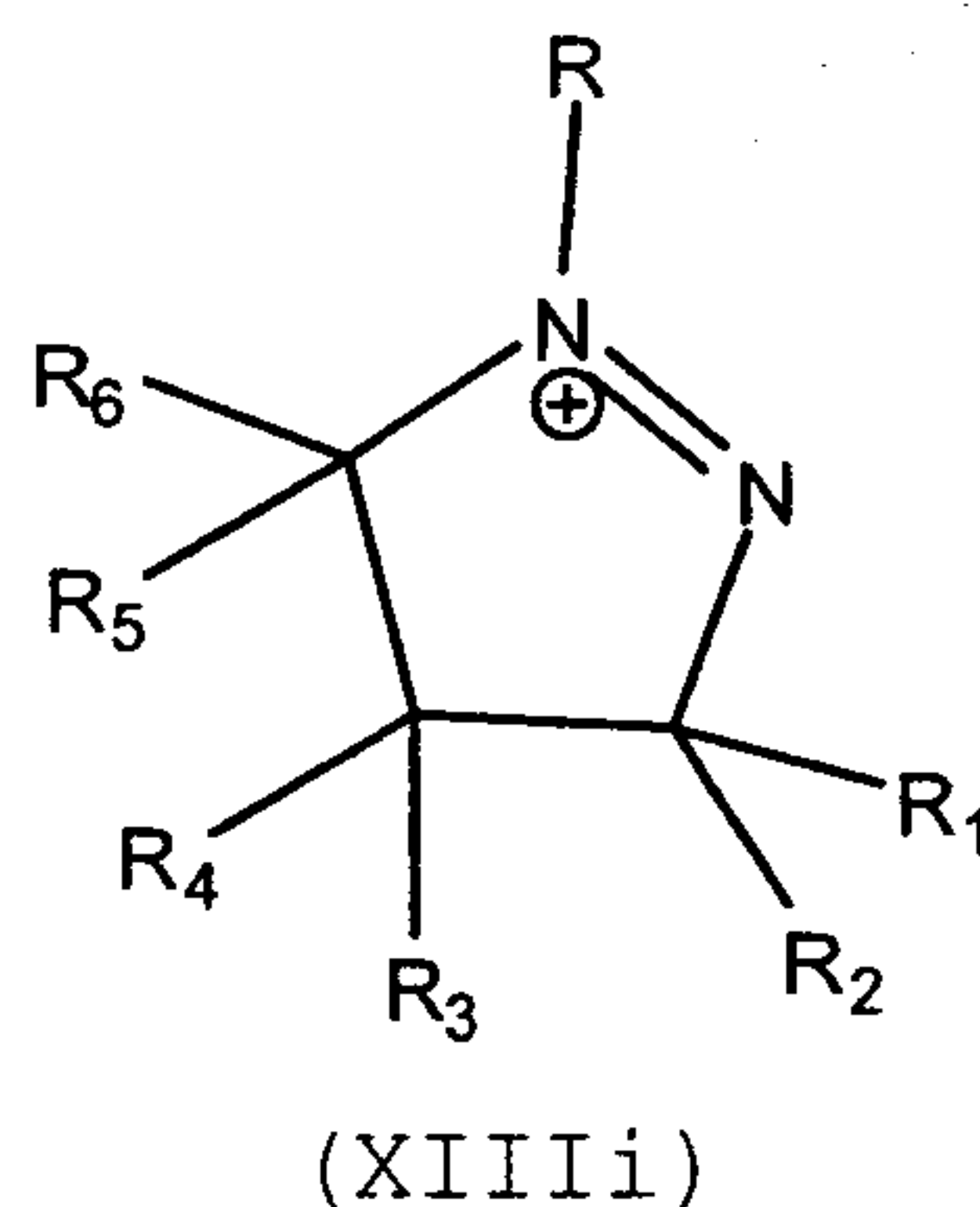


10

where

- 15 R_1 to R_4 are each, independently of one another, hydrogen or methyl.

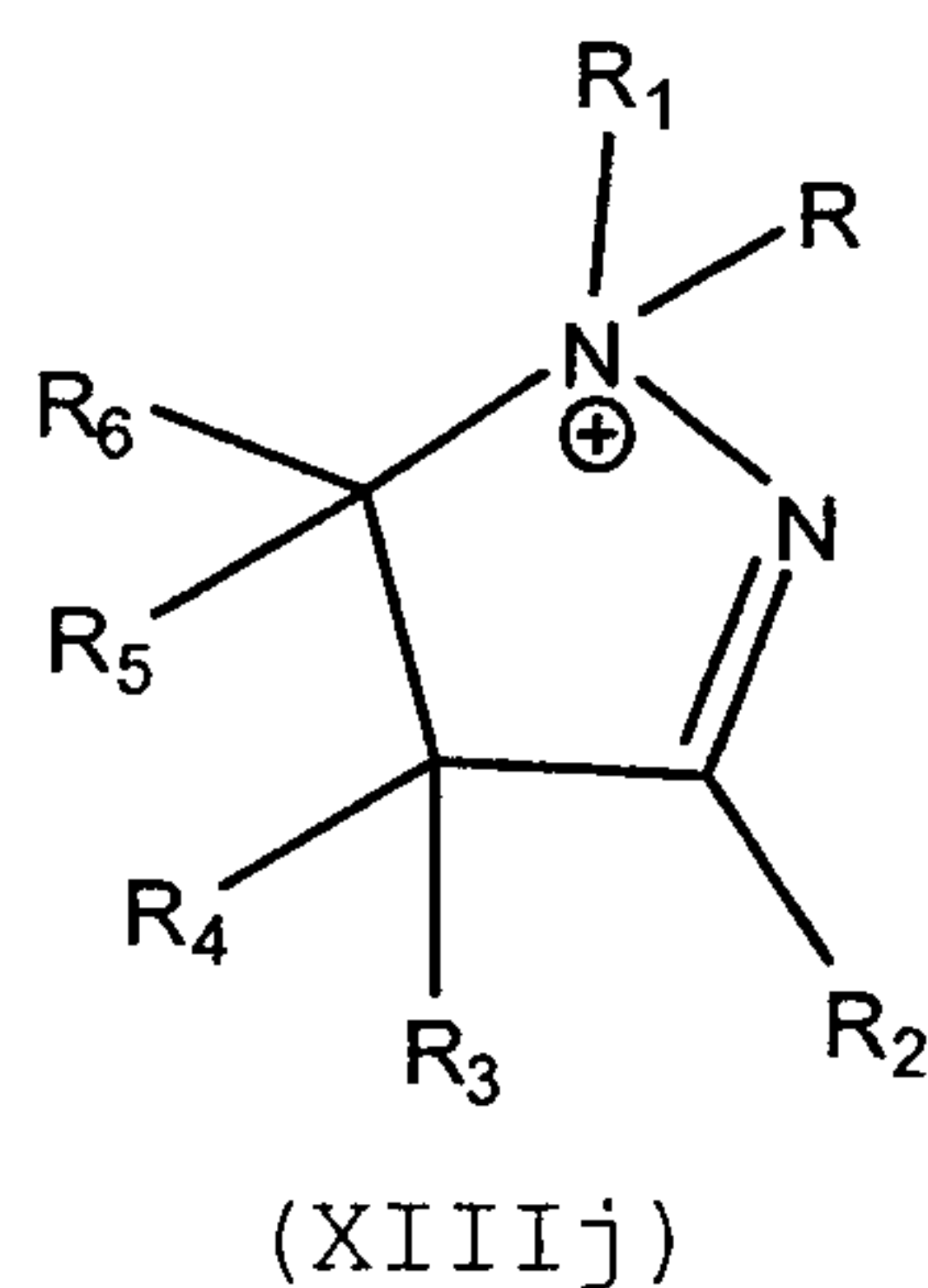
Additional possible ionic liquids are those in which the cation $[A]^+$ is a 1-pyrazolinium ion (XIIIi),



where

- 5 R_1 to R_6 are each, independently of one another, hydrogen or methyl.

Further possible ionic liquids are those in which the cation $[A]^+$ is a 2-pyrazolinium ion (XIIIj),

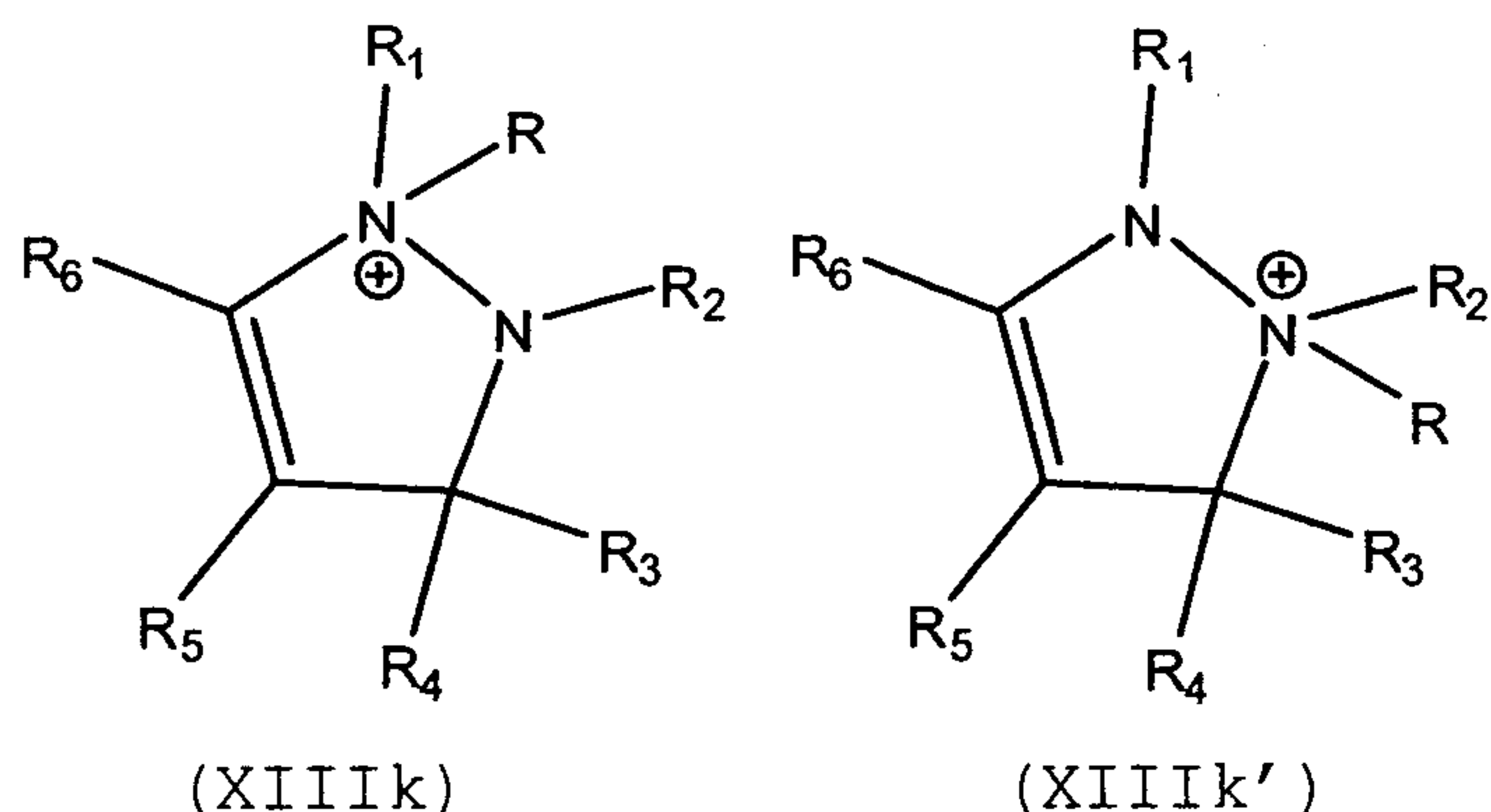


10

where

- 15 R_1 is hydrogen, methyl, ethyl or phenyl and R_2 to R_6 are each, independently of one another, hydrogen or methyl.

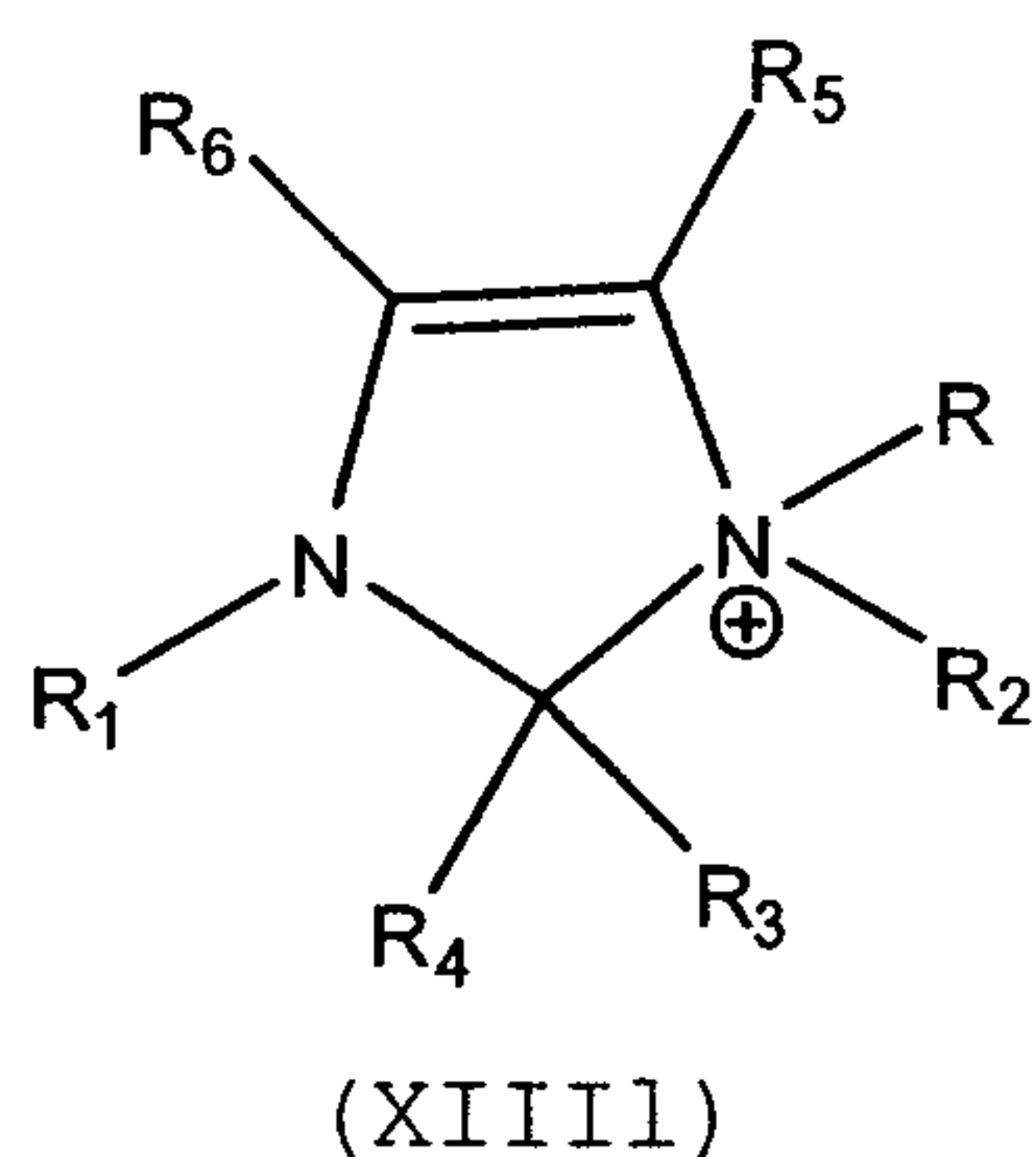
Further suitable ionic liquids are those in which the cation $[A]^+$ is a 3-pyrazolinium ion (XIIIk) or (XIIIk'),



where

- 5 R₁ and R₂ are each, independently of one another, hydrogen, methyl, ethyl or phenyl and R₃ to R₆ are each, independently of one another, hydrogen or methyl.

Additional possible ionic liquids are those in which the
 10 cation [A]⁺ is an imidazolinium ion (XIIIll),

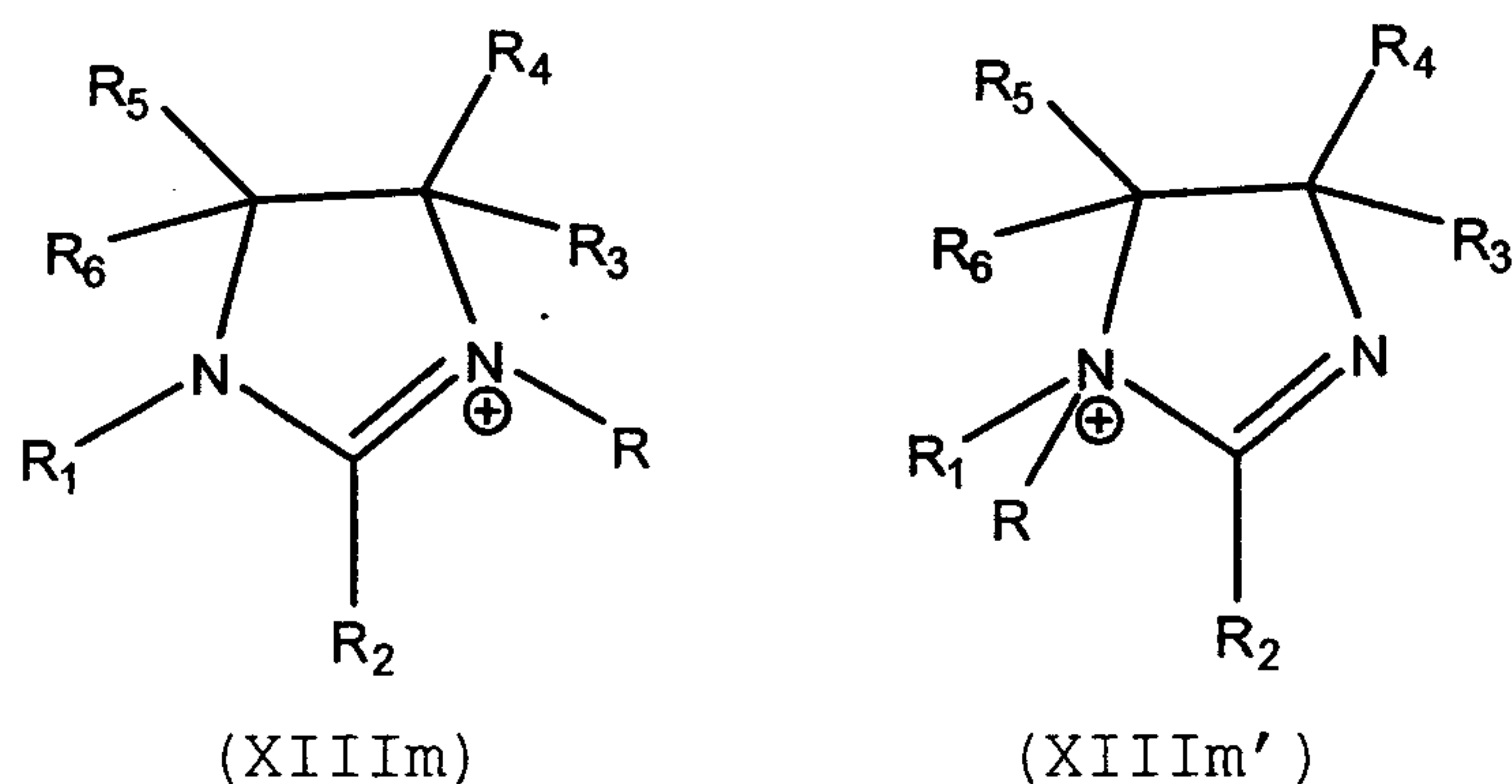


where

- 15 R is H or methyl, R₁ and R₂ are each, independently of one another, hydrogen, methyl or ethyl or a linear saturated or unsaturated acyl radical having from 14 to 22, preferably from 16 to 18, carbon atoms and R₃ to R₆ are each, independently of one another, hydrogen, a
 20 linear saturated alkyl radical which has 1-4 carbon atoms and may contain OH groups, preferably methyl or a fatty acid radical; with particular preference being given to R₁ and R₂ being fatty acyl radicals and R or R₂ and R₃ being fatty acyl radicals. The substances corresponding

to formula (XIIIIm) are of particular importance. In the literature, these are sometimes also given misleading formulae (analogous to XIIIIm' or XIIIIl).

