CLAIMS

What is claimed is:

1. A compound represented by Formula (**AI**):

$$[R^1R^2R^3EH]_d^+[M^{k+}Q_n]^{d-} \qquad \textbf{(AI)}$$

wherein:

E is nitrogen or phosphorous;

d is 1, 2 or 3; k is 1, 2, or 3; n is 1, 2, 3, 4, 5, or 6; n - k = d;

R^1 is a C_1-C_{20} linear alkyl group; wherein R^1 is optionally substituted,

each of R^2 and R^3 is independently an optionally substituted C_1-C_{40} linear alkyl group or a meta- and/or para-substituted phenyl group, where the meta and para substituents are, independently, an optionally substituted C_1 to C_{40} hydrocarbyl group, an optionally substituted alkoxy group, an optionally substituted silyl group, a halogen, or a halogen containing group, wherein R^1, R^2, and R^3 together comprise 15 or more carbon atoms;

M is an element selected from group 13 of the Periodic Table of the Elements; and

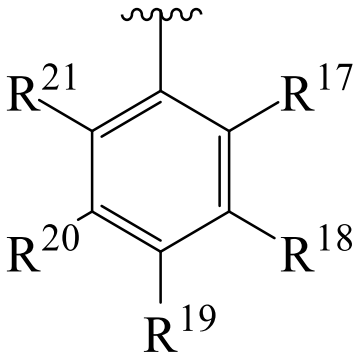
each Q is independently a hydride, bridged or unbridged dialkylamido, halide, alkoxide, aryloxide, hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, or halosubstituted-hydrocarbyl radical, provided that when Q is a fluorophenyl group, then R^2 is not a C_1-C_{40} linear alkyl group.

2. The compound of claim 1 wherein R^1 is C_1 to C_{10} linear alkyl group, preferably methyl; R^2 is a meta- and/or para-substituted phenyl group, where the meta and para substituents are, independently, an optionally substituted C_1 to C_{40} hydrocarbyl group, an optionally substituted alkoxy group, an optionally substituted silyl group, a halogen or a halogen containing group; and R^3 is an optionally substituted C_1-C_{40} linear alkyl group.

3. The compound of any of the above claims, wherein R^2 is a para substituted phenyl selected from the group consisting of methylphenyl, ethylphenyl, n-propylphenyl, n-butylphenyl, n-pentylphenyl, n-hexylphenyl, n-heptylphenyl, n-octylphenyl, n-nonylphenyl, n-decylphenyl, n-undecylphenyl, n-dodecylphenyl, n-tridecylphenyl, n-tetradecylphenyl, n-pentadecylphenyl, n-hexadecylphenyl, n-heptadecylphenyl, n-octadecylphenyl, n-nonadecylphenyl, n-icosylphenyl, n-henicosylphenyl, n-docosylphenyl, n-tricosylphenyl, n-tetracosylphenyl, n-pentacosylphenyl, n-hexacosylphenyl, n-heptacosylphenyl, n-octacosylphenyl, n-nonacosylphenyl, and n-tricontylphenyl.

4. The compound of any of claims 1 to 3, wherein R^2 is a meta substituted phenyl having one or two meta substituents, which may be the same or different, where the substituents are independently selected from the group consisting of: methylphenyl, ethylphenyl, n-propylphenyl, n-butylphenyl, n-pentylphenyl, n-hexylphenyl, n-heptylphenyl, n-octylphenyl, n-nonylphenyl, n-decylphenyl, n-undecylphenyl, n-dodecylphenyl, n-tridecylphenyl, n-tetradecylphenyl, n-pentadecylphenyl, n-hexadecylphenyl, n-heptadecylphenyl, n-octadecylphenyl, n-nonadecylphenyl, n-icosylphenyl, n-henicosylphenyl, n-docosylphenyl, n-tricosylphenyl, n-tetracosylphenyl, n-pentacosylphenyl, n-hexacosylphenyl, n-heptacosylphenyl, n-octacosylphenyl, n-nonacosylphenyl, n-tricontylphenyl.

