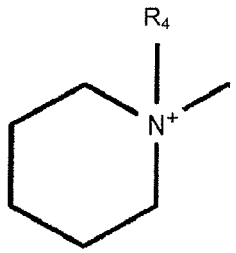
CLAIMS

What is claimed is:

1. A method of synthesizing a crystalline molecular sieve having an **MSE** framework type, the method comprising crystallizing a reaction mixture comprising a source of water, a source of an oxide of a tetravalent element, Y, selected from at least one of silicon, tin, titanium, vanadium, and germanium, optionally a source of a trivalent element, X, a source of an alkali or alkaline earth metal, M, and a source of organic cations, Q, having the following general structure:

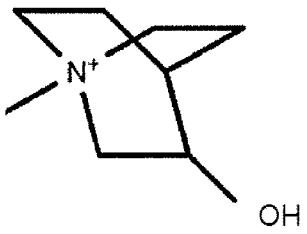
$$R_1\text{-}R_3\text{-}R_2$$

where R_1 and R_2 are the same or different, and where R_1 or R_2 or both R_1 and R_2 are an N-alkylpiperidinium group of the formula



(I)

or where R_1 or R_2 or both R_1 and R_2 are a quinuclidinium group of the formula



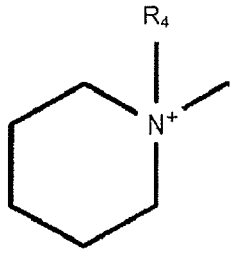
(II)

where R_3 is an polymethylene group of the formula $(CH_2)_n$, where n is from 4 to 6, or where R_3 is a cylcoalkylene group having from 5 to 8 carbon atoms, and

where R_4 is an alkyl group having 1 to 4 carbon atoms~~, for example a methyl group~~.

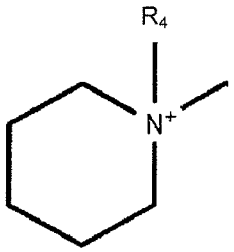
2. The method of claim 1, wherein R_4 is a methyl group.

~~2.~~3. The method of claim ~~1~~ 2, wherein R_1 and R_2 are both an N-alkylpiperidinium group of the formula



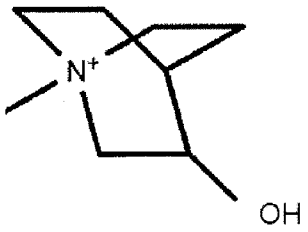
(I)

~~3.~~4. The method of claim ~~1~~ 2, wherein R_1 is an N-alkylpiperidinium group of the formula



(I)

where R_2 is a quinuclidinium group of the formula



(II)

and where n is 4 or 5.

~~4.~~5. The method of ~~any one of the previous claims~~ claim 1, wherein a molar ratio Q/YO_2 in said reaction mixture is in a range from about 0.01 to about 1.0~~, for example from about 0.05 to about 0.7~~.

6. The method of claim 1, wherein a molar ratio Q/YO_2 in said reaction mixture is in a range from about 0.05 to about 0.7.

~~5.~~7. The method of ~~any one of the previous claims~~ claim 1, wherein said reaction mixture comprises a source of an oxide of trivalent element, X, selected from at least one of aluminum, boron, gallium, iron, and chromium.

~~6.~~8. The method of claim ~~5~~ 7, wherein a molar ratio YO_2/X_2O_3 in said reaction mixture is in a range from about 4 to about 200~~, for example from about 8 to about 120~~.

9. The method of claim 7, wherein a molar ratio YO_2/X_2O_3 in said reaction mixture is in a range from about 8 to about 120.

~~7.~~10. The method of claim ~~5 or claim 6~~ 7, wherein the reaction mixture has the following molar composition:

YO_2/X_2O_3	~4 to ~200
H_2O/YO_2	~5 to 200
OH^-/YO_2	~0.05 to ~1
M/YO_2	~0.05 to ~2
Q/YO_2	~0.01 to ~1.

~~8.~~11. The method of ~~any one of claims 5-7~~ claim 7, wherein the reaction mixture has the following molar composition:

YO_2/X_2O_3	~8 to ~120
H_2O/YO_2	~14 to ~50
OH^-/YO_2	~0.10 to ~0.53
M/YO_2	~0.15 to ~0.9
Q/YO_2	~0.05 to ~0.7.

~~9.~~12. The method of ~~any one of the previous claims~~ claim 1, wherein said tetravalent element, Y, is silicon~~, and said trivalent element, X, is aluminum~~.

13. The method of claim 1 wherein said trivalent element, X, is aluminum.

~~10.~~14. The method of ~~any one of the previous claims~~ claim 1, wherein said alkali or alkaline earth metal, M, comprises at least one of sodium and potassium~~, for example is potassium~~.

15. The method of claim 1, wherein said alkali or alkaline earth metal, M, is potassium.

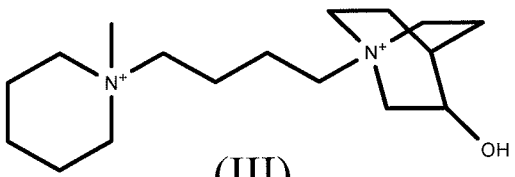
~~11.~~16. The method of ~~any one of the previous claims~~ claim 1, wherein said reaction mixture does not comprise seeds of an **MSE** framework type molecular sieve.