- 5 Additional possible ionic liquids are those in which the cation $[A]^+$ is an imidazolinium ion (XIIIIm) or (XIIIIm'),



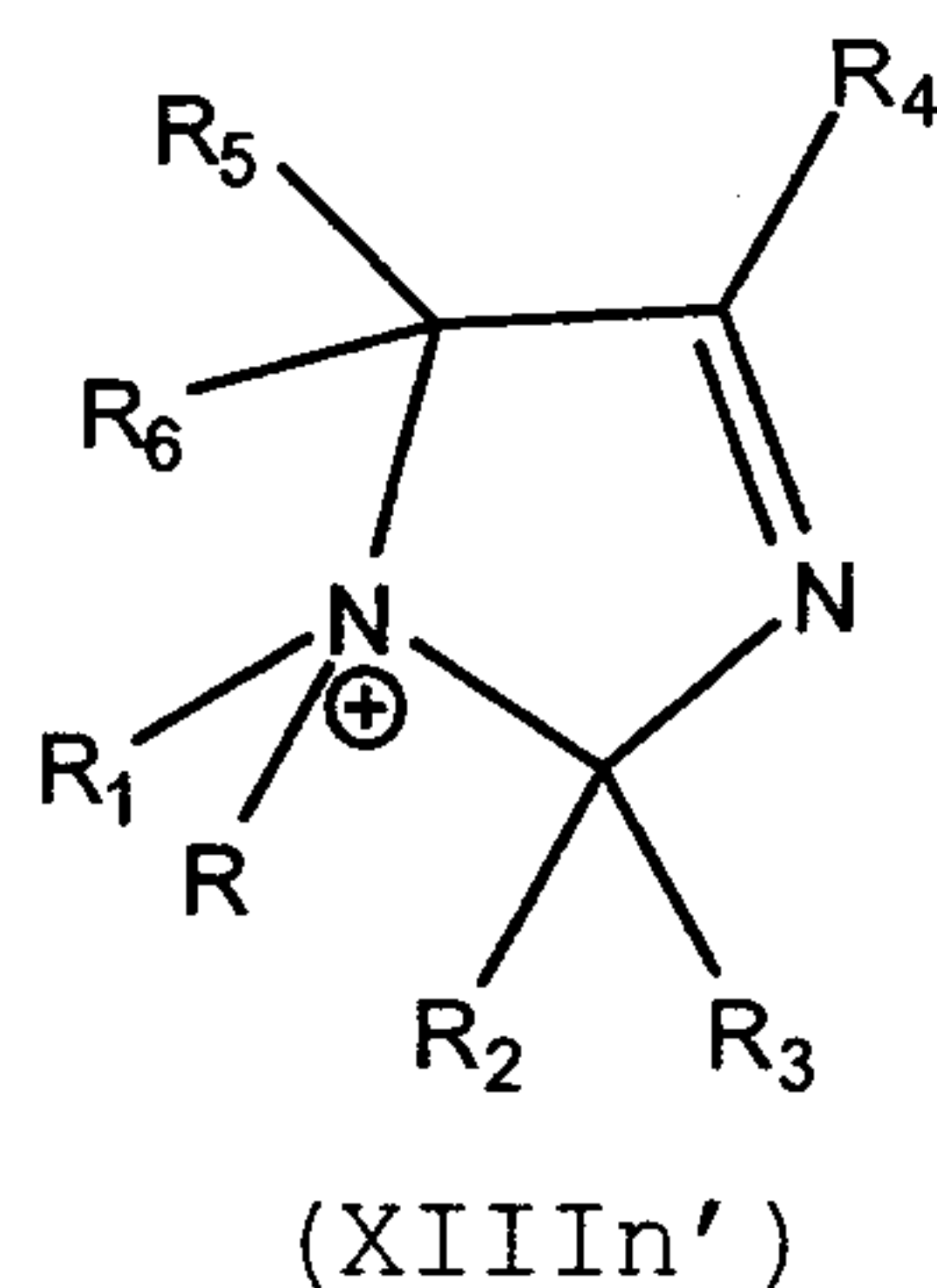
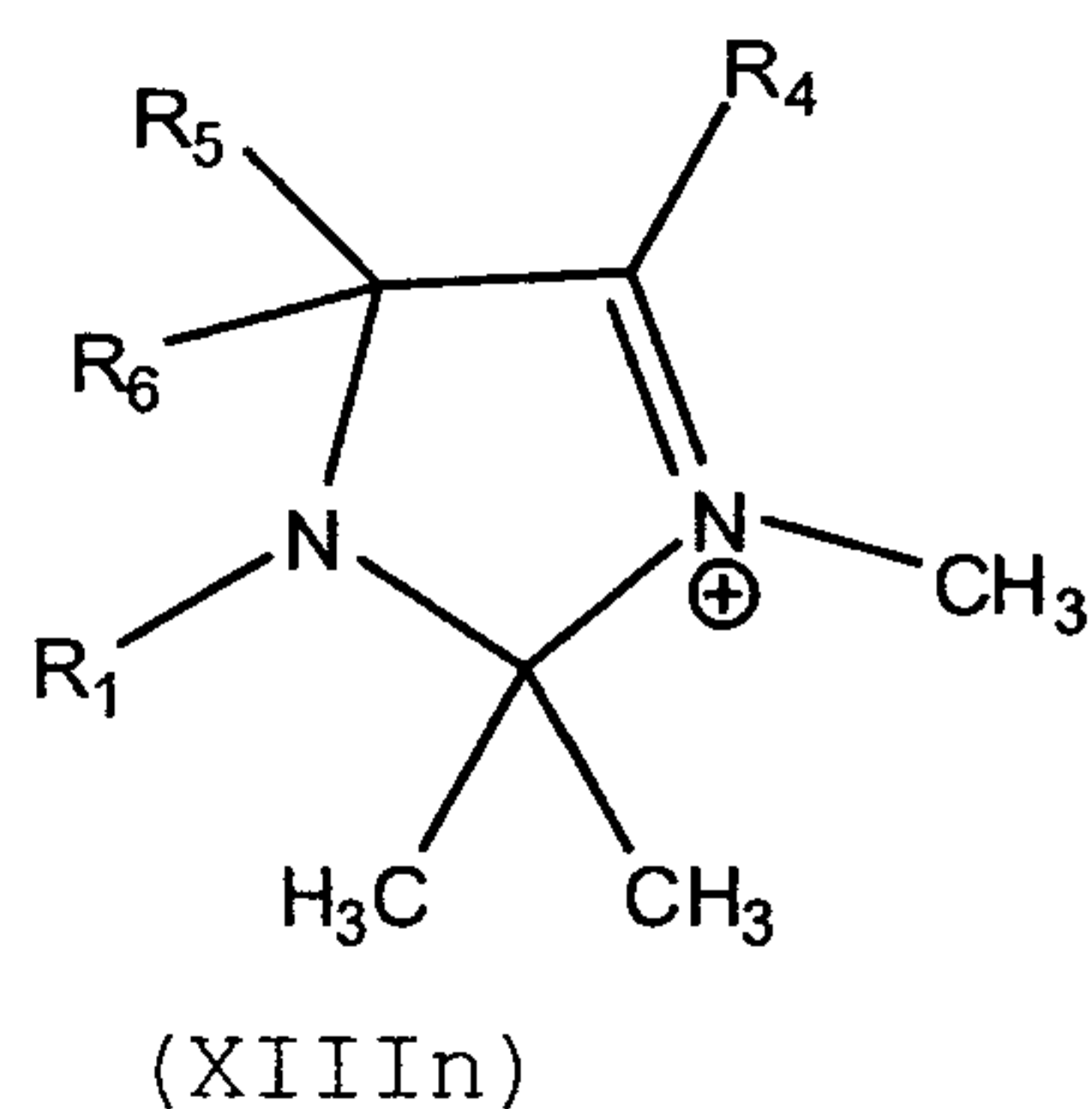
10

where

R is H or methyl, R₁ and R₂ are each, independently of one another, hydrogen, methyl or ethyl or a linear saturated or unsaturated acyl radical having from 14 to 22, preferably from 16 to 18, carbon atoms and R₃ to R₆ are each, independently of one another, hydrogen, a linear saturated alkyl radical which has 1-4 carbon atoms and may contain OH groups, preferably methyl or a fatty acid radical; with particular preference given to R₁ and R₂ being fatty acyl radicals and R or R₂ and R₃ being fatty acyl radicals. The substances corresponding to formula (XIIIIm) are of particular importance. In the literature, these are sometimes also given misleading formulae (analogous to XIIIIm' or XIIIIl).

25

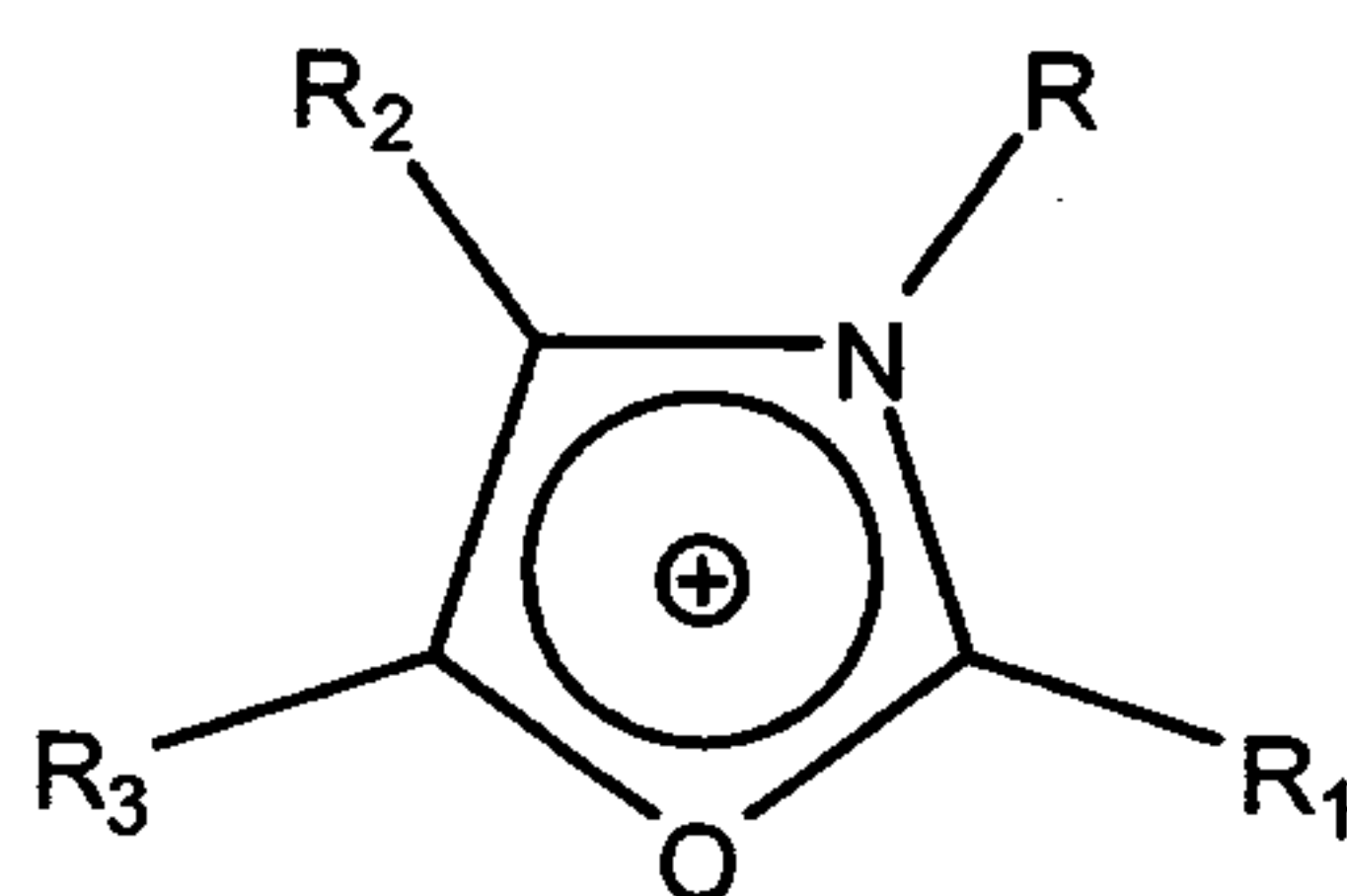
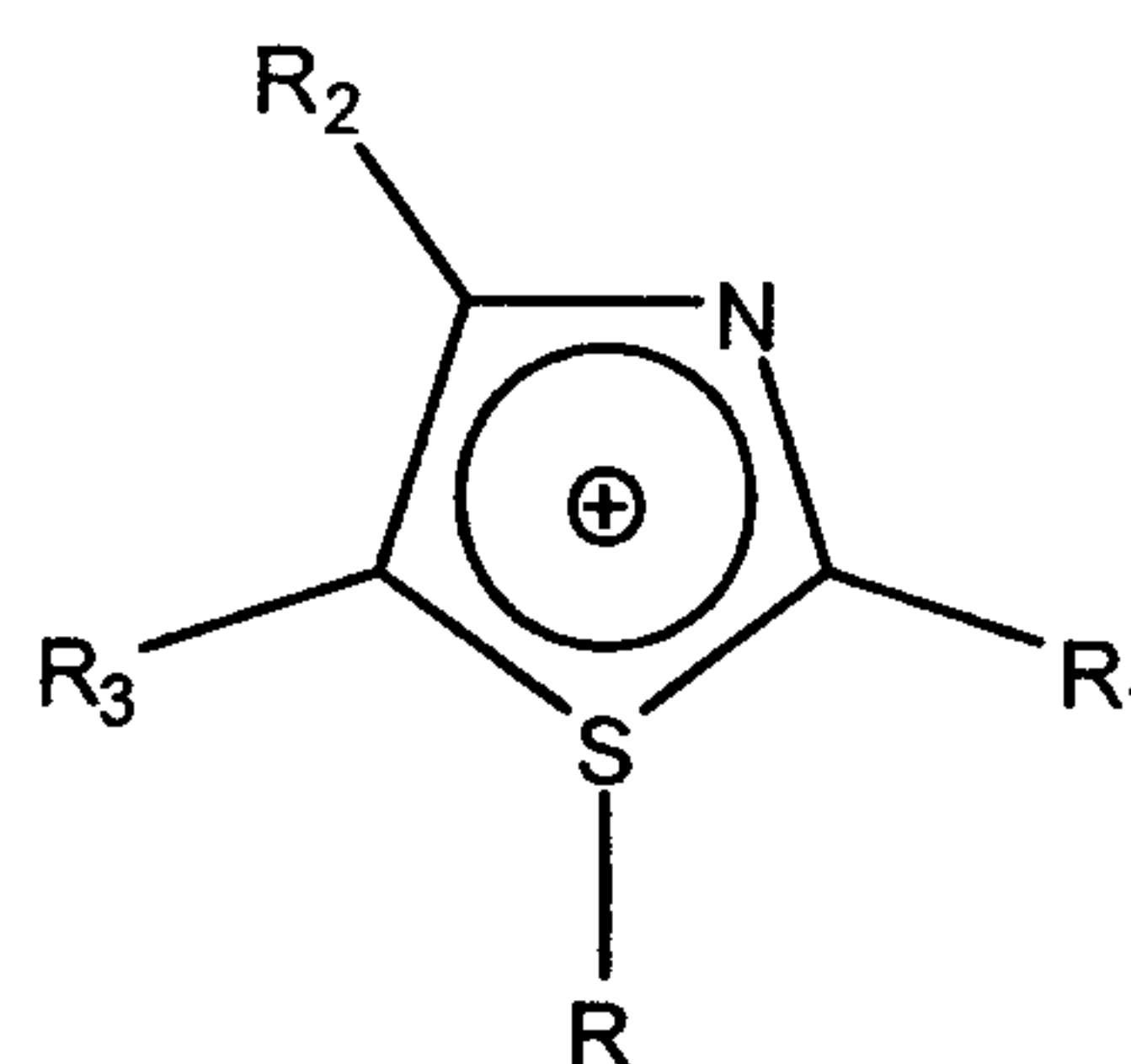
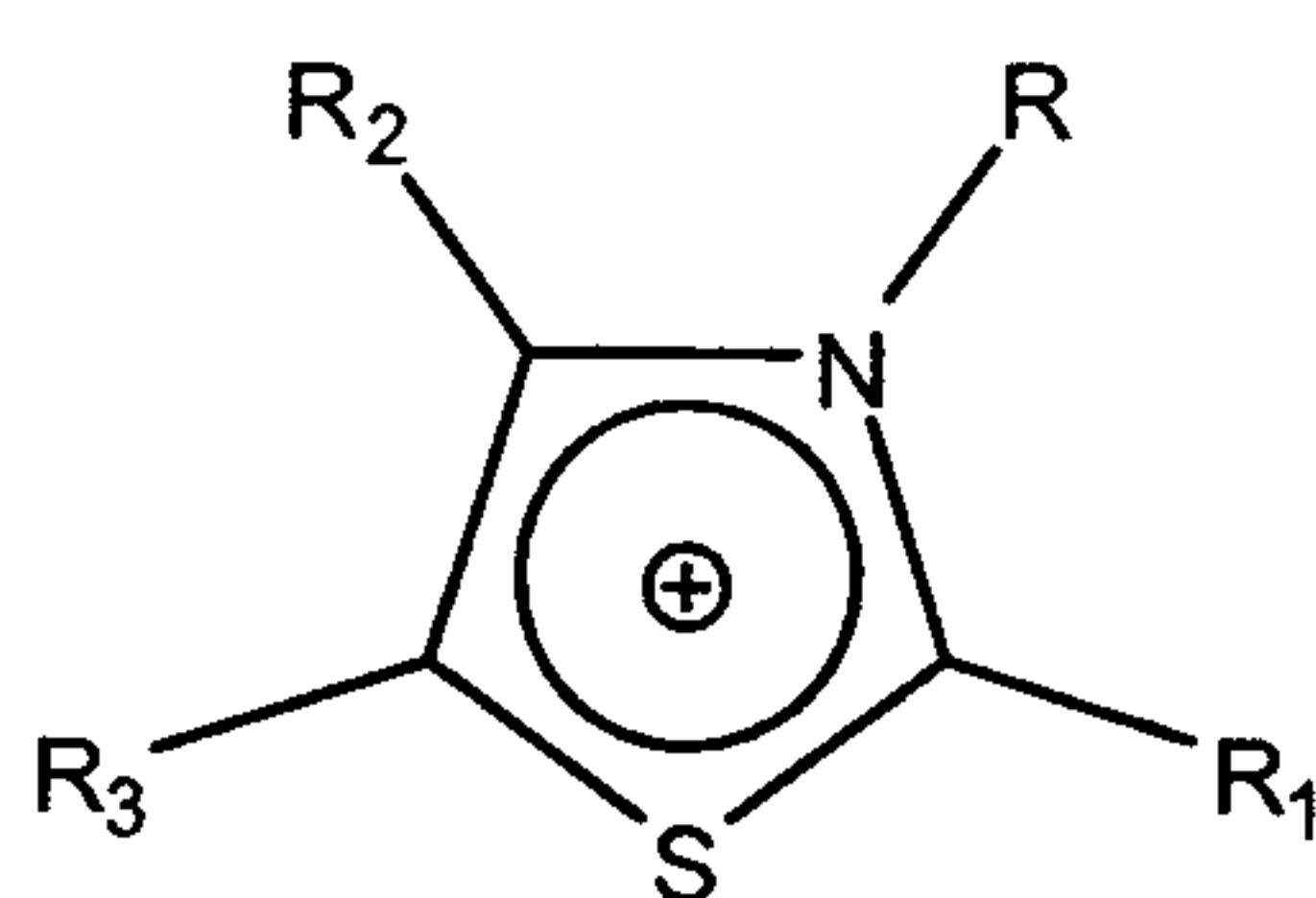
Further possible ionic liquids are those in which the cation $[A]^+$ is an imidazolinium ion (XIIIIn) or (XIIIIn'),



where

- 5 R₁ to R₃ are each, independently of one another, hydrogen, methyl or ethyl and R₄ to R₆ are each, independently of one another, hydrogen or methyl.