5. The compound of any of claims 1 to 4, wherein the meta- and/or para-substituted phenyl group is represented by the formula:



, where R^{17} and R^{21} are hydrogen, and each of R^{18}, R^{19}, and R^{20} is independently selected from hydrogen, C_1-C_{40} hydrocarbyl or C_1-C_{40} substituted hydrocarbyl, halogen, or a halogen-containing group.

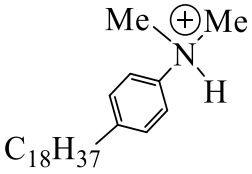
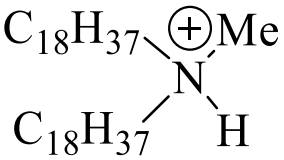
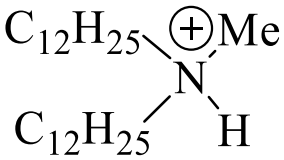
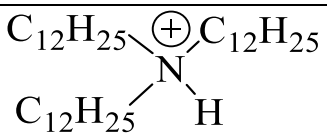
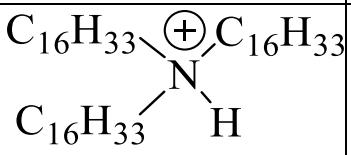
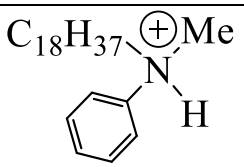
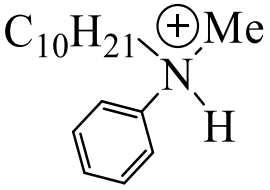
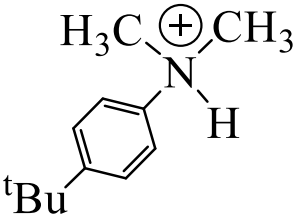
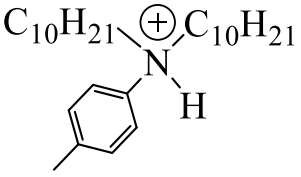
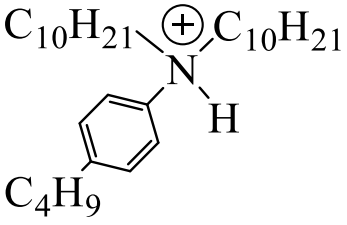
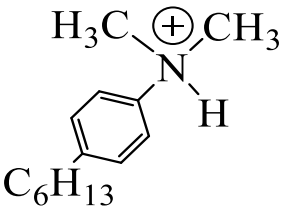
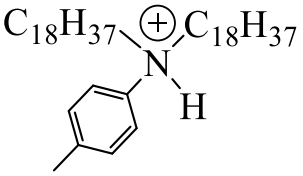
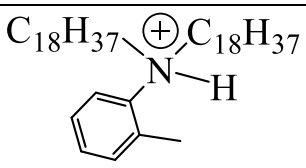
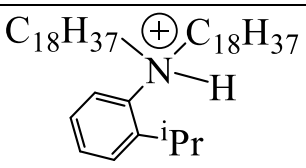
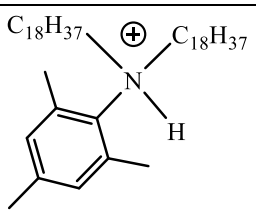
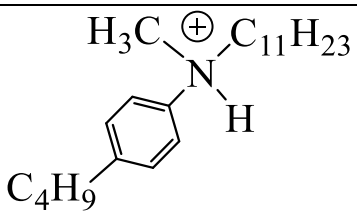
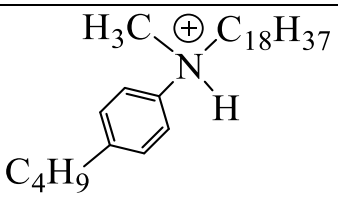
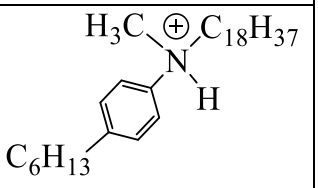
6. The compound of claim 1 wherein, $\mathbf{R^1}$ is methyl, $\mathbf{R^2}$ is n-hexyl, n-heptyl, n-octyl, n-nonyl, n-decyl, n-undecyl, n-dodecyl, n-tridecyl, n-tetradecyl, n-pentadecyl, n-hexadecyl, n-heptadecyl, n-octadecyl, n-nonadecyl, or n-icosyl, and $\mathbf{R^3}$ is methylphenyl, ethylphenyl, n-propylphenyl, n-butylphenyl, n-pentylphenyl, n-hexylphenyl, n-heptylphenyl, n-octylphenyl, n-nonylphenyl, n-decylphenyl, n-undecylphenyl, n-dodecylphenyl, n-tridecylphenyl, n-tetradecylphenyl, n-pentadecylphenyl, n-hexadecylphenyl, n-heptadecylphenyl, n-octadecylphenyl, n-nonadecylphenyl, or n-icosylphenyl.