Additional possible ionic liquids are those in which the
 10 cation [A]⁺ is a thiazolium ion (XIII Io) or (XIII Io') or an oxazolium ion (XIII Ip),



15

(XIII Io)

(XIII Io')

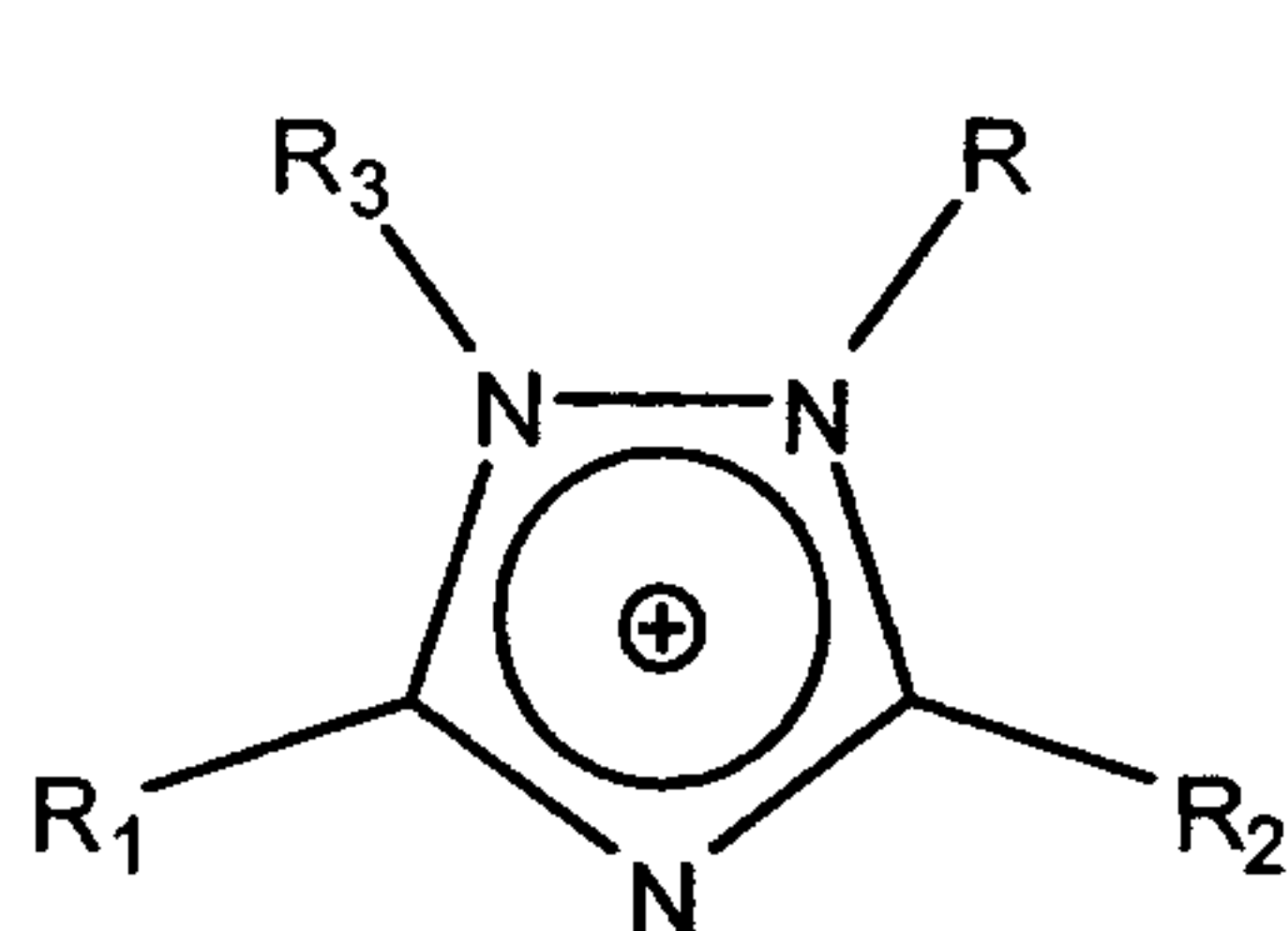
(XIII Ip)

where

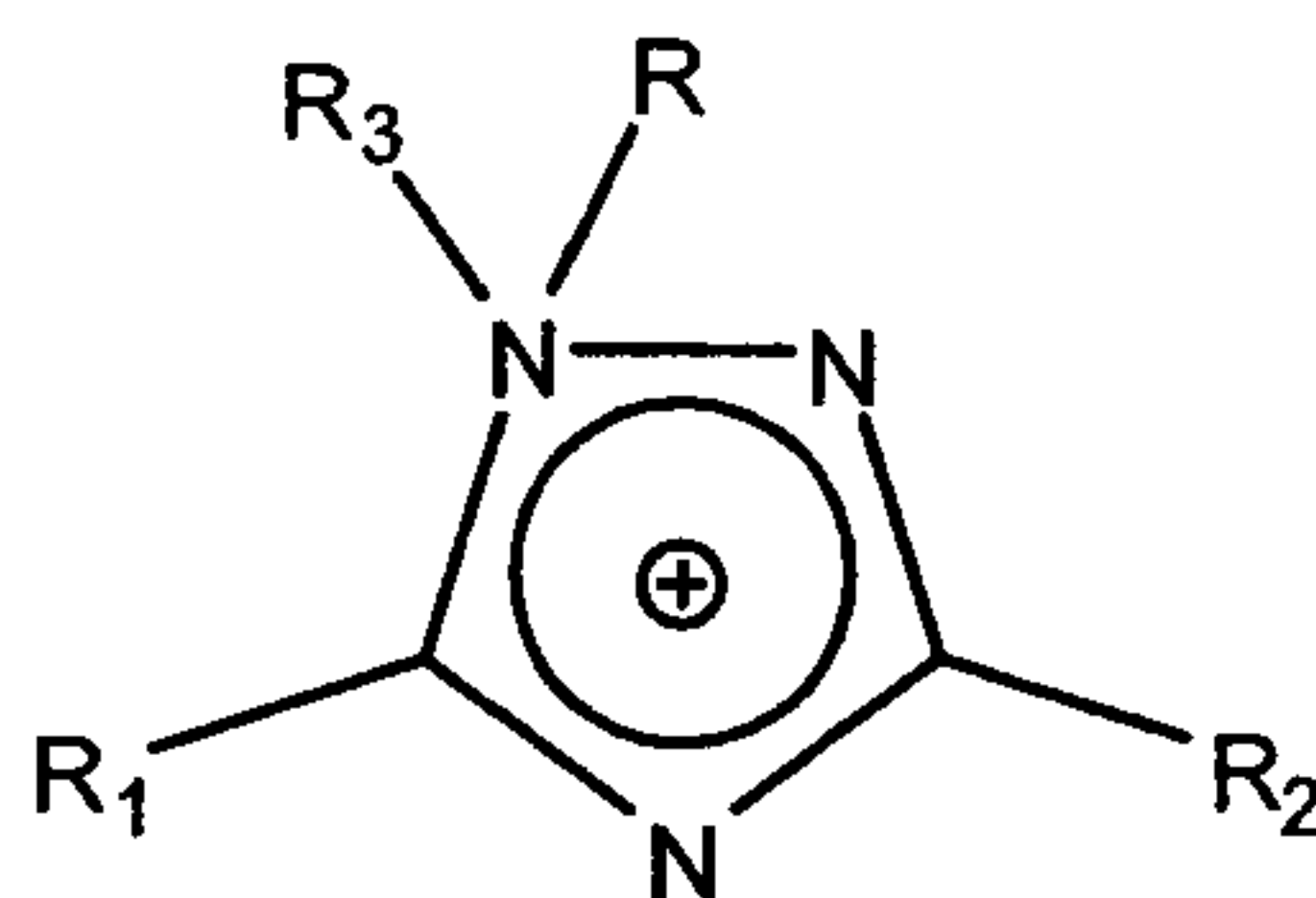
R₁ is hydrogen, methyl, ethyl or phenyl and R₂ and R₃ are each, independently of one another, hydrogen or methyl.

Further possible ionic liquids are those in which the cation $[A]^+$ is a 1,2,4-triazolium ion (XIIIq), (XIIIq') or (XIIIq''),

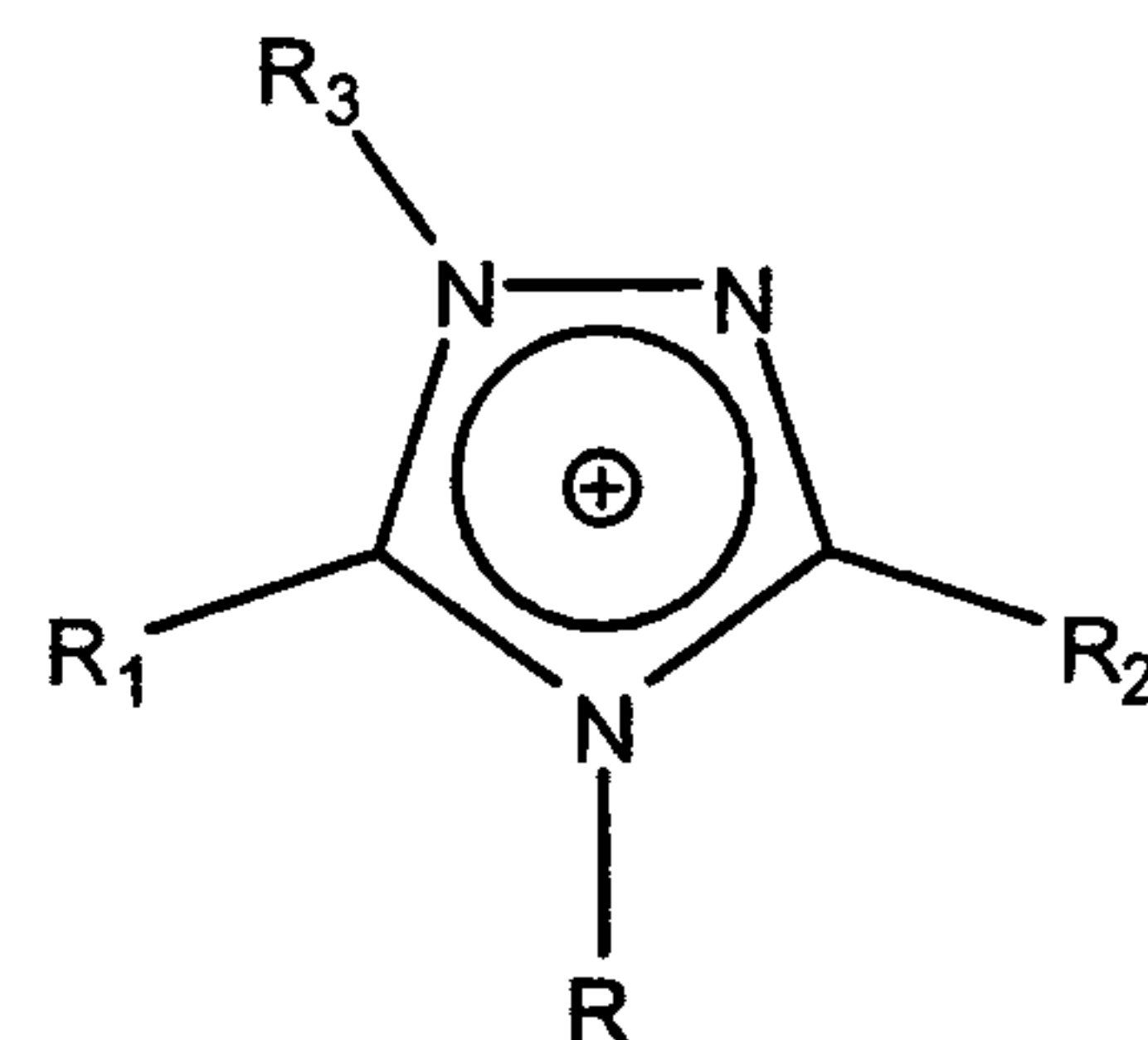
5



(XIIIq)



(XIIIq')

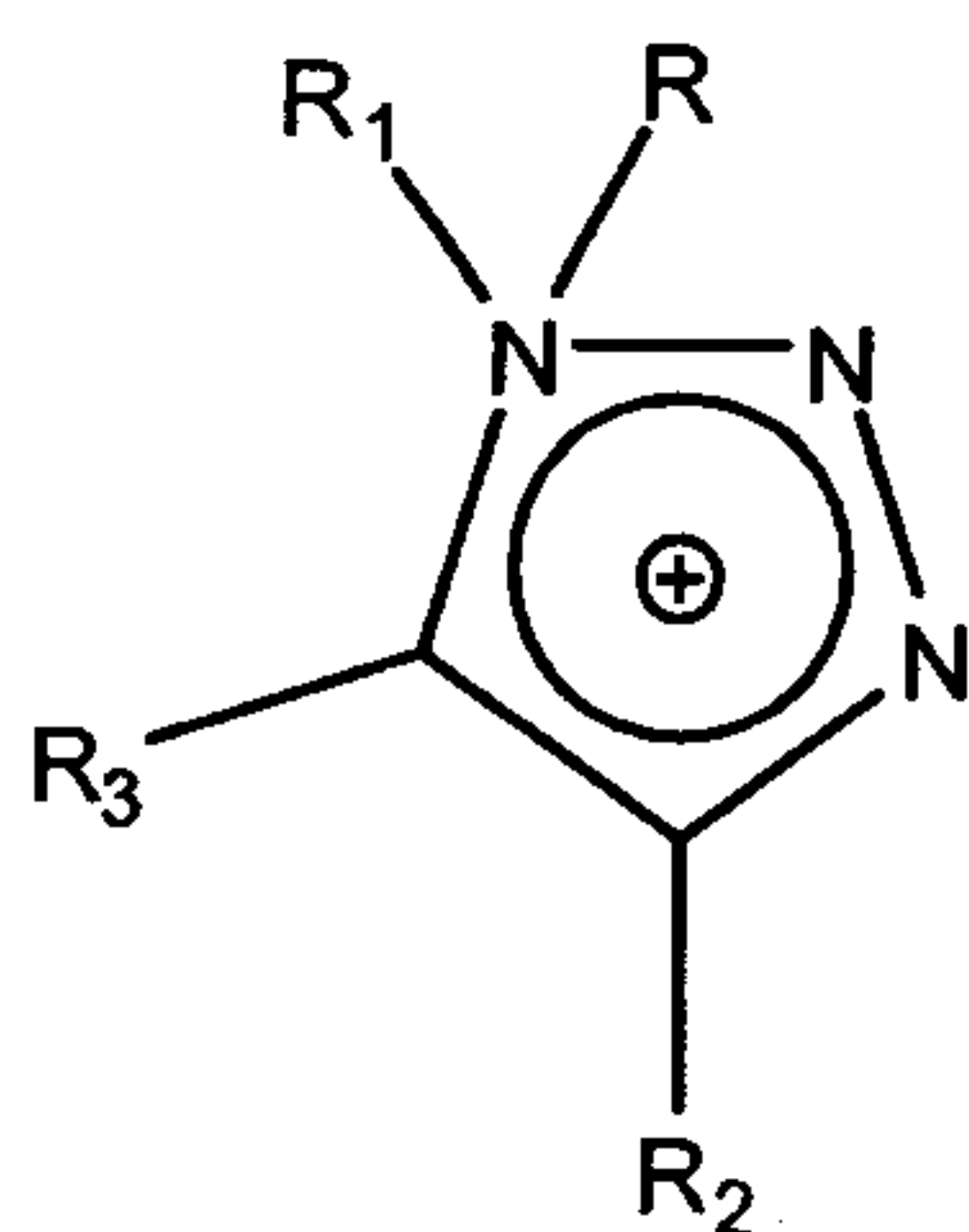


(XIIIq'')

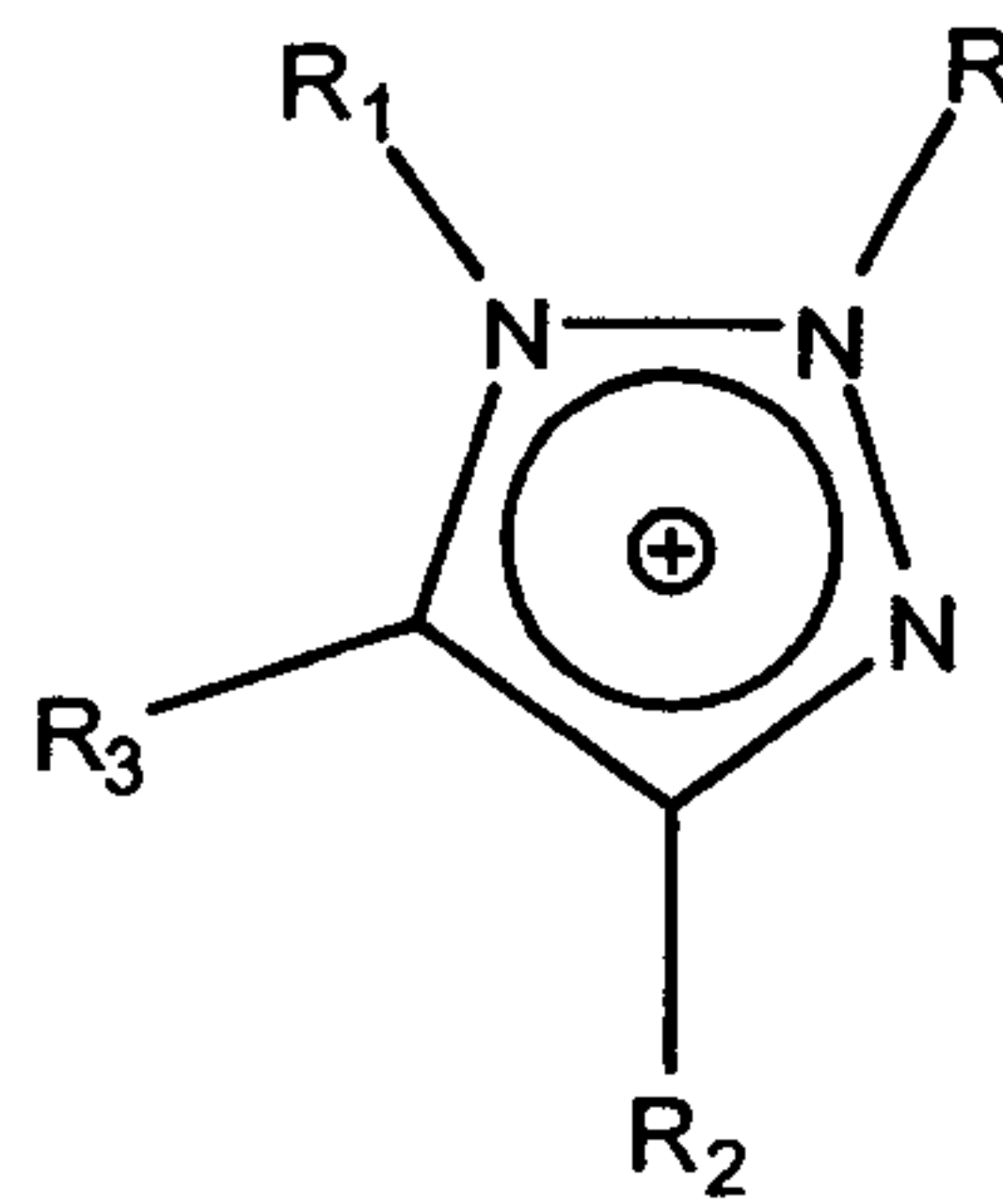
where

10 R_1 and R_2 are each, independently of one another, hydrogen, methyl, ethyl or phenyl and R_3 is hydrogen, methyl or phenyl.

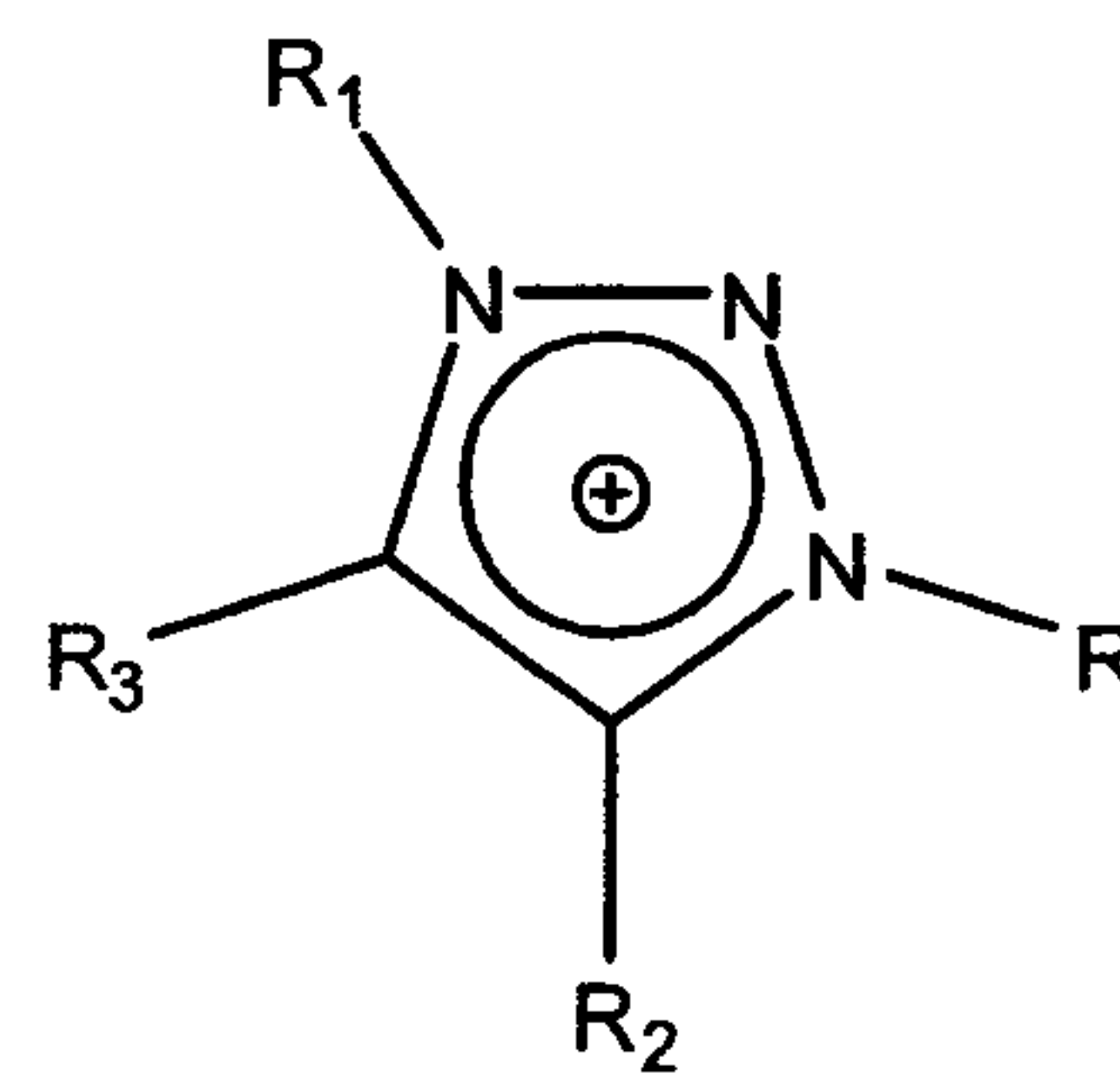
15 Further possible ionic liquids are those in which the cation $[A]^+$ is a 1,2,3-triazolium ion (XIIIr), (XIIIr') or (XIIIr''),



(XIIIr)



(XIIIr')



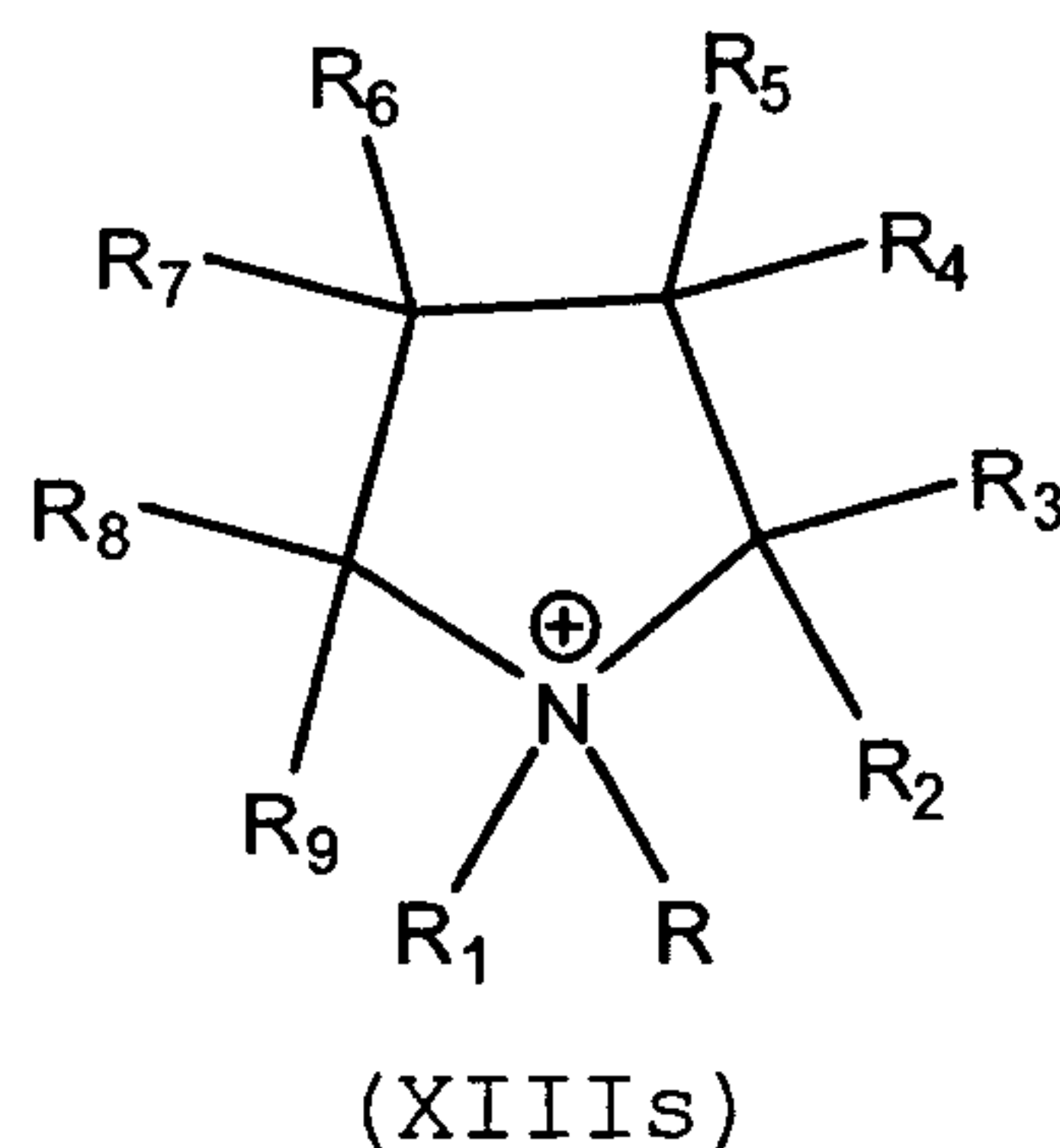
(XIIIr'')

20

where

R_1 is hydrogen, methyl or ethyl and R_2 and R_3 are each, independently of one another, hydrogen or methyl or R_2 and R_3 together are 1,4-buta-1,3-dienylene.

Additional possible ionic liquids are those in which the cation $[A]^+$ is a pyrrolidinium ion (XIIIIs),



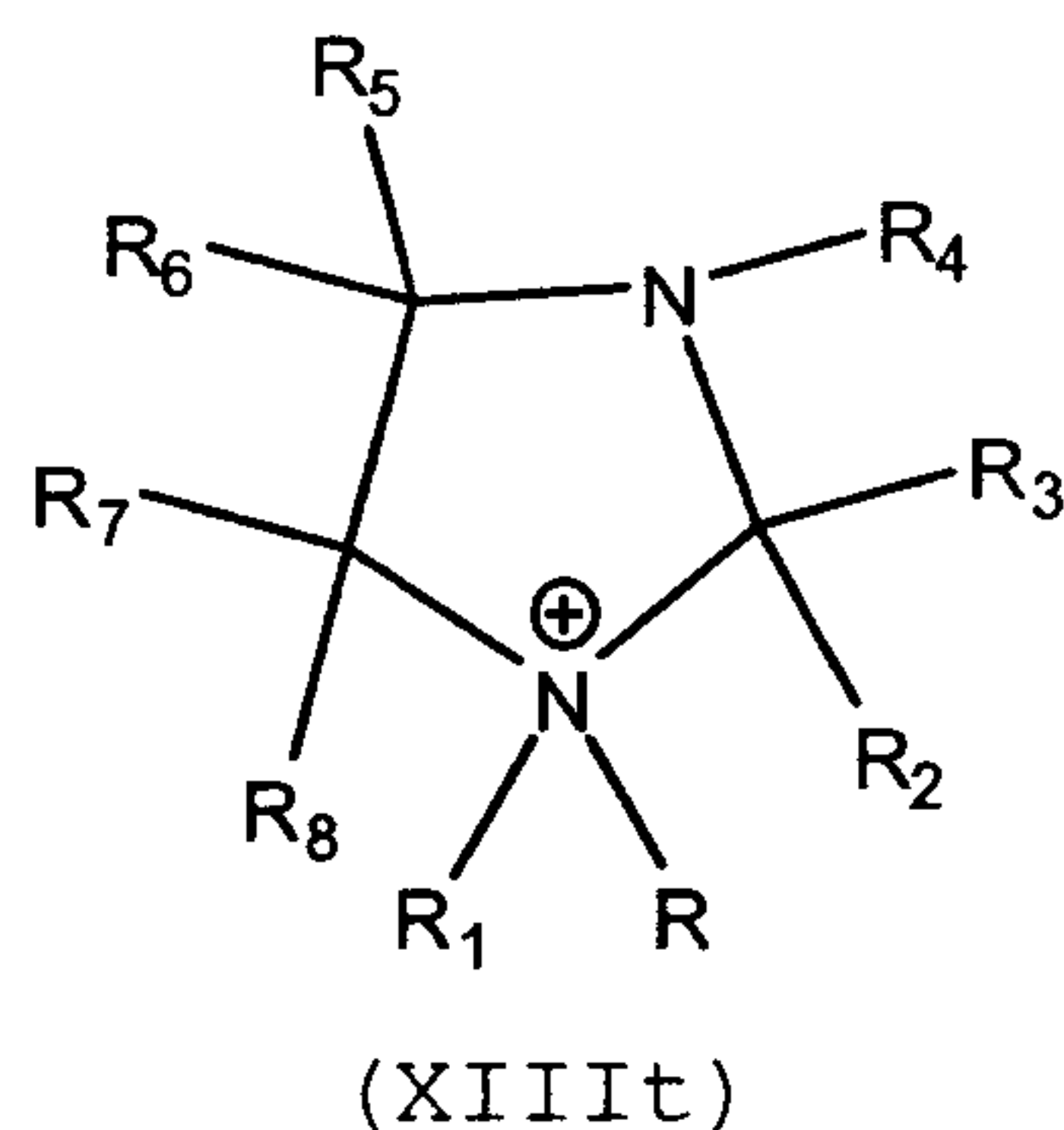
5

where

R_1 is hydrogen, methyl, ethyl or phenyl and R_2 to R_9 are each, independently of one another, hydrogen or methyl.

10

Additional possible ionic liquids are those in which the cation $[A]^+$ is an imidazolidinium ion (XIIIIt),



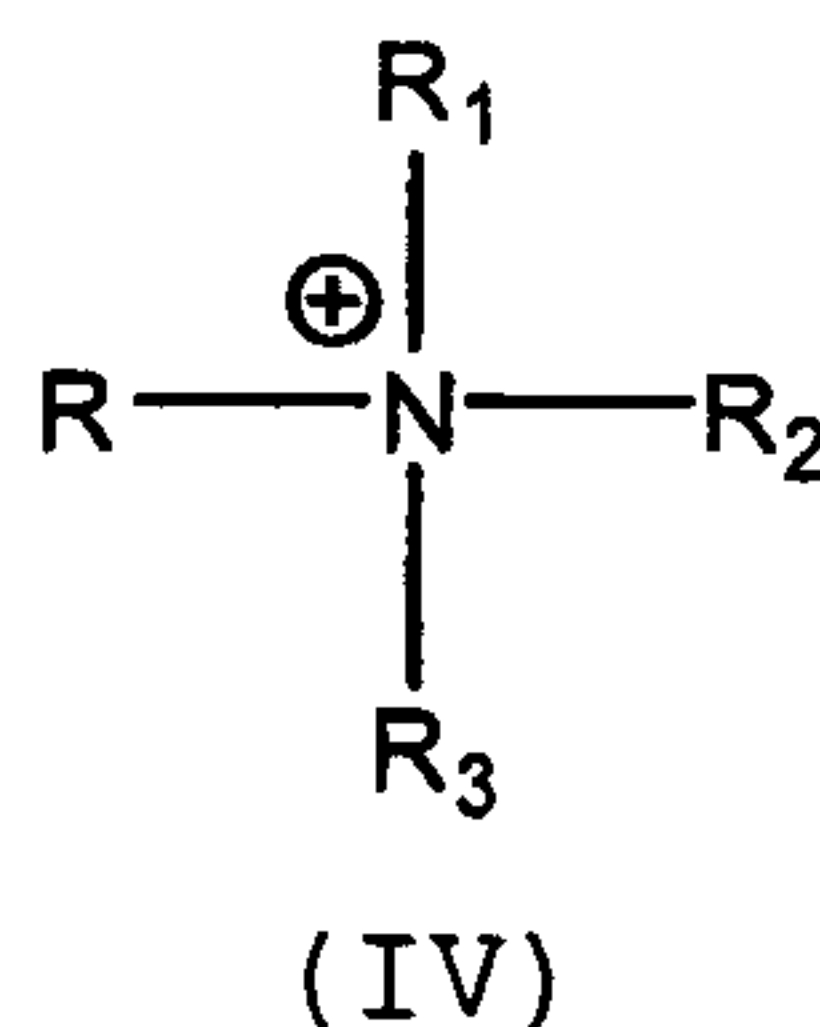
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where

R_1 and R_4 are each, independently of one another, hydrogen, methyl, ethyl or phenyl and R_2 and R_3 and also R_5 to R_8 are each, independently of one another, hydrogen or methyl.

20

Further possible ionic liquids are those in which the cation $[A]^+$ is an ammonium ion (IV),



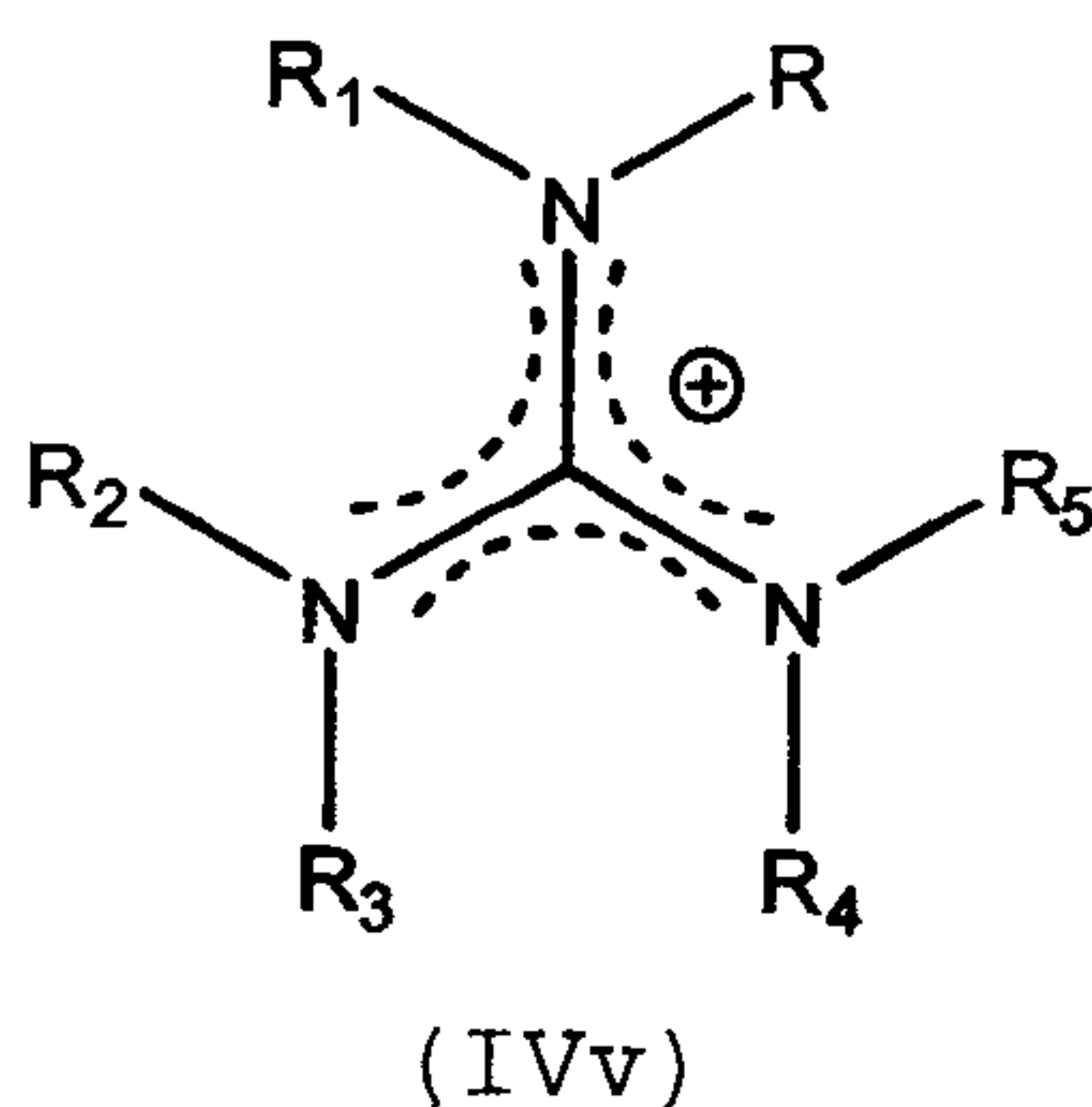
where

5 R_1 to R_3 are each, independently of one another, C1-C18-alkyl; or

R_1 to R_3 are each, independently of one another, hydrogen or C1-C18-alkyl and R_4 is 2-hydroxyethyl; or

10 R_1 and R_2 together are 1,5-pentylene or 3-oxa-1,5-pentylene and R_3 is C1-C18-alkyl, 2-hydroxyethyl or 2-cyanoethyl.