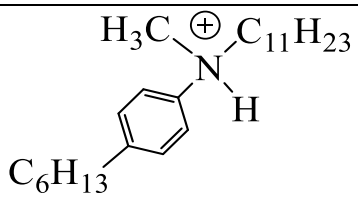
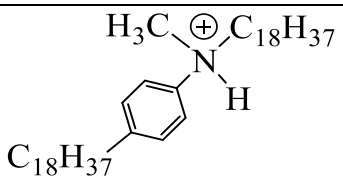
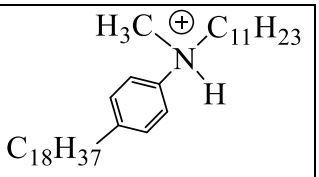
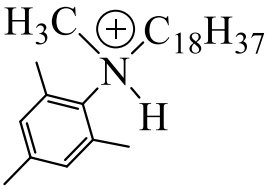
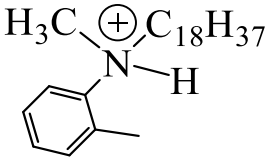
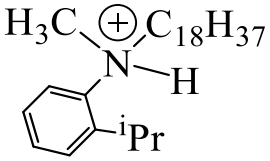
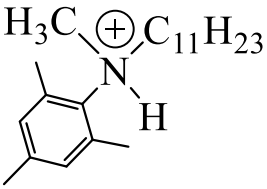
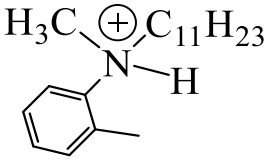
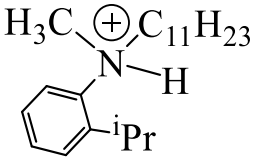
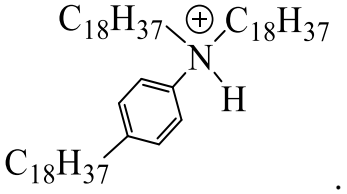
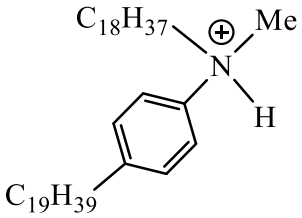
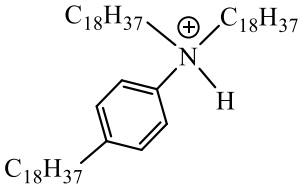
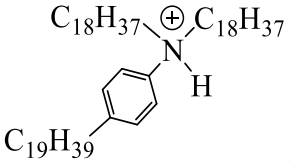
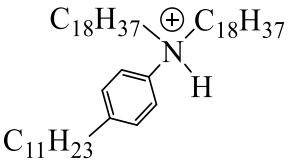
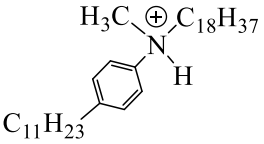
7. The compound of any of the above claims wherein E is nitrogen, M is boron; and Q is an optionally substituted aryl group, preferably a halogen substituted aryl group, preferably Q is a perfluoroaryl group such as perfluoronaphthyl.