Particularly preferred ammonium ions (IV) are methyltri(1-butyl)ammonium, 2-hydroxyethylammonium, 15 bis(2-hydroxyethyl)dimethylammonium, N,N-dimethylpiperidinium and N,N-dimethylmorpholinium. Additional possible ionic liquids are those in which the cation $[A]^+$ is a guanidinium ion (IVv),



20

where

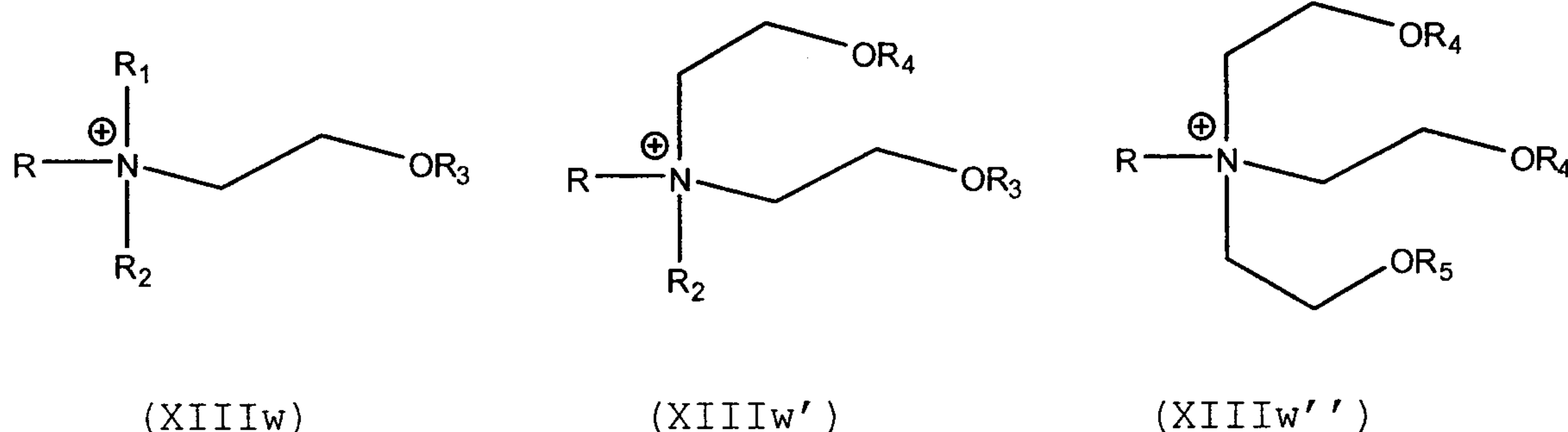
R_1 to R_5 are each methyl; or

25 R_1 to R_5 are each, independently of one another, C1-C18-alkyl; or

R_1 to R_5 are each, independently of one another, hydrogen or C1-C18-alkyl or 2-hydroxyethyl.

A very particularly preferred guanidinium ion (IVv) is
 5 N,N,N',N',N'',N''-hexamethylguanidinium.

Further possible ionic liquids are those in which the
 cation $[A]^+$ is a derivative of ethanolamine, e.g. a
 cholinium ion (XIIIw) or a diethanolamine (XIIIw') or a
 10 triethanolamine (XIIIw''),



15

where

R_1 and R_2 are each, independently of one another, methyl, ethyl, 1-butyl or 1-octyl and R_3 is hydrogen, methyl, ethyl, acetyl, $-SO_2OH$ or $-PO(OH)_2$; or

20 R_1 is methyl, ethyl, 1-butyl or 1-octyl, R_2 is a $-CH_2-CH_2-OR_4$ group and R_3 and R_4 are each, independently of one another, hydrogen, methyl, ethyl, acetyl, $-SO_2OH$ or $-PO(OH)_2$; or

R_1 is a $-CH_2-CH_2-OR_4$ group, R_2 is a $-CH_2-CH_2-OR_5$ group and
 25 R_3 to R_5 are each, independently of one another, hydrogen, methyl, ethyl, acetyl, $-SO_2OH$ or $-PO(OH)_2$; or

R_1 is methyl, ethyl, 1-butyl, 1-octyl, acetyl, $-SO_2OH$, or $-PO(OH)_2$ and R_3 to R_5 are each, independently of one
 another, hydrogen, methyl, ethyl, acetyl, $-SO_2OH$,
 30 $-PO(OH)_2$ or $-(C_nH_{2n}O)_mR_1$ where $n = 1$ to 5 and $m = 1$ to 100.

Preference is also given to compounds in which R, R₁ and R₂ are alkyl groups having from 1 to 4 carbon atoms, particularly preferably methyl groups, and R₃ and/or R₄ are saturated or unsaturated fatty acid or acyl radicals having from 8 to 22 carbon atoms, preferably from 12 to 18 carbon atoms. It is also possible for mixtures of acyl or fatty acid radicals (in particular, for example, in naturally occurring ratios) to be present.

10

In formula (XIIIw''), very particular preference is given to R, R₁, R₂ each being an alkyl radical having from 1 to 4 carbon atoms, in particular a methyl group, and R₃ being a fatty acid radical and R₄ and R₅ each being a fatty acid radical or hydrogen.

15

Possible ionic liquids include those in which the cation [A]⁺ is a phosphonium ion (VI) in which R₁ to R₃ are each, independently of one another, C1-C18-alkyl, in particular butyl, isobutyl, 1-hexyl or 1-octyl.

20

Among the abovementioned cations, preference is given to the pyridinium ions (XIIIa), imidazolium ions (XII) and ammonium ions (IV), in particular 1-methylpyridinium, 1-ethylpyridinium, 1-(1-butyl)pyridinium, 1-(1-hexyl)pyridinium, 1-(1-octyl)pyridinium, 1-(1-hexyl)pyridinium, 1-(1-octyl)pyridinium, 1-(1-dodecyl)pyridinium, 1-(1-tetradecyl)pyridinium, 1-(1-hexadecyl)pyridinium, 1,2-dimethylpyridinium, 1-ethyl-2-methylpyridinium, 1-(1-butyl)-2-methylpyridinium, 1-(1-hexyl)-2-methylpyridinium, 1-(1-octyl)-2-methylpyridinium, 1-(1-dodecyl)-2-methylpyridinium, 1-(1-tetradecyl)-2-methylpyridinium, 1-(1-hexadecyl)-2-methylpyridinium, 1-methyl-

25

30

2-ethylpyridinium, 1,2-diethylpyridinium, 1-(1-butyl)-2-ethylpyridinium, 1-(1-hexyl)-2-ethylpyridinium, 1-(1-octyl)-2-ethylpyridinium, 1-(1-dodecyl)-2-ethylpyridinium, 1-(1-tetradecyl)-2-ethylpyridinium, 1-(1-hexadecyl)-2-ethylpyridinium, 1,2-dimethyl-5-ethylpyridinium, 1,5-diethyl-2-methylpyridinium, 1-(1-butyl)-2-methyl-3-ethylpyridinium, 1-(1-hexyl)-2-methyl-3-ethylpyridinium, 1-(1-octyl)-2-methyl-3-ethylpyridinium, 1-(1-dodecyl)-2-methyl-3-ethylpyridinium, 1-(1-tetradecyl)-2-methyl-3-ethylpyridinium, 1-(1-hexadecyl)-2-methyl-3-ethylpyridinium, 1-methylimidazolium, 1-ethylimidazolium, 1-(1-butyl)imidazolium, 1-(1-octyl)imidazolium, 1-(1-dodecyl)imidazolium, 1-(1-tetradecyl)imidazolium, 1-(1-hexadecyl)imidazolium, 1,3-dimethylimidazolium, 1-ethyl-3-methylimidazolium, 1-(1-butyl)-3-methylimidazolium, 1-(1-hexyl)-3-methylimidazolium, 1-(1-octyl)-3-methylimidazolium, 1-(1-dodecyl)-3-methylimidazolium, 1-(1-tetradecyl)-3-methylimidazolium, 1-(1-hexadecyl)-3-methylimidazolium, 1,2-dimethylimidazolium, 1,2,3-trimethylimidazolium, 1-ethyl-2,3-dimethylimidazolium, 1-(1-butyl)-2,3-dimethylimidazolium, 1-(1-hexyl)-2,3-dimethylimidazolium and 1-(1-octyl)-2,3-dimethylimidazolium, 1,4-dimethylimidazolium, 1,3,4-trimethylimidazolium, 1,4-dimethyl-3-ethylimidazolium, 3-butylimidazolium, 1,4-dimethyl-3-octylimidazolium, 1,4,5-trimethylimidazolium, 1,3,4,5-tetramethylimidazolium, 1,4,5-trimethyl-3-ethylimidazolium, 1,4,5-trimethyl-3-butylimidazolium, 1,4,5-trimethyl-3-octylimidazolium and 2-hydroxyethylammonium.

30

The metal cations $[M^1]^+$, $[M^2]^+$, $[M^3]^+$, $[M^4]^{2+}$ and $[M^5]^{3+}$ mentioned in the formulae (IIIa) to (IIIj) are generally metal cations of groups 1., 2., 6., 7., 8., 9., 10., 11.,

12. and 13. of the Periodic Table. Suitable metal cations are, for example, Li^+ , Na^+ , K^+ , Cs^+ , Mg^{2+} , Ca^{2+} , Ba^{2+} , Cr^{3+} , Fe^{2+} , Fe^{3+} , Co^{2+} , Ni^{2+} , Cu^{2+} , Ag^+ , Zn^{2+} and Al^{3+} .

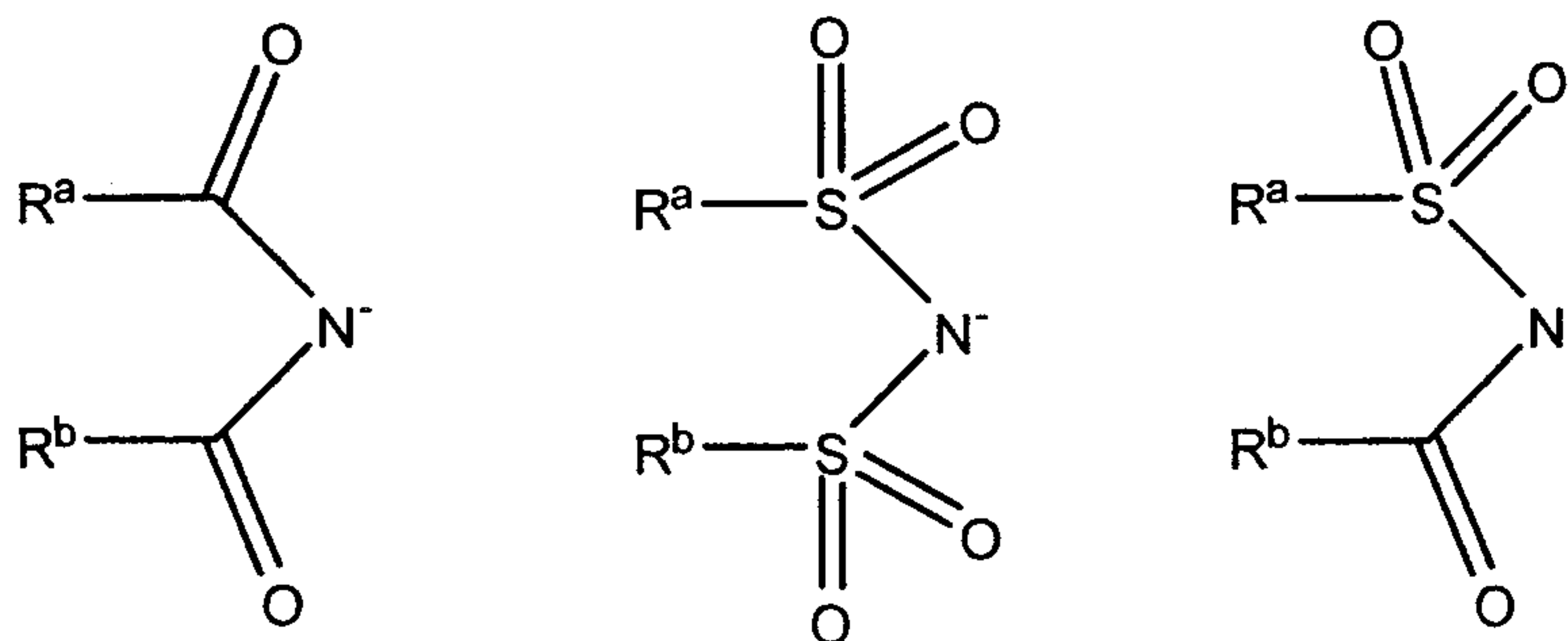
- 5 The ionic liquids used according to the invention comprise at least one of the abovementioned cations combined with, in each case, at least one anion. Possible anions are in principle all anions which in combination with the cation lead to an ionic liquid.
- 10 The anion $[\text{Y}]^{n-}$ of the ionic liquid is, for example, selected from:
- the group of halides and halogen-containing compounds of the formulae: F^- , Cl^- , Br^- , I^- , BF_4^- , PF_6^- , AlCl_4^- , Al_2Cl_7^- , $\text{Al}_3\text{Cl}_{10}^-$, AlBr_4^- , FeCl_4^- , BCl_4^- , SbF_6^- , AsF_6^- , ZnCl_3^- , SnCl_3^- ,
- 15 CuCl_2^- , CF_3SO_3^- , $(\text{CF}_3\text{SO}_3)_2\text{N}^-$, CF_3CO_2^- , $\text{CCl}_3\text{CO}_2^-$, CN^- , SCN^- , OCN^- , NO_2^- , NO_3^- , $\text{N}(\text{CN})^-$;
- the group of sulphates, sulphites and sulphonates of the general formulae: SO_4^{2-} , HSO_4^- , SO_3^{2-} , HSO_3^- , R^aOSO_3^- , R^aSO_3^- ;
- the group of phosphates of the general formulae: PO_4^{3-} ,
- 20 HPO_4^{2-} , H_2PO_4^- , $\text{R}^a\text{PO}_4^{2-}$, HR^aPO_4^- , $\text{R}^a\text{R}^b\text{PO}_4^-$;
- the group of phosphonates and phosphinates of the general formulae: R^aHPO_3^- , $\text{R}^a\text{R}^b\text{PO}_2^-$, $\text{R}^a\text{R}^b\text{PO}_3^-$;
- the group of phosphites of the general formulae: PO_3^{3-} , HPO_3^{2-} , H_2PO_3^- , $\text{R}^a\text{PO}_3^{2-}$, R^aHPO_3^- , $\text{R}^a\text{R}^b\text{PO}_3^-$;
- 25 the group of phosphonites and phosphinites of the general formulae: $\text{R}^a\text{R}^b\text{PO}_2^-$, R^aHPO_2^- , $\text{R}^a\text{R}^b\text{PO}^-$, R^aHPO^- ;
- the group of carboxylates of the general formula: R^aCOO^- ;
- the group of borates of the general formulae: BO_3^{3-} , HBO_3^{2-} , H_2BO_3^- , $\text{R}^a\text{R}^b\text{BO}_3^-$, R^aHBO_3^- , $\text{R}^a\text{BO}_3^{2-}$,
- 30 $\text{B}(\text{OR}^a)(\text{OR}^b)(\text{OR}^c)(\text{OR}^d)^-$, $\text{B}(\text{HSO}_4)^-$, $\text{B}(\text{R}^a\text{SO}_4)^-$;
- the group of boronates of the general formulae: $\text{R}^a\text{BO}_2^{2-}$, $\text{R}^a\text{R}^b\text{BO}^-$;

the group of carbonates and carbonic esters of the general formulae: HCO_3^- , CO_3^{2-} , R^aCO_3^- ;

the group of silicates and silicic esters of the general formulae: SiO_4^{4-} , HSiO_4^{3-} , $\text{H}_2\text{SiO}_4^{2-}$, H_3SiO_4^- , $\text{R}^a\text{SiO}_4^{3-}$,
 5 $\text{R}^a\text{R}^b\text{SiO}_4^{2-}$, $\text{R}^a\text{R}^b\text{R}^c\text{SiO}_4^-$, $\text{HR}^a\text{SiO}_4^{2-}$, $\text{H}_2\text{R}^a\text{SiO}_4^-$, $\text{HR}^a\text{R}^b\text{SiO}_4^-$;

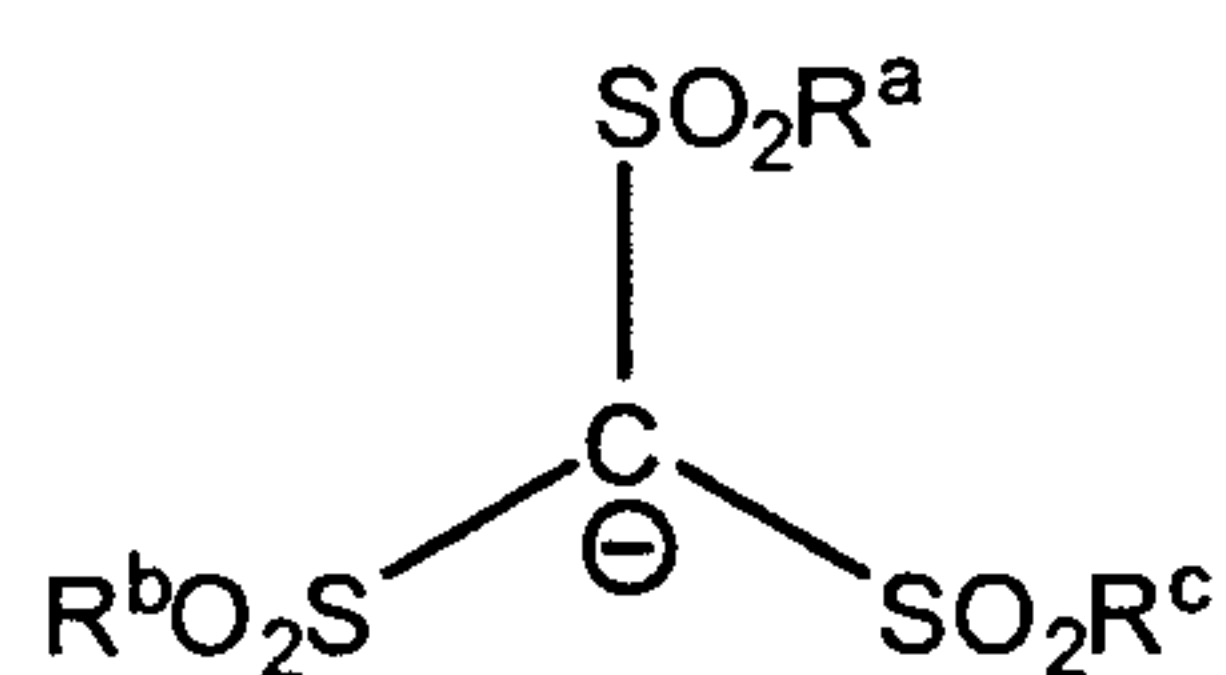
the group of alkylsilane and arylsilane salts of the general formulae: $\text{R}^a\text{SiO}_3^{3-}$, $\text{R}^a\text{R}^b\text{SiO}_2^{2-}$, $\text{R}^a\text{R}^b\text{R}^c\text{SiO}^-$,
 $\text{R}^a\text{R}^b\text{R}^c\text{SiO}_3^-$, $\text{R}^a\text{R}^b\text{R}^c\text{SiO}_2^-$, $\text{R}^a\text{R}^b\text{SiO}_3^{2-}$;

10 the group of carboximides, bis(sulphonyl)imides and sulphonylimides of the general formulae:



the group of methides of the general formula:

15



the group of alkoxides and aryloxides of the general formula: R^aO^- ;

20 the group of halometalates of the general formula $[\text{M}_r\text{Hal}_t]^{s-}$, where M is a metal and Hal is fluorine, chlorine, bromine or iodine, r and t are positive integers and indicate the stoichiometry of the complex and s is a positive integer and indicates the charge on
 25 the complex;

the group of sulphides, hydrogensulphides, polysulphides, hydrogenpolysulphides and thiolates of the general formulae:

5 S^{2-} , HS^{-} , $[S_v]^{2-}$, $[HS_v]^{-}$, $[R^a S]^{-}$, where v is a positive integer from 2 to 10;

the group of complex metal ions such as $Fe(CN)_6^{3-}$, $Fe(CN)_6^{4-}$, MnO_4^{-} , $Fe(CO)_4^{-}$.

Here, R^a , R^b , R^c and R^d are each, independently of one another, hydrogen; C_1 - C_{30} -alkyl and its aryl-,
 10 heteroaryl-, cycloalkyl-, halogen-, hydroxyl-, amino-, carboxy-, formyl-, -O-, -CO-, -CO-O- or -CO-N-substituted derivatives, for example methyl, ethyl, 1-propyl, 2-propyl, 1-butyl, 2-butyl, 2-methyl-1-propyl (isobutyl), 2-methyl-2-propyl (tert-butyl), 1-pentyl, 2-pentyl, 3-pentyl,
 15 2-methyl-1-butyl, 3-methyl-1-butyl, 2-methyl-2-butyl, 3-methyl-2-butyl, 2,2-dimethyl-1-propyl, 1-hexyl, 2-hexyl, 3-hexyl, 2-methyl-1-pentyl, 3-methyl-1-pentyl, 4-methyl-1-pentyl, 2-methyl-2-pentyl, 3-methyl-2-pentyl, 4-methyl-2-pentyl, 2-methyl-3-pentyl, 3-methyl-3-pentyl,
 20 2,2-dimethyl-1-butyl, 2,3-dimethyl-1-butyl, 3,3-dimethyl-1-butyl, 2-ethyl-1-butyl, 2,3-dimethyl-2-butyl, 3,3-dimethyl-2-butyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, icosyl, henicosyl,
 25 docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, phenylmethyl (benzyl), diphenylmethyl, triphenylmethyl, 2-phenylethyl, 3-phenylpropyl, cyclopentylmethyl, 2-cyclopentylethyl, 3-cyclopentylpropyl, cyclohexylmethyl, 2-cyclohexylethyl, 3-cyclohexylpropyl, methoxy, ethoxy,
 30 formyl, acetyl or $C_q F_{2(q-a)+(1-b)} H_{2a+b}$ where $q < 30$, $0 \leq a \leq q$ and $b = 0$ or 1 (for example CF_3 , C_2F_5 , $CH_2CH_2-C_{(q-2)}F_{2(q-2)+1}$, C_6F_{13} , C_8F_{17} , $C_{10}F_{21}$, $C_{12}F_{25}$);

C_3-C_{12} -cycloalkyl and its aryl-, heteroaryl-, cycloalkyl-, halogen-, hydroxyl-, amino-, carboxy-, formyl-, -O-, -CO- or -CO-O-substituted derivatives, for example cyclopentyl, 2-methyl-1-cyclopentyl, 3-methyl-1-cyclopentyl, cyclohexyl, 2-methyl-1-cyclohexyl, 3-methyl-1-cyclohexyl, 4-methyl-1-cyclohexyl or $C_qF_{2(q-a)-(1-b)}H_{2a-b}$ where $q \leq 30$, $0 \leq a \leq q$ and $b = 0$ or 1 ;

C_2-C_{30} -alkenyl and its aryl-, heteroaryl-, cycloalkyl-, halogen-, hydroxyl-, amino-, carboxy-, formyl-, -O-, -CO- or -CO-O-substituted derivatives, for example 2-propenyl, 3-butenyl, cis-2-butenyl, trans-2-butenyl or $C_qF_{2(q-a)-(1-b)}H_{2a-b}$ where $q \leq 30$, $0 \leq a \leq q$ and $b = 0$ or 1 ;

C_3-C_{12} -cycloalkenyl and its aryl-, heteroaryl-, cycloalkyl-, halogen-, hydroxyl-, amino-, carboxy-, formyl-, -O-, -CO- or -CO-O-substituted derivatives, for example 3-cyclopentenyl, 2-cyclohexenyl, 3-cyclohexenyl, 2,5-cyclohexadienyl or $C_qF_{2(q-a)-3(1-b)}H_{2a-3b}$ where $q \leq 30$, $0 \leq a \leq q$ and $b = 0$ or 1 ;

aryl or heteroaryl having from 2 to 30 carbon atoms, and their alkyl-, aryl-, heteroaryl-, cycloalkyl-, halogen-, hydroxyl-, amino-, carboxy-, formyl-, -O-, -CO- or -CO-O-substituted derivatives, for example phenyl, 2-methylphenyl (2-tolyl), 3-methylphenyl (3-tolyl), 4-methylphenyl, 2-ethylphenyl, 3-ethylphenyl, 4-ethylphenyl, 2,3-dimethylphenyl, 2,4-dimethylphenyl, 2,5-dimethylphenyl, 2,6-dimethylphenyl, 3,4-dimethylphenyl, 3,5-dimethylphenyl, 4-phenylphenyl, 1-naphthyl, 2-naphthyl, 1-pyrrolyl, 2-pyrrolyl, 3-pyrrolyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl or $C_6F_{(5-a)}H_a$ where $0 \leq a \leq 5$; or

two radicals form an unsaturated, saturated or aromatic ring which may be substituted by functional groups, aryl, alkyl, aryloxy, alkyloxy, halogen, heteroatoms and/or

heterocycles and may be interrupted by one or more oxygen and/or sulphur atoms and/or one or more substituted or unsubstituted imino groups.

Possible anions are, for example, chloride; bromide;
 5 iodide; thiocyanate; hexafluorophosphate;
 trifluoromethanesulphonate; methanesulphonate; formate;
 acetate; glycolate; lactate; oxalate; citrate; malate;
 maleate; tartrate; mandelate; nitrate; nitrite;
 trifluoroacetate; sulphate; hydrogensulphate;
 10 methylsulphate; ethylsulphate; 1-propylsulphate; 1-
 butylsulphate; 1-hexylsulphate; 1-octylsulphate;
 phosphate; dihydrogenphosphate; hydrogenphosphate; C₁-C₄-
 dialkylphosphate; propionate; tetrachloroaluminate;
 Al₂Cl₇⁻; chlorozincate; chloroferrate; bis(trifluoro-
 15 methylsulphonyl)imide; bis(pentafluoroethyl-
 sulphonyl)imide; bis(methylsulphonyl)imide; bis(p-
 tolylsulphonyl)imide; tris(trifluoromethylsulphonyl)-
 methide; bis(pentafluoroethylsulphonyl)methide; p-
 tolylsulphonate; tetracarbonylcobaltate; dimethylene-
 20 glycolmonomethylethersulphate; oleate; stearate;
 acrylate; methacrylate; maleate; hydrogencitrate;
 vinylphosphonate; bis(pentafluoroethyl)phosphinate;
 borates such as bis[salicylato(2-)]borate, bis[oxalato(2-
)]borate, bis[1,2-benzoldiolato(2-)-O,O']borate,
 25 tetracyanoborate, tetrafluoroborate; dicyanamide;
 tris(pentafluoroethyl)trifluorophosphate; tris(hepta-
 fluoropropyl)trifluorophosphate, cyclic arylphosphates
 such as catecholphosphate (C₆H₄O₂)P(O)O⁻ and
 chlorocobaltate.

30

Preferred anions are selected from the group consisting of, without making a claim as to completeness, halides, bis(perfluoroalkylsulphonyl)amides or bis(perfluoroalkyl-

sulphonyl)imides, e.g. bis(trifluoromethylsulphonyl)-
 imide, alkyltosylates and aryltosylates, perfluoro-
 alkyltosylates, nitrate, sulphate, hydrogensulphate,
 alkylsulphates and arylsulphates, polyether sulphates and
 5 polyethersulphonates, perfluoroalkylsulphates,
 sulphonate, alkylsulphonates and arylsulphonates,
 perfluorinated alkylsulphonates and arylsulphonates,
 alkylcarboxylates and arylcarboxylates,
 perfluoroalkylcarboxylates, perchlorate, tetrachloro-
 10 aluminate, saccharinate. Further preferred anions are
 dicyanamide, thiocyanate, isothiocyanate,
 tetraphenylborate, tetrakis(pentafluorophenyl)borate,
 tetrafluoroborate, hexafluorophosphate, polyether
 phosphates and phosphate.
 15 Very particularly preferred anions are chloride, bromide,
 hydrogensulphate, tetrachloroaluminate, thiocyanate,
 methylsulphate, ethylsulphate, methanesulphonate,
 formate, acetate, glycolate, lactate, dimethylphosphate,
 diethylphosphate, p-tolylsulphonate, tetrafluoroborate
 20 and hexafluorophosphate.

Very particularly preferred ionic liquids for the
 purposes of the present disclosure are:
 1-butyl-3-methylimidazolium 2-(2-methoxyethoxy)ethyl-
 25 sulphate, 1-butyl-3-methylimidazolium acetate, 1-ethyl-3-
 methylimidazolium acetate, tetrabutylammonium benzoate,
 trihexyltetradecylphosphonium bis(2,4,4-trimethylpentyl)-
 phosphinate, 1-ethyl-3-methylimidazolium bis(pentafluoro-
 ethylsulphonyl)imide, 1-butyl-1-methylpyrrolidinium
 30 bis(trifluoromethylsulphonyl)imide, 1-butyl-3-methyl-
 imidazolium bis(trifluoromethylsulphonyl)imide, 1-butyl-
 3-methylpyridinium bis(trifluoromethylsulphonyl)imide,
 1,2-dimethyl-3-propylimidazolium bis(trifluoromethyl-

sulphonyl)imide, 1-ethyl-3-methylimidazolium bis(tri-
 fluoromethylsulphonyl)imide, 3-methyl-1-propylpyridinium
 bis(trifluoromethylsulphonyl)imide, methyltrioctyl-
 ammonium bis(trifluoromethylsulphonyl)imide, tetrabutyl-
 5 ammonium bis(trifluoromethylsulphonyl)imide, trihexyl-
 tetradecylphosphonium bis(trifluoromethylsulphonyl)imide,
 1-butyl-1-methylpyrrolidinium bromide, 1-butylpyridinium
 bromide, 1-ethyl-3-methylimidazolium bromide, 4-methyl-N-
 butylpyridinium bromide, tetrabutylammonium bromide,
 10 tetrabutylphosphonium bromide, tetraheptylammonium
 bromide, tetrahexylammonium bromide, tetraoctylammonium
 bromide, tetraoctylphosphonium bromide,
 tetrapentylammonium bromide, tributylhexadecylphosphonium
 bromide, 1-allyl-3-methylimidazolium chloride, 1-benzyl-
 15 3-methylimidazolium chloride, 1-butyl-1-
 methylpyrrolidinium chloride, 1-butyl-2,3-
 dimethylimidazolium chloride, 1-butyl-3-methylimidazolium
 chloride, 1-butyl-4-methylpyridinium chloride, 1-ethyl-
 2,3-dimethylimidazolium chloride, 1-ethyl-3-
 20 methylimidazolium chloride, 1-hexyl-3-methylimidazolium
 chloride, 1-methyl-3-octylimidazolium chloride,
 methylimidazolium chloride, tetrabutylammonium chloride,
 tetrabutylphosphonium chloride, tetraheptylammonium
 chloride, tetraoctylammonium chloride,
 25 trihexyltetradecylphosphonium chloride, butylammonium α -
 cyano-4-hydrocinnamate, diethylammonium α -cyano-4-
 hydrocinnamate, trihexyltetradecylphosphonium decanoate,
 1-butyl-1-methylpyrrolidinium dicyanamide, 1-butyl-3-
 methylimidazolium dicyanamide, 1-ethyl-3-
 30 methylimidazolium dicyanamide, trihexyltetradecyl-
 phosphonium dicyanamide, 1-ethyl-2,3-dimethylimidazolium
 ethylsulphate, 1-ethyl-3-methylimidazolium ethylsulphate,
 1-benzyl-3-methylimidazolium hexafluorophosphate, 1-

butyl-2,3-dimethylimidazolium hexafluorophosphate, 1-
 butyl-3-(3,3-tridecafluorooctyl)imidazolium hexafluoro-
 phosphate, 1-butyl-3-methylimidazolium hexafluoro-
 phosphate, 1-ethyl-3-methylimidazolium hexafluoro-
 5 phosphate, 1-hexyl-3-methylimidazolium hexafluoro-
 phosphate, 1-methyl-3-(3,3-tridecafluorooctyl)imidazolium
 hexafluorophosphate, 1-butyl-4-methylpyridinium hexa-
 fluorophosphate, 1-methyl-3-octylimidazolium
 hexafluorophosphate, trihexyltetradecylphosphonium
 10 hexafluorophosphate, 1-butyl-3-methylimidazolium
 hydrogensulphate, 1-ethyl-3-methylimidazolium
 hydrogensulphate, methylimidazolium hydrogensulphate, 1-
 dodecyl-3-methylimidazolium hydrogensulphate, 1-dodecyl-
 3-methylimidazolium iodide, tetrahexylammonium iodide, 1-
 15 butyl-3-methylimidazolium methanesulphonate, 1-ethyl-3-
 methylimidazolium methanesulphonate, tetrabutylammonium
 methanesulphonate, tetrabutylphosphonium
 methanesulphonate, 1-butyl-3-methylimidazolium
 methylsulphate, 1,3-dimethylimidazolium methylsulphate,
 20 methyltributylammonium methylsulphate, 1-ethyl-3-
 methylimidazolium methylsulphate, 1,2,3-
 trimethylimidazolium methylsulphate, 1-butyl-3-
 methylimidazolium nitrate, 1-ethyl-3-methylimidazolium
 nitrate, tetrabutylammonium nonafluorobutanesulphonate,
 25 tetrabutylammonium heptadecafluorooctanesulphonate, 1-
 butyl-3-methylimidazolium octylsulphate, 4-(3-butyl-1-
 imidazolio)butane-1-sulphonate, 3-(triphenylphosphonio)-
 propane-1-sulphonate, 1-butyl-3-methylimidazolium
 tetrachloroaluminate, 1-ethyl-3-methylimidazolium
 30 tetrachloroaluminate, 1-benzyl-3-methylimidazolium
 tetrafluoroborate, 1-butyl-2,3-dimethylimidazolium
 tetrafluoroborate, 1-butyl-3-methylimidazolium
 tetrafluoroborate, 1-ethyl-3-methylimidazolium

tetrafluoroborate, 1-hexyl-3-methylimidazolium tetra-
 fluoroborate, 1-methyl-3-octylimidazolium tetrafluoro-
 borate, 1-butyl-1-methylpyrrolidinium tetrafluoroborate,
 1-butyl-4-methylpyridinium tetrafluoroborate, tetrabutyl-
 5 ammonium tetrafluoroborate, tetrahexylammonium
 tetrafluoroborate, tetrabutylphosphonium tetrafluoro-
 borate, trihexyltetradecylphosphonium tetrafluoroborate,
 1-butyl-3-methylimidazolium thiocyanate, 1-ethyl-3-
 methylimidazolium thiocyanate, tetrapentylammonium
 10 thiocyanate, trioctylmethylammonium thiosalicylate, 1-
 butyl-3-methylimidazolium tosylate, 1-ethyl-3-
 methylimidazolium tosylate, tetrabutylphosphonium
 tosylate, triisobutylmethylphosphonium tosylate, 3-
 (triphenylphosphonio)propane-1-sulphonic acid tosylate,
 15 tetraethylammonium trifluoroacetate, 4-(3-butyl-1-
 imidazolio)butane-1-sulphonic acid trifluoromethane-
 sulphonate, 1-butyl-3-methylimidazolium trifluoromethane-
 sulphonate, 1-ethyl-2,3-dimethylimidazolium trifluoro-
 methanesulphonate, 1-ethyl-3-methylimidazolium
 20 trifluoromethanesulphonate, 1-hexyl-3-methylimidazolium
 trifluoromethanesulphonate, 1-methyl-3-octylimidazolium
 trifluoromethanesulphonate, tetraethylammonium
 trifluoromethanesulphonate, 1,2,3-trimethylimidazolium
 trifluoromethanesulphonate, 1-hydroxyethyl-3-
 25 methylimidazolium 2-(2-methoxyethoxy)ethylsulphate, 1-
 hydroxyethyl-3-methylimidazolium acetate, 1-hydroxyethyl-
 3-methylimidazolium trifluoroacetate, 1-hydroxyethyl-3-
 methylimidazolium bis(trifluoromethylsulphonyl)imide, 1-
 hydroxyethyl-3-methylimidazolium bromide, 1-hydroxyethyl-
 30 3-methylimidazolium chloride, 1-hydroxyethyl-3-
 methylimidazolium decanoate, 1-hydroxyethyl-3-
 methylimidazolium dicyanamide, 1-hydroxyethyl-3-
 methylimidazolium hexafluorophosphate, 1-hydroxyethyl-3-

	methylimidazolium	hydrogensulphate,	1-hydroxyethyl-3-
	methylimidazolium	iodide,	1-hydroxyethyl-3-
	methylimidazolium	methanesulphonate,	1-hydroxyethyl-3-
	methylimidazolium	methysulphate,	1-hydroxyethyl-3-
5	methylimidazolium	ethylsulphate,	1-hydroxyethyl-3-
	methylimidazolium	nitrate,	1-hydroxyethyl-3-
	methylimidazolium	phosphate,	1-hydroxyethyl-3-
	methylimidazolium	octylsulphate,	1-hydroxyethyl-3-
	methylimidazolium	tetrachloroaluminate,	1-hydroxyethyl-3-
10	methylimidazolium	tetrafluoroborate,	1-hydroxyethyl-3-
	methylimidazolium	thiocyanate,	1-hydroxyethyl-3-
	methylimidazolium	salicylate,	1-hydroxyethyl-3-
	methylimidazolium	thiosalicylate,	1-hydroxyethyl-3-
	methylimidazolium	tosylate,	1-hydroxyethyl-3-
15	methylimidazolium	trifluoromethanesulphonate,	1-
	hydroxyethyl-3-methylimidazolium	lactate,	1-hydroxyethyl-
	3-methylimidazolium	glycolate,	1-hydroxyethyl-3-
	methylimidazolium	citrate,	1-hydroxyethyl-3-
	methylimidazolium	oxalate,	1-hydroxyethyl-3-
20	methylimidazolium	tartrate,	bis(hydroxyethyl)dimethyl-
	ammonium	acetate,	bis(hydroxyethyl)dimethylammonium
	trifluoroacetate,	bis(hydroxyethyl)dimethylammonium	
	bis(trifluoromethylsulphonyl)imide,	bis(hydroxyethyl)-	
	dimethylammonium	bromide,	bis(hydroxyethyl)dimethyl-
25	ammonium	chloride,	bis(hydroxyethyl)dimethylammonium
	decanoate,	bis(hydroxyethyl)dimethylammonium	dicyanamide,
	bis(hydroxyethyl)dimethylammonium	hexafluorophosphate,	
	bis(hydroxyethyl)dimethylammonium	hydrogensulphate,	
	bis(hydroxyethyl)dimethylammonium	iodide,	bis(hydroxy-
30	ethyl)dimethylammonium	methanesulphonate,	
	bis(hydroxyethyl)dimethylammonium	methysulphate,	
	bis(hydroxyethyl)dimethylammonium	ethylsulphate,	
	bis(hydroxyethyl)dimethylammonium	nitrate,	

bis(hydroxyethyl)dimethylammonium phosphate,
 bis(hydroxyethyl)dimethylammonium octylsulphate,
 bis(hydroxyethyl)dimethylammonium tetrachloroaluminate,
 bis(hydroxyethyl)dimethylammonium tetrafluoroborate,
 5 bis(hydroxyethyl)dimethylammonium thiocyanate,
 bis(hydroxyethyl)dimethylammonium salicylate,
 bis(hydroxyethyl)dimethylammonium thiosalicylate,
 bis(hydroxyethyl)dimethylammonium tosylate,
 bis(hydroxyethyl)dimethylammonium trifluoromethane-
 10 sulphonate, bis(hydroxyethyl)dimethylammonium lactate,
 bis(hydroxyethyl)dimethylammonium glycolate,
 bis(hydroxyethyl)dimethylammonium citrate,
 bis(hydroxyethyl)dimethylammonium oxalate,
 bis(hydroxyethyl)dimethylammonium tartrate.

15

In a further preferred embodiment of the invention, use
 is made of ionic liquids or mixtures thereof which
 contain a combination of a 1,3-dialkylimidazolium, 1,2,3-
 trialkylimidazolium, 1,3-dialkylimidazolinium and 1,2,3-
 20 trialkylimidazolinium cation with an anion selected from
 the group consisting of halides, bis(trifluoromethyl-
 sulphonyl)imide, perfluoroalkyltosylates, alkylsulphates
 and alkylsulphonates, perfluorinated alkylsulphonates and
 alkylsulphates, perfluoroalkylcarboxylates, perchlorate,
 25 dicyanamide, thiocyanate, isothiocyanate, tetraphenyl-
 borate, tetrakis(pentafluorophenyl)borate, tetrafluoro-
 borate, hexafluorophosphate.