8. The compound of any of the above claims wherein when Q is a fluorophenyl group, then R^2 is not an optionally substituted C_1-C_{40} linear alkyl group.

9. The compound of any of the above claims wherein when Q is a substituted phenyl group, then R^2 is not a C_1-C_{40} linear alkyl group.

10. The compound of claim any of the above claims, wherein the cation represented by the formula $[R^1R^2R^3EH]_d^+$ is selected from the group consisting of:

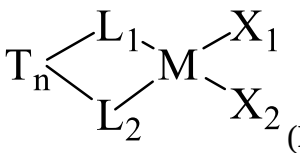
1		**2**		**3**	
4		**5**		**6**	
7		**8**		**9**	
10		**11**		**12**	
13		**14**		**15**	
16		**17 A**		**18**	

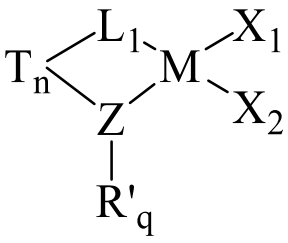
19		**20 A**		**21**	
22		**23**		**24**	
25		**26**		**27**	
28	 .	**29**		**30**	
31	 , and	**32**	 .	**33**	

11. The compound of any of claims 1 to 10, wherein the compound has a solubility of more than 10 mM at 25°C, stirred 2 hours, in methylcyclohexane and /or a solubility of more than 1 mM at 25°C, stirred 2 hours, in isohexane.

12. A catalyst system comprising a catalyst and the activator compound of any of claims 1 to 11; and optional support material.

13. The catalyst system of claim 12, wherein the catalyst is represented by formula (**II**) or formula (**III**):


(**II**)


(**III**),

wherein in formula (**II**) and formula (**III**): M is the metal center, and is a Group 4 metal; n is 0 or 1; T is an optional bridging group selected from dialkylsilyl, diarylsilyl, dialkylmethyl, ethylenyl or hydrocarbylethylenyl wherein one, two, three or four of the hydrogen atoms in ethylenyl are substituted by hydrocarbyl; Z is nitrogen, oxygen, sulfur, or phosphorus; R′ is a cyclic, linear or branched C_1 to C_{40} alkyl or substituted alkyl group, preferably R' is a linear C_1-C_{40} alkyl or substituted alkyl group, preferably a linear C_1-C_{40} alkyl or substituted alkyl group; q is 1 or 2; and X_1 and X_2 are, independently, hydrogen, halogen, hydride radicals, hydrocarbyl radicals, substituted hydrocarbyl radicals, halocarbyl radicals, substituted halocarbyl radicals, silylcarbyl radicals, substituted silylcarbyl radicals, germylcarbyl radicals, or substituted germylcarbyl radicals; or both X_1 and X_2 are joined and bound to the metal atom to form a metallacycle ring containing from 3 to 20 carbon atoms; or both together can be an olefin, diolefin or aryne ligand, the catalyst is optionally C2 symmetrical.