Furthermore, it is also possible to use simple,
 30 commercially available, acyclic quaternary ammonium salts
 such as TEGO® IL T16ES, TEGO® IL K5MS, TEGO® IL DS or
 TEGO® IL 2MS (products of Evonik Goldschmidt GmbH).

Foams in aqueous systems are formed because amphiphilic and thus surface-active surfactant molecules accumulate at the water/gas interface and lead to a decrease in the surface tension. Owing to the resulting decreased surface
5 tension, a new water/gas interface (= foam) is easily created. In addition, the foam formed in an aqueous system is stabilized by the surfactants by means of various mechanisms.

10 Mention may be made here by way of example of the Gibbs-Maragoni effect which is known to those skilled in the art and also the electrostatic or steric repulsion of surfactant molecules at reduced foam lamella thickness. The antifoams developed for these aqueous surfactant
15 systems influence these stabilization mechanisms in various ways in which, for example, the displacement and deactivation of the surfactant molecules at the water/gas interface plays a role.

20 In contrast to aqueous, largely nonionic (surfactant-stabilized) systems, ionic liquids consist only of ionic components. Stabilization of the foam of an ionic liquid occurs by mechanisms different from those operating in an aqueous system. It should, in particular, instead
25 resemble the stabilization of the foams of organic nonaqueous oils (e.g. diesel oil) which occurs by means of impurities having nonsurfactant character.

It was all the more surprising to discover that
30 particularly antifoams which have been developed for defoaming surfactant-stabilized aqueous systems also have a good antifoaming effect in water-free (or low-water)

ionic liquids and thus achieve the object of the invention.

For the purposes of the present invention, antifoams
5 generally comprise hydrophobic oils which are insoluble
in water under use conditions or finely divided,
hydrophobic solids. The oils can contain finely divided,
hydrophobic particles to improve their action. Such
hydrophobic solids, oils or dispersions of particles in
10 oils can be modified by blending with additives (e.g.
emulsifiers) so that they can readily be emulsified with
little shear in aqueous applications. If appropriate,
these oils or dispersions can also be formulated directly
to form aqueous emulsions, with customary additives
15 (emulsifiers, thickeners, protective colloids,
preservatives) and homogenization techniques for emulsion
production being able to be used.

Examples of hydrophobic oils which are used in antifoam
20 formulations for aqueous systems are mineral oils (A),
vegetable oils (B), silicone oils (C), polyoxyalkylenes
(D), modified polysiloxanes (E) and mixtures of these
components.

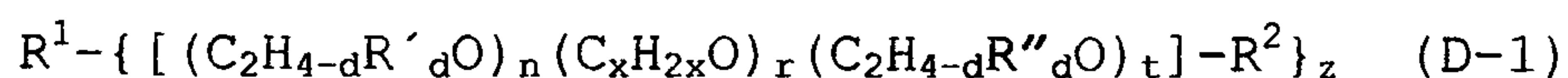
25 Examples of hydrophobic inorganic solids are optionally
hydrophobicized silica (F), aluminium oxide, alkaline
earth metal carbonates or the like, finely divided solids
which are known and customary in the prior art. Organic
hydrophobic substances are alkaline earth metal salts of
30 long-chain fatty acids having from 12 to 22 carbon atoms
which are known for this purpose, the amides of such
fatty acids, polyureas (G) and waxes (H) and also
mixtures of these solids.

The mineral oils **(A)** can be, in particular, fuel oils, mineral sealing oils, naphthene oils and paraffin oils.

5 The silicone oils **(C)** can be linear or branched polysiloxanes which have methyl and/or hydroxyl end groups and preferably have a viscosity of > 50 mPas, particularly preferably a viscosity in the range from 100 mPas to 10 000 mPas.

10

The polyoxyalkylenes **(D)** can have the general formula (D-1):



15

where R^1 corresponds to the radical of an alcohol, polyetherol or phenol R^1-H (the H belongs to the OH group of the alcohol or phenol). R^1-H is preferably a monohydric or polyhydric polyether alcohol or alcohol having a molar mass of preferably from 18 to 2000 g/mol and having from 1 to 8, preferably from 1 to 4, hydroxyl groups. Examples which may be mentioned are allyl alcohol, butanol, octanol, dodecanol, stearyl alcohol, 2-ethylhexanol, cyclohexanol, benzyl alcohol, ethylene glycol, propylene glycol, diethylene, triethylene and polyethylene glycols, 1,2-propylene glycol, dipropylene and polypropylene glycols, 1,4-butanediol, 1,6-hexanediol, trimethylolpropane, glycerol, pentaerythritol, sorbitol or hydroxyl-containing compounds based on natural materials.

20

25

30

- 43 -

Furthermore,

d is from 1 to 3,

n $\geq$ 0,

5 x is from 2 to 10, preferably from 2.5 to 4,

r $\geq$ 0 and is preferably from 5 to 350,

t $\geq$ 0,

n + r + t $\geq$ 1,

10 z is from 1 to 8, preferably from 1 to 4, particularly preferably 1 or 2, and

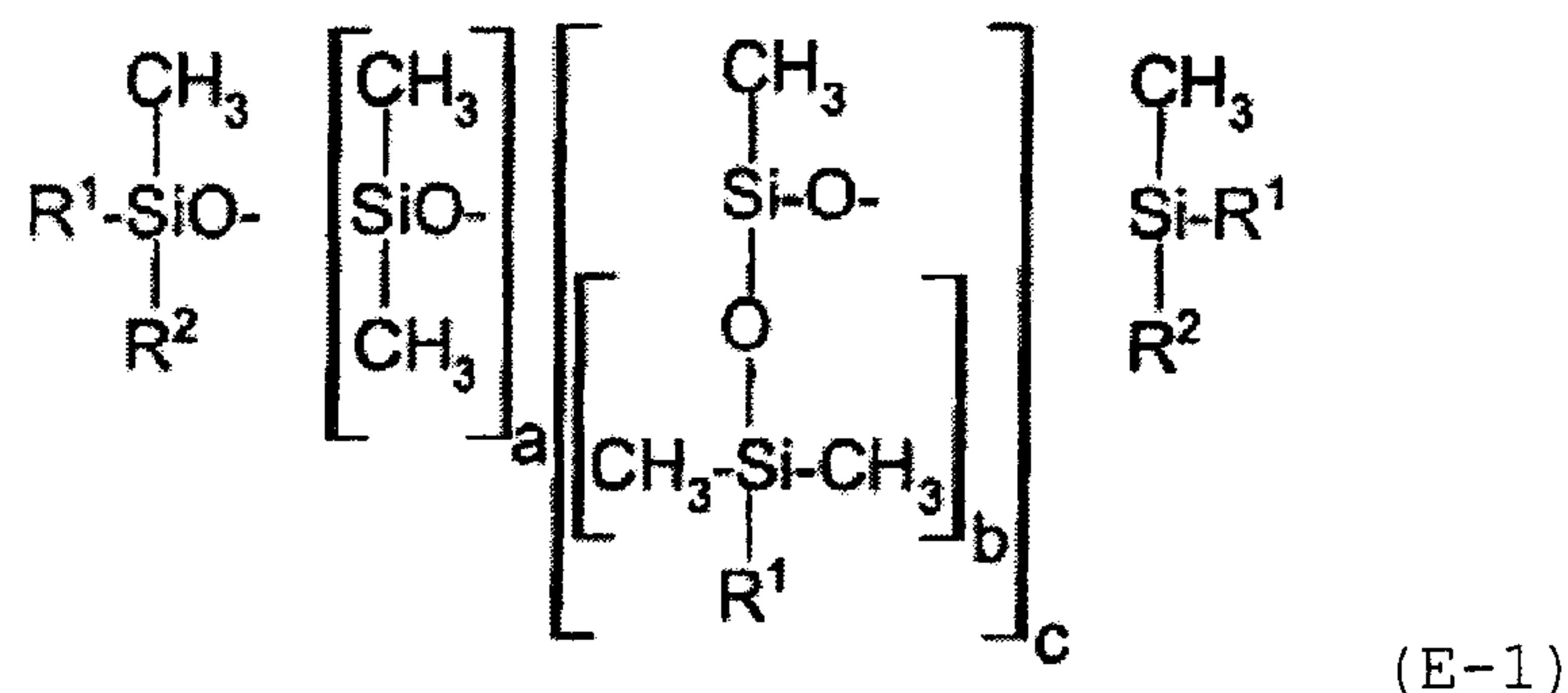
R' is a monovalent aromatic, unsubstituted or substituted hydrocarbon radical,

R'' is hydrogen or a monovalent hydrocarbon radical having from 1 to 18 carbon atoms,

15 R² is an H atom, a monovalent organic linear or branched alkyl radical having from 1 to 40 carbon atoms or a carboxy radical of a branched or unbranched alkyl or aryl ester.

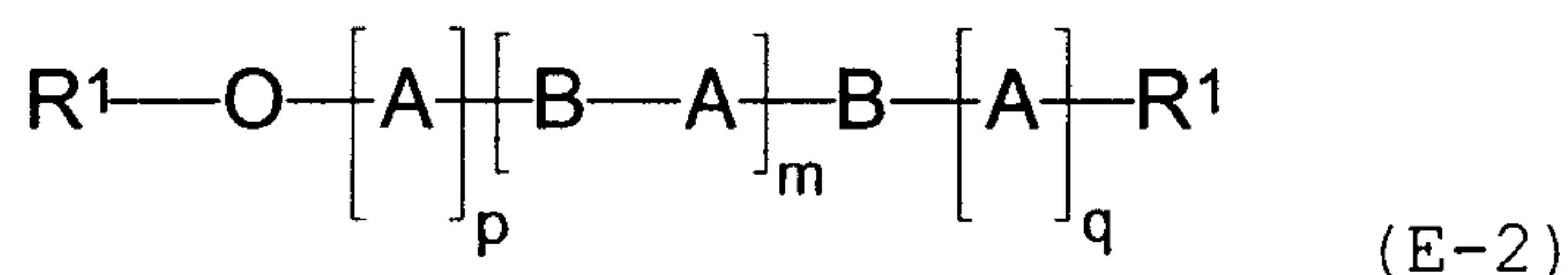
20 The compounds can be present either as pure compounds or in a statistical mixture with one another, with the numerical values indicated in the formulae corresponding to the mean of the statistical distribution of the value of the indices.

25 Suitable polysiloxanes (**E**) are described, for example, in DE 10353856 and DE 2829906. These can have the following structure (E-1),

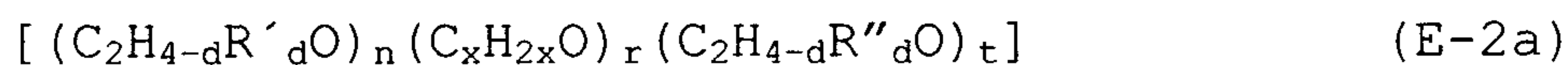


where the radicals R^1 in the average molecule can be identical or different and are each a possibly -OH-
 5 functional hydrocarbon radical which has from 1 to 14 carbon atoms and may contain double bonds or a radical -O- R^* where R^* is an alkyl radical having 1, 2, 3 or 4 carbon atoms or the radical -Z-($\text{C}_n\text{H}_{2n}\text{-O}$) $_m\text{R}'$, where R' is hydrogen or an alkyl radical having from 1 to 8
 10 carbon atoms or acyl,
 R^2 is phenyl, ethyl, methyl, hydroxyl, amine with at least 90% methyl,
 Z is a divalent radical of the formula -O-, -NH-, -NR³- where $\text{R}^3 = \text{C}_{1-4}\text{-alkyl radical}$, -S-, -(CH₂)_p-O- or
 15 -CH₂-CH(CH₃)-CH₂-O- where $p = 2, 3, 4$,
 n has an average numerical value of from > 2.5 to 4.0,
 m has an average numerical value of from 5 to 350,
 a has an average numerical value of from 4 to 1500,
 b has an average numerical value of from 0 to 100,
 20 c has an average numerical value of from 0 to 100.

Further suitable modified polysiloxanes have structures of the formula (E-2)



where the radical A is a polyoxyalkylene block of the average formula (E-2a),



5

where

d is from 1 to 3,

n $\geq$ 0,

x is from 2 to 10,

10 r $\geq$ 0,

t $\geq$ 0,

n + r + t $\geq$ 1,

and

15 R' is a monovalent aromatic, substituted or unsubstituted hydrocarbon radical,

R'' is hydrogen or a monovalent hydrocarbon radical having from 1 to 18 carbon atoms,

20 R¹ is an H atom, a monovalent organic linear or branched alkyl radical having from 1 to 40 carbon atoms or a carboxy radical of a branched or unbranched alkyl or aryl ester,

B is a polysiloxane block of the average formula (E-2b),



25

where the radicals

R² are identical or different and are each an alkyl radical having from 1 to 4 carbon atoms or a phenyl radical and

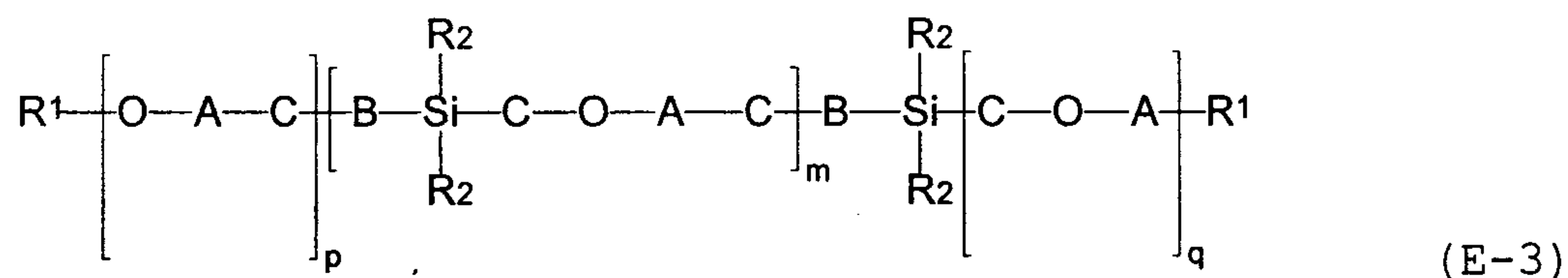
30 y is from 5 to 200,

m is from 2 to 100,

p is 0 or 1 and

q is 0 or 1.

Additional suitable modified polysiloxanes have
5 structures of the formula (E-3)



where the radicals

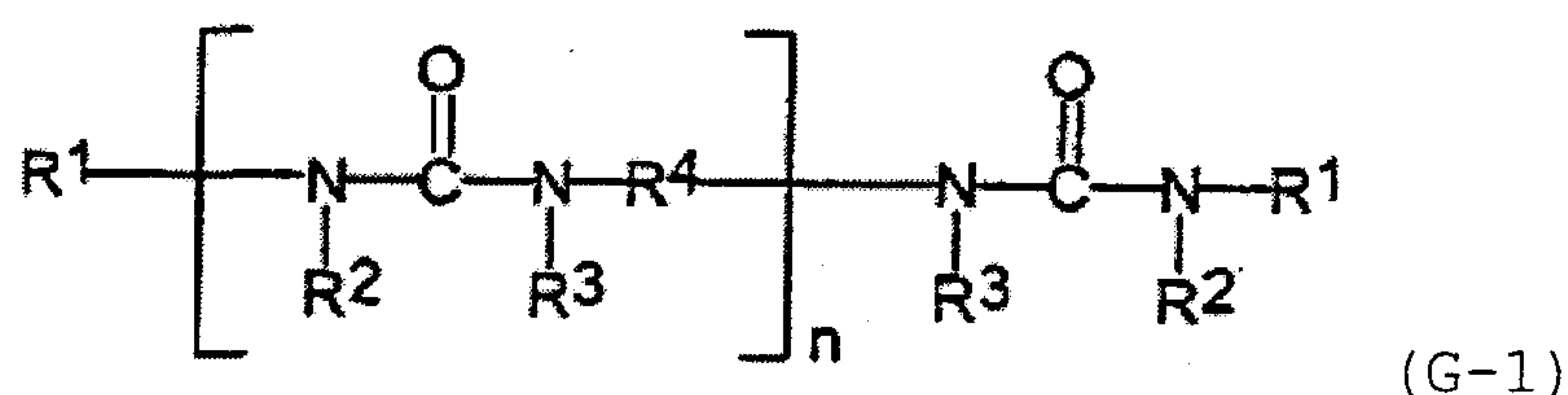
10 R^1 , A, B and m, p and q are as defined above in the case of structure (E-2) and

C is a linear or branched alkylene radical having from 2 to 20 carbon atoms.

15 The compounds can be present either as pure compounds or in a statistical mixture with one another, with the numerical values indicated in the formulae corresponding to the mean of the statistical distribution of the value of the indices.

20

Examples of urea derivatives (G) are described in DE 3245482 and DE 19917186. DE 19917186 indicates the general formula (G-1):



25

where R^1 is a hydrocarbon radical having from 4 to 30 carbon atoms or a hydrocarbon radical having from 4 to 24

carbon atoms and a nitrogen atom or a hydrocarbon radical having from 4 to 30 carbon atoms and a carbonyl group,

R^2 is a hydrogen atom or a hydrocarbon radical having from 1 to 24 carbon atoms,

5 R^3 is a hydrogen atom or a hydrocarbon radical having from 1 to 24 carbon atoms,

R^4 is an organic radical having from 2 to 30 carbon atoms and

$n = 0$ to 5.

10

Examples of waxes (H) are polyethylene waxes, polyamide waxes and mixtures thereof having a melting or softening point above the use temperature.

15 The compositions of the invention contain from 80 to 99.999% by weight, preferably from 90 to 99.999% by weight, in particular at least 95% by weight and particularly preferably from > 98 to 99.999% by weight, of one or more ionic liquids,

20 and from 0 to 20% by weight, preferably from 0 to 10% by weight and particularly preferably from 0 to 5% by weight, of solvents,

and from 0 to 20% by weight, preferably from 0 to 10% by weight and particularly preferably from 0 to 5% by weight, of auxiliaries and additives,

25 and from 0.001 to 10% by weight, preferably from 0.001 to 5% by weight and particularly preferably from 0.05 to 1% by weight, of one or more antifoams according to the invention,

30 where the sum of all components of the composition adds up to 100% by weight.

Further subjects of the invention are characterized by the claims.

5 The antifoams and compositions of the invention together with ionic liquids and their use are described by way of example below, without the invention being restricted to these illustrative embodiments.

10 Where ranges, general formulae or classes of compounds are indicated below, these are intended to encompass not only the ranges or groups of compounds which are specifically mentioned but also all subranges and subgroups of compounds which can be obtained by leaving out individual values (ranges) or compounds.

15

Examples:

20

The present invention is illustrated by way of example in the examples described below without the invention, whose scope is given by the entire description and the claims, being restricted to the embodiments presented in the
25 examples.

Table 1 below shows, by way of example, the basis of the active ingredients of commercially available products for defoaming aqueous systems.

30

Product	Hydrophobic oil	Hydrophobic particles
Rapeseed oil	B	-
Tegiloxan® 1000	C	-
TEGO® Antifoam 2290	A	H
TEGO® Antifoam 3062	E	F
TEGO® Antifoam 7001 XP	E	F
TEGO® Antifoam 793	E	F
TEGO® Antifoam KS 53	B	F
TEGO® Antifoam KE 600	D	F
TEGO® Antifoam KS 6	A	F
TEGO® Antifoam KS 911	D	-
TEGO® Antifoam MR 1015	E	F
TEGO® Antifoam MR 2101	E	G
TEGO® Antifoam MR 465	E	-
TEGO® Antifoam N	C	F
Tegopren® 3158	E	-
Tegopren® 5851	E	-
Paraffinic white oil	A	-

Testing by means of ASTM test D 892

5 The following tests were carried out using the ionic liquids TEGO® IL IM ES (1-methyl-3-ethylimidazolium ethylsulphate) and TEGO® IL T 16 ES (ethylbis(polyethoxy(8)ethyl)tallowammonium ethylsulphate).

10 The antifoaming effect was tested in a manner analogous to ASTM test D 892 at room temperature. For this purpose, 200 ml of the ionic liquid to be defoamed was introduced into a measuring cylinder of the ASTM apparatus and the cylinder was closed with a rubber stopper which has a

hole through which the air introduction rod was passed and to which the measurement body was affixed. A defined amount of gas (N_2 gas, compressed air or ambient air, if appropriate generated by means of an aquarium pump) 5 (90 ml/min) was passed through the liquid and foam was produced. It had to be ensured that the measurement body hangs centrally in the cylinder. After 5 minutes, the foam height was determined and the antifoam was introduced by means of a pipette. The collapse of the 10 foam was observed and the antifoaming effect was assessed after a further 5 minutes.

The antifoaming effect was assessed according to a scale of grades, as follows:

15

grade 1: foam ring up to a maximum of 50 ml of foam
grade 2: 50 ml - 100 ml of foam
grade 3: 100 ml - max. of foam

Table 2 below summarizes the results of the tests.

	Fresh values		4 Weeks storage	
	TEGO® IL IM ES	TEGO® IL T 16 ES	TEGO® IL IM ES	TEGO® IL T 16 ES
Blank (without antifoam)	3	3	3	3
TEGO® Antifoam MR 1015	1	1	1	1
Rapeseed oil		1		
TEGO® Antifoam 793	1	1	1	1
TEGO® Antifoam 7001 XP	1	1	1	1
TEGOPREN® 3158	1	2	1	2
Tegiloxan® 1000	1	1	1	1
TEGO® Antifoam KE 600	1	1	1	1
TEGO® Antifoam KS 6	1	1	1	1
TEGO® Antifoam 2290	1	1	1	1
TEGO® Antifoam 911	3	1	3	1
TEGO® Antifoam MR 465	3	1	3	1
TEGO® Antifoam 3062	1	1	1	1
TEGO® Antifoam N	1	2	1	2
White oil (viscosity = 25 mPas)		1		

Continuation of Table 2	Fresh values		4 Weeks storage	
	Addition of 5% of H ₂ O		Addition of 10% of H ₂ O	
	TEGO [®] IL IM ES	TEGO [®] IL T 16 ES	TEGO [®] IL IM ES	TEGO [®] IL T 16 ES
Blank (without antifoam)	3	3	3	3
TEGO [®] Antifoam MR 1015	1	1	1	1
TEGO [®] Antifoam 793	1	1	1	1
TEGO [®] Antifoam 7001 XP				
TEGOPREN [®] 3158				
Tegiloxan [®] 1000	2	1	2	2
TEGO [®] Antifoam KE 600				
TEGO [®] Antifoam KS 6	2	1	2	1
TEGO [®] Antifoam 2290				
TEGO [®] Antifoam 911				
TEGO [®] Antifoam 465				
TEGO [®] Antifoam 3062				
TEGO [®] Antifoam N	1	1	1	1

Table 2 shows that a better grade (1-2) than in the case of the blank (3) can be achieved throughout by use of the antifoam components.

The antifoaming effect can still be seen even when the ionic liquid contains water which is present as impurity and/or can be formed in industrial processes.

5

Test having mechanical foam instrument (DIN 53902/1)

The following tests were carried out using the ionic liquid Rewoquat® W 18 (dinortallowcarboxyethyl)hydroxy-
10 ethylmethylummonium methylsulphate).

The trial was carried out in a 6-cylinder mechanical foam instrument (DIN 53902/1).

15 The individual cylinders of the instrument are equipped with plungers made of perforated metal sheet which can be sent into rapid up and down motion during operation. An ml scale which enables the fill height to be read off before and after the test is provided on the outside of
20 the cylinder. The number of "strokes" can be set individually. The experiment was carried out at a temperature of 60°C (cylinders are surrounded by flowing water and heating can be provided by means of a thermostat). The test substances were brought to 60°C and
25 introduced into the cylinders. The cylinders were filled to the 250 ml mark with product and the fill levels were read off after 100 strokes of the plunger. The increase in the volume over 250 ml is caused by formation of foam due to the air introduced.

30

Two trials were carried out. In trial I, a sample containing pure ionic liquid Rewoquat W 18 and also 4 samples each containing 0.01% by weight of different

antifoams according to the invention were examined. In a second experiment, a sample containing pure ionic liquid Rewoquat® W 18 was tested together with 4 samples in which the amount of antifoam was increased to 0.05% by weight. The results are summarized in Table 3 below.

Ionic liquid: Rewoquat® W 15	Fill height after 100 strokes (initial height: 250 ml)
Antifoam	Trial I (use of 0.01% of antifoam)
Blank (no antifoam)	320 ml
TEGO® Antifoam 793	260 ml
TEGO® Antifoam 7001 XP	260 ml
TEGOPREN® 5851	280 ml
TEGO® Antifoam MR 465	280 ml

It can be seen that even an addition of only 0.01% by weight of antifoam results in a clear reduction in foaming compared to the blank.

An increase in the amount of antifoam to 0.05% by weight may enable the effect to be increased further; in the case of TEGO® Antifoam 7001 XP, a foam height of only 250 ml was found.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of defoaming a composition containing at least 80% by weight of one or more ionic liquids, the composition being free of ketone residues, ketone-aldehyde resins, and/or urea-aldehyde resins and/or their hydrogenated derivatives, the method comprising:

adding a polyether siloxane antifoam to said composition.

2. The method according to claim 1, wherein the antifoam contains finely divided, hydrophobic particles.

3. The method according to claim 1 or 2, wherein the antifoam contains further additives and emulsifiers.

4. The method according to any one of claims 1 to 3, wherein the antifoam has been emulsified in water using a customary additive comprising an emulsifier, a thickener, a protective colloid, or a preservative, or any combination thereof.

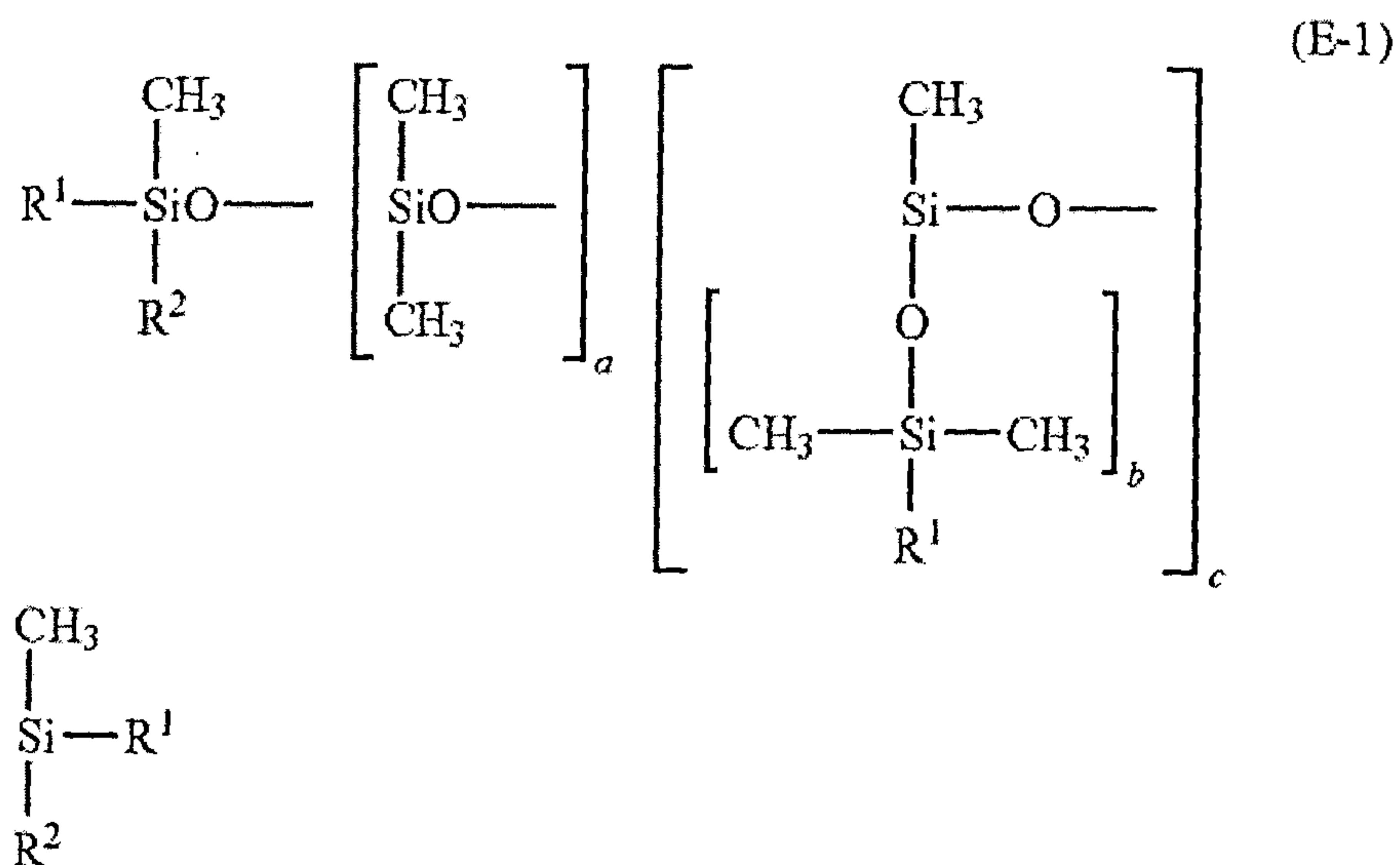
5. The method according to any one of claims 1 to 4, wherein the composition contains an organic solvent or water, or a mixture thereof.

6. The method according to claim 5, wherein the solvent is an organic solvent.

7. The method according to any one of claims 1 to 6, wherein said polyether siloxane is a compound of the general formula (E-1), (E-2), (E-2a), (E-2b), or (E-3);

wherein formula (E-1) is defined as:

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where:

R^1 in the average molecule can be identical or different and are each a radical $-\text{Z}-(\text{C}_n\text{H}_{2n}-\text{O})_m\text{R}'$, where R' is hydrogen or an alkyl radical having from 1 to 8 carbon atoms or acyl;

R^2 is phenyl, ethyl, methyl, hydroxyl, amine with at least 90% methyl;

Z is a divalent radical of the formula $-\text{O}-$, $-\text{NH}-$, $-\text{NR}^3-$ where $\text{R}^3=\text{C}_{1-4}$ -alkyl radical, $-\text{S}-$, $-(\text{CH}_2)_p-\text{O}-$ where $p=2, 3, 4$, or $-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{O}-$;

n has an average numerical value of from >2.5 to 4.0 ;

m has an average numerical value of from 5 to 350;

a has an average numerical value of from 4 to 1500;

b has an average numerical value of from 0 to 100;

and

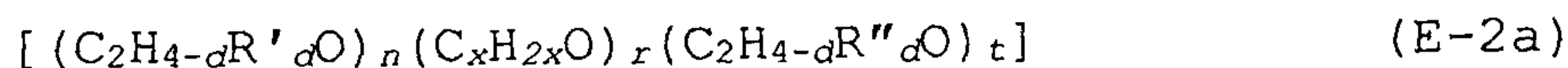
c has an average numerical value of from 0 to 100;

wherein formula (E-2) is defined as:



where the radical A is a polyoxyalkylene block of the average formula (E-2a);

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where:

d is from 1 to 3;

$n \geq 0$;

x is from 2 to 10;

$r \geq 0$;

$t \geq 0$;

$n + r + t \geq 1$;

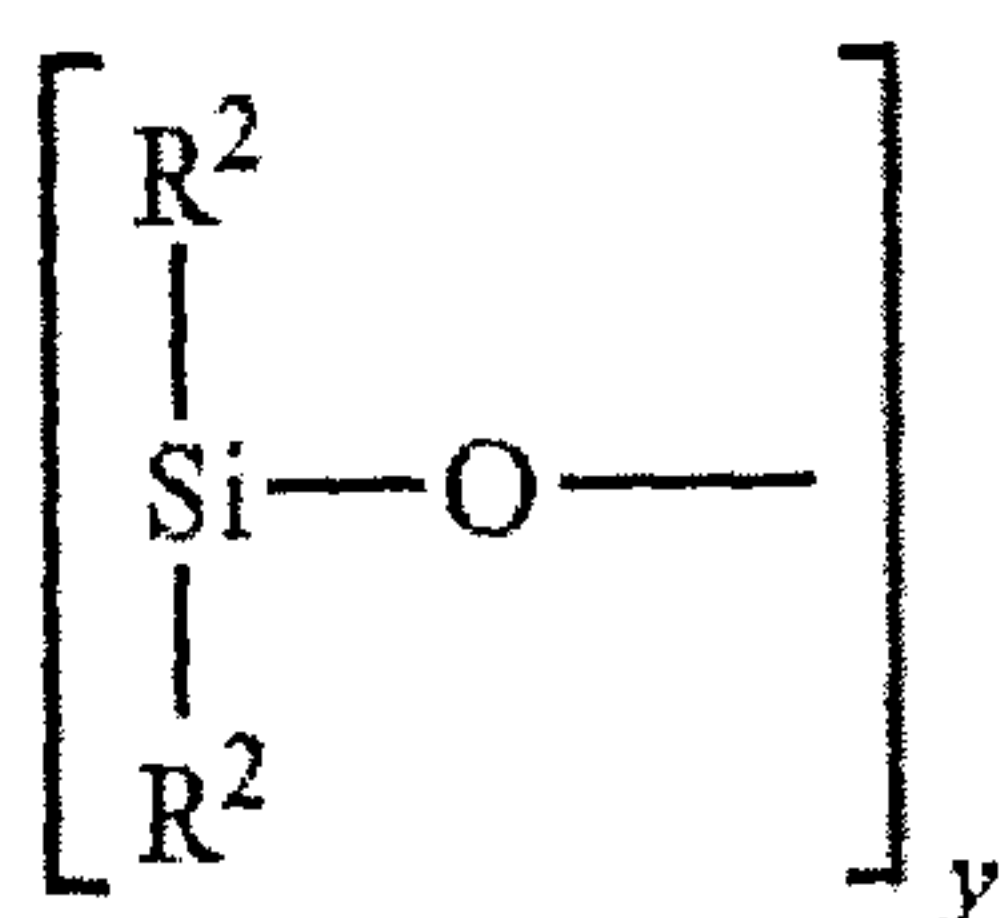
R' is a monovalent aromatic, substituted or unsubstituted hydrocarbon radical;

R'' is hydrogen or a monovalent hydrocarbon radical having from 1 to 18 carbon atoms; and

R¹ is an H atom, a monovalent organic linear or branched alkyl radical having from 1 to 40 carbon atoms or a carboxy radical of a branched or unbranched alkyl or aryl ester;

where the radical B is a polysiloxane block of the average formula (E-2b),

(E-2b)



where:

the radicals R² are identical or different and are each an alkyl radical having from 1 to 4 carbon atoms or a phenyl radical; and

y is from 5 to 200; and

where:

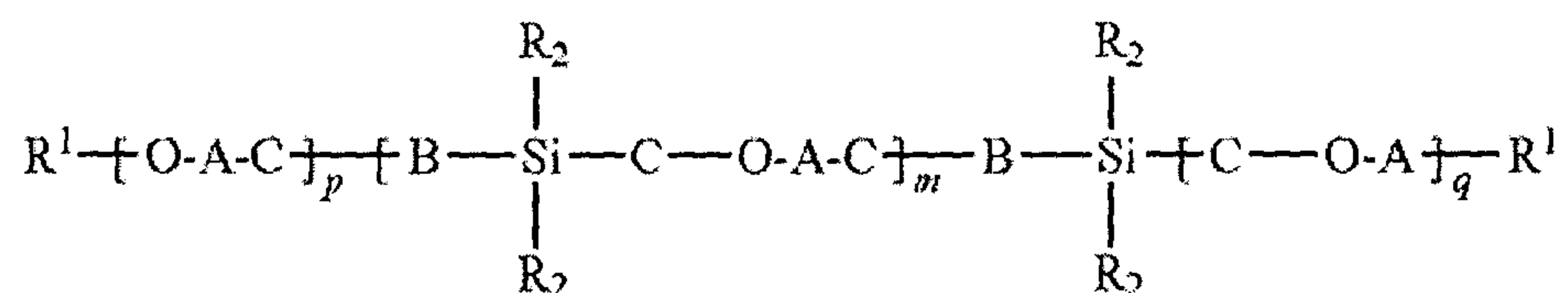
m is from 2 to 100;

p is 0 or 1; and

q is 0 or 1; and

wherein formula (E-3) is defined as:

(E-3)



where:

R^1 , A, B, m, p, and q are as defined above in the case of structure (E-2); and

C is a linear or branched alkylene radical having from 2 to 20 carbon atoms.

8. The method of any one of claims 1 to 7, further comprising:

after the polyether siloxane antifoam has been added to the composition to obtain a defoamed composition, performing an additional step of:

using the defoamed composition as a lubricant, a hydraulic fluid, a thermal fluid, an electrolyte liquid, an absorbent in an absorption refrigeration process, or a cleaning liquid, or any combination thereof; or

using the defoamed composition in a separation process, a biorefinery process, a cellulose spinning process or a cellulose derivatization.

9. The method of any one of claims 1 to 7, wherein the composition comprises:

from 80 to 99.999% by weight of one or more ionic liquids;

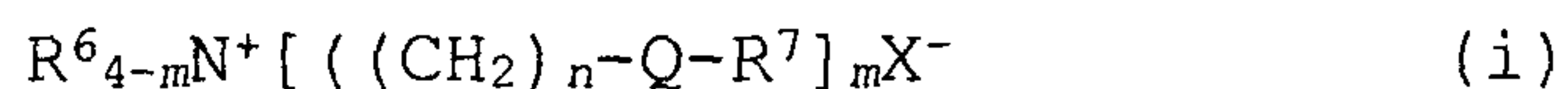
from 0 to 20% by weight of solvents; and

from 0 to 20% by weight of auxiliaries and additives; and

wherein said polyether siloxane antifoam is added in an amount of from 0.001 to 10% by weight.

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10. The method of any one of claims 1 to 7, wherein said one or more ionic liquids are compounds of formula (i):



where:

each radical R^6 is independently an alkyl group, or hydroxyalkyl group having from 1 to 6 carbon atoms, or a benzyl group;

each radical R^7 is independently hydrogen, a linear or branched alkyl group having from 11 to 22 carbon atoms, or a linear or branched alkenyl group having from 11 to 22 carbon atoms, with the proviso that at least one radical R^7 is not hydrogen;

Q is $-O-C(O)-$, $-C(O)O$, $-NR^8-C(O)-$, $-C(O)-NR^8-$, $-O-C(O)-O$, $-CHR^9-O-C(O)-$ or $-CH(OCOR^7)-CH_2-O-C(O)-$;

where R^8 is hydrogen, methyl, ethyl, propyl or butyl; and

where R^9 is hydrogen or methyl; and

X^{-} is chloride or methylsulphate.

11. The method of claim 10, wherein said one or more ionic liquids of formula (i) are each:

N,N-di(tallowyloxyethyl)-N,N-dimethylammonium chloride;

N,N-di(canolyloxyethyl)-N,N-dimethylammonium chloride;

N,N-di(tallowyloxyethyl)-N-methyl-N-(2-hydroxyethyl) ammonium methylsulphate;

N,N-di(canolyloxyethyl)-N-methyl-N-(2-hydroxyethyl) ammonium methylsulphate;

N,N-di(tallowylamidoethyl)-N-methyl-N-(2-hydroxyethyl) ammonium methylsulphate;

N,N-di(2-tallowyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

N,N-di(2-canolyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

- 60 -

N,N-di(2-tallowyloxyethylcarbonyloxyethyl)-N,N-ditnethylarmonium chloride;

N,N-di(2-canolyloxyethylcarbonyloxyethyl)-N,N-dimethylammonium chloride;

N-(2-tallowoyloxy-2-ethyl)-N-(2-tallowyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

N-(2-canolyloxy-2-ethyl)-N-(2-canolyloxy-2-oxo-ethyl)-N,N-dimethylammonium chloride;

N,N,N-tri(tallowyloxyethyl)-N-methylammonium chloride;

N,N,N-tri(canolyloxyethyl)-N-methylammonium chloride;

1,2-ditallowyloxy-3-N,N,N-trimethylammoniopropyl chloride; or

1,2-dicanolyloxy-3-N,N,N-trimethylammoniopropyl chloride.