14. The catalyst system of claim 13, wherein the catalyst is one or more of:

rac-dimethylsilyl-bis(indenyl)hafnium dimethyl;

dimethylsilylbis(tetrahydroindenyl)MX_n;

dimethylsilyl bis(2-methylindenyl)MX_n;

dimethylsilyl bis(2-methylfluorenyl)MX_n;

dimethylsilyl bis(2-methyl-5,7-propylindenyl)MX_n;

dimethylsilyl bis(2-methyl-4-phenylindenyl)MX_n;

dimethylsilyl bis(2-ethyl-5-phenylindenyl)MX_n;

dimethylsilyl bis(2-methyl-4-biphenylindenyl)MX_n;

dimethylsilylene bis(2-methyl-4-carbazolylindenyl)MX_n;

rac-dimethylsilyl-bis-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-methyl-1H-benz(f)indene)MX_n;

diphenylmethylene (cyclopentadienyl)(fluoreneyl)MX_n;

bis(methylcyclopentadienyl)MX_n;

rac-dimethylsiylbis(2-methyl,3-propyl indenyl)MX_n;

dimethylsilylbis(indenyl)MX_n;

Rac-meso-diphenylsilyl-bis(n-propylcyclopentadienyl)MX_n;

1, 1'-bis(4-triethylsilylphenyl)methylene-(cyclopentadienyl)(3,8-di-tertiary-butyl-1-fluorenyl)MX_n (bridge is considered the 1 position);

bis-trimethylsilylphenyl-methylene(cyclopentadienyl)(di-t-butylfluorenyl)MX_n;

bis-trimethylsilylphenyl-methylene(cyclopentadienyl)(fluorenyl)MX_n;

bisphenylmethylene(cyclopentadienyl)(dimethylfluorenyl)MX_n;

bis(n-propylcyclopentadienyl)MX_n;

bis(n-butylcyclopentadienyl)MX_n;

bis(n-pentylcyclopentadienyl)MX_n;

(n-propyl cyclopentadienyl)(n-butylcyclopentadienyl)MX_n;

bis[(2-trimethylsilylethyl)cyclopentadienyl]MX_n;

bis(trimethylsilyl cyclopentadienyl)MX_n;

dimethylsilylbis(n-propylcyclopentadienyl)MX_n;

dimethylsilylbis(n-butylcyclopentadienyl)MX_n;

bis(1-n-propyl-2-methylcyclopentadienyl)MX_n;

(n-propylcyclopentadienyl)(1-n-propyl-3-n-butylcyclopentadienyl)MX_n;

bis(1-methyl, 3-n-butyl cyclopentadienyl)MX_n;

bis(indenyl)MX_n;

dimethylsilyl (tetramethylcyclopentadienyl)(cyclododecylamido)MX_n;

dimethylsilyl (tetramethylcyclopentadienyl)(t-butylamido)MX_n;

μ-$(CH_3)_2$Si(cyclopentadienyl)(l-adamantylamido)MX_n;

μ-$(CH_3)_2$Si(3-tertbutylcyclopentadienyl)(1-adamantylamido)MX_n;

μ-$(CH_3)_2$(tetramethylcyclopentadienyl)(1-adamantylamido)MX_n;

μ-$(CH_3)_2$Si(tetramethylcyclopentadienyl)(1-adamantylamido)MX_n;

μ-$(CH_3)_2$C(tetramethylcyclopentadienyl)(1-adamantylamido)MX_n;

μ-$(CH_3)_2$Si(tetramethylcyclopentadienyl)(1-tertbutylamido)MX_n;

μ-$(CH_3)_2$Si(fluorenyl)(1-tertbutylamido)MX_n;

μ-$(CH_3)_2$Si(tetramethylcyclopentadienyl)(1-cyclododecylamido)MX_n;

μ-$(C_6H_5)_2$C(tetramethylcyclopentadienyl)(1-cyclododecylamido)MX_n;

μ-$(CH_3)_2$Si(η^5-2,6,6-trimethyl-1,5,6,7-tetrahydro-s-indacen-1-yl)(tertbutylamido)MX_n;

bis(1-methyl, 3-n-butyl cyclopentadienyl) $M(R)_2$;

dimethylsilyl bis(indenyl)$M(R)_2$;

bis(indenyl)$M(R)_2$;

dimethylsilyl bis(tetrahydroindenyl)$M(R)_2$;

bis(n-propylcyclopentadienyl)$M(R)_2$;

dimethylsilyl (tetramethylcyclopentadienyl)(cyclododecylamido)$M(R)_2$;

dimethylsilyl (tetramethylcyclopentadienyl)(cyclododecylamido)$M(R)_2$;

dimethylsilyl (tetramethylcyclopentadienyl)(t-butylamido)$M(R)_2$;

dimethylsilyl (tetramethylcyclopentadienyl)(t-butylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(cyclopentadienyl)(l-adamantylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(3-tertbutylcyclopentadienyl)(1-adamantylamido)$M(R)_2$;

μ-$(CH_3)_2$(tetramethylcyclopentadienyl)(1-adamantylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(tetramethylcyclopentadienyl)(1-adamantylamido)$M(R)_2$;

μ-$(CH_3)_2$C(tetramethylcyclopentadienyl)(1-adamantylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(tetramethylcyclopentadienyl)(1-tertbutylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(fluorenyl)(1-tertbutylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(tetramethylcyclopentadienyl)(1-cyclododecylamido)$M(R)_2$;

μ-$(C_6H_5)_2$C(tetramethylcyclopentadienyl)(1-cyclododecylamido)$M(R)_2$;

μ-$(CH_3)_2$Si(η^5-2,6,6-trimethyl-1,5,6,7-tetrahydro-s-indacen-1-yl)(tertbutylamido)$M(R)_2$;

where M is selected from Ti, Zr, and Hf; R is selected from halogen or C_1 to C_5 alkyl; X is selected from the group consisting of halogens, hydrides, $C_{1\text{-}12}$ alkyls, $C_{2\text{-}12}$ alkenyls, $C_{6\text{-}12}$ aryls, $C_{7\text{-}20}$ alkylaryls, $C_{1\text{-}12}$ alkoxys, $C_{6\text{-}16}$ aryloxys, $C_{7\text{-}18}$ alkylaryloxys, $C_{1\text{-}12}$ fluoroalkyls, $C_{6\text{-}12}$ fluoroaryls, and $C_{1\text{-}12}$ heteroatom-containing hydrocarbons, substituted derivatives thereof, and combinations thereof, and where n is zero or an integer from 1 to 4, preferably X is selected from halogens , or C_1 to C_{20} alkyls and n is 1 or 2, preferably 2.

15. The catalyst system of claim 12, wherein the catalyst selected from pyridyldiamido complexes; quinolinyldiamido complexes; phenoxyimine complexes; bisphenolate complexes; cyclopentadienyl-amidinate complexes; and iron pyridyl bis(imine) complexes or any combination thereof, including any combination with metallocene complexes.

16. A method of polymerizing olefins to produce at least one polyolefin, the method comprising contacting at least one olefin with the catalyst system of any of claims 12-15, and obtaining a polyolefin.

17. The method of claim 16, wherein the method is performed in the absence of aromatic solvents.

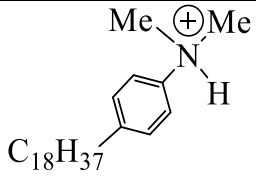
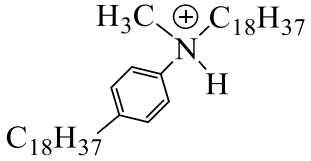
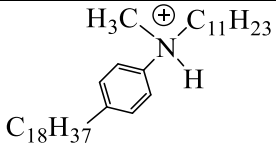
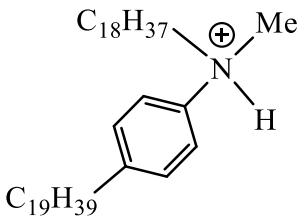
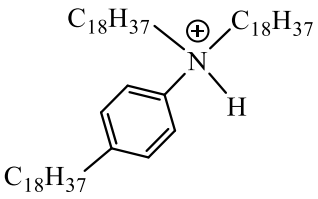
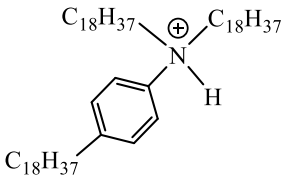
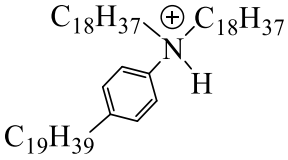
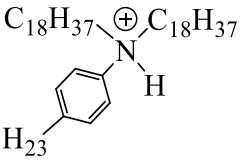
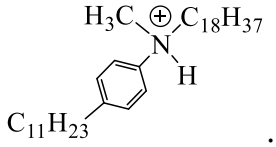
18. A composition comprising the compound of any of claims 1-11 or the catalyst system of any of claims 12-15 and an aliphatic solvent, where aromatic solvents are absent.

19. A compound represented by Formula:

$$[\text{cation}]^+[MQ_4]^- \qquad (\textbf{AI})$$

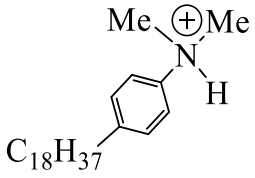
wherein:

M is an element selected from group 13 of the Periodic Table of the Elements; each Q is independently a hydride, bridged or unbridged dialkylamido, halide, alkoxide, aryloxide, hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, or halosubstituted-hydrocarbyl radical; and the [cation]+ is selected from the group consisting of:

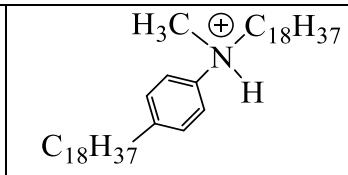
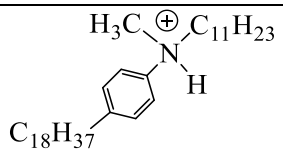
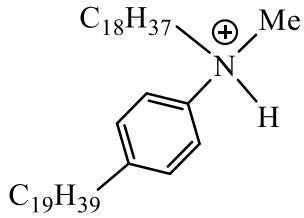
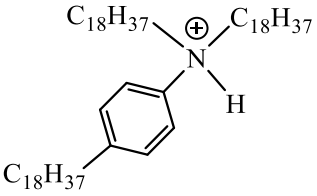
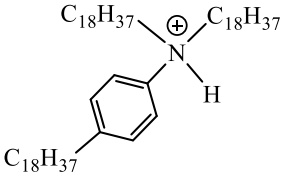
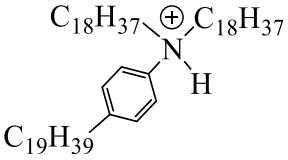
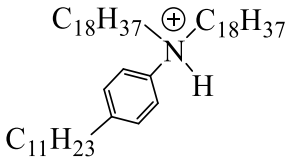
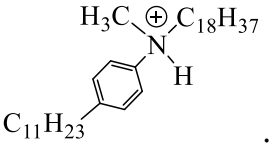
1		**2**		**3**	
4		**5**		**6**	
7		**8**		**9**	 .

20. The compound of claim 19, wherein the $[MQ_4]^-$ is perfluoroaryl.

21. The compound of claim 19, wherein the [cation]+ is

 .

22. The compound of claim 19, wherein the [cation]+ is selected from the group consisting of

2		**3**			
4		**5**		**6**	
7		**8**		**9**	

23. A catalyst system comprising a catalyst and the activator compound of claim 19.

24. A method of polymerizing olefins to produce at least one polyolefin, the method comprising contacting at least one olefin with the catalyst system claim 23, and obtaining a polyolefin.

25. The method of claim 24, wherein the at least one olefin is propylene and the polyolefin is isotactic polypropylene.

26. A composition or solution comprising the catalyst system of claim 23 and an aliphatic solvent, where aromatic solvents are absent.

27. A method of polymerizing olefins to produce at least one polyolefin, the method comprising contacting two or more different olefins with the catalyst system of claim 23; and obtaining a polyolefin.