17. The method of claim 1, wherein seeds of an **MSE** framework type molecular sieve are present in an amount such that the molar ratio of seeds/YO_2 in said reaction mixture is between about 0.001 and about 0.1.

~~12.~~18. The method of ~~any one of the previous claims~~ claim 1, wherein the crystallizing is conducted at a temperature between about 100°C and about 200°C for up to about 28 days~~, for example between about 145°C and about 175°C for between about 24 hours and about 170 hours~~.

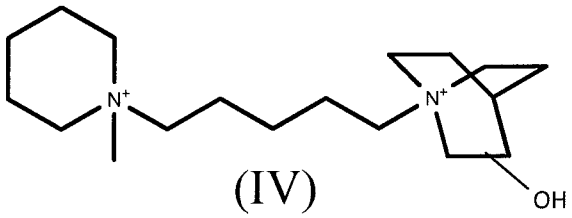
19. The method of claim 1, wherein the crystallizing is conducted at a temperature between about 145°C and about 175°C for between about 24 hours and about 170 hours.

~~13.~~20. The method of ~~any one of the previous claims~~ claim 1, wherein Q is 3-hydroxy-1-(4-(1-methylpiperidin-1-ium-1-yl)butyl)quinuclidin-1-ium dication of the formula



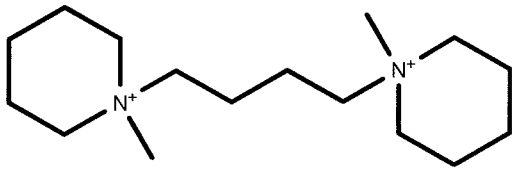
(III)

21. The method of claim 1, ~~or~~ wherein Q is a 3-hydroxy-1-(5-(1-methylpiperidin-1-ium-1-yl)pentyl)quinuclidin-1-ium dication of the formula



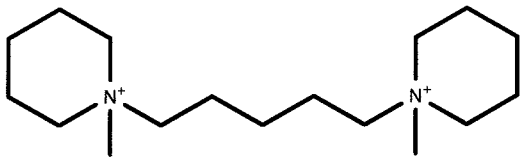
(IV)

22. The method of claim 1, ~~or~~ wherein Q is a 1,1'-(butane-1,4-diyl)bis(1-methylpiperidin-1-ium) dication of the formula



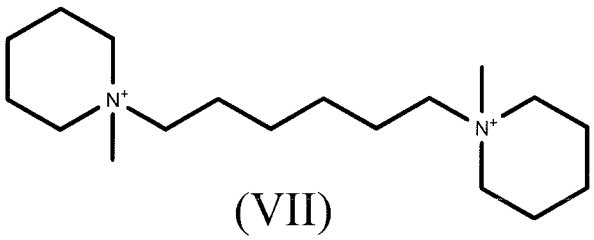
(V)

23. The method of claim 1, ~~or~~ wherein Q is a 1,1'-(pentane-1,5-diyl)bis(1-methylpiperidin-1-ium) dication of the formula



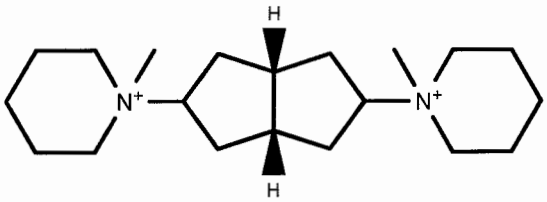
(VI)

24. The method of claim 1, ~~or~~ wherein Q is a 1,1'-(hexane-1,6-diyl)bis(1-methylpiperidin-1-ium) dication of the formula



(VII)

25. The method of claim 1, ~~or~~ wherein Q is a 1,1'-((3a*s*,6a*s*)-octahydropentalene-2,5-diyl)bis(1-methylpiperidin-1-ium) dication of the formula



(VIII)

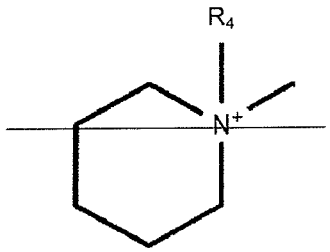
~~14.~~26. A crystalline molecular sieve having an **MSE** framework type and containing within its pore structure a dication ~~comprising~~ selected from the group consisting of a 3-hydroxy-1-(4-(1-methylpiperidin-1-ium-1-yl)butyl)quinuclidin-1-ium, a 1-(5-(1-methylpiperidin-1-ium-1-yl)pentyl)quinuclidin-1-ium, a 1,1'-(butane-1,4-diyl)bis(1-methylpiperidin-1-ium), a 1,1'-(pentane-1,5-diyl)bis(1-methylpiperidin-1-ium), a 1,1'-(hexane-1,6-diyl)bis(1-methylpiperidin-1-ium), ~~or~~ and a 1,1'-((3a*s*,6a*s*)-octahydropentalene-2,5-diyl)bis(1-methylpiperidin-1-ium).

27. The molecular sieve according to claim 26 and having, in its anhydrous, as-synthesized form, an X-ray diffraction pattern including the following lines:

d(Å)	**Relative Intensity [100 x I/I(o)]**
13.56 +/- 0.39	VW
12.93 +/- 0.37	M - S
10.92 +/- 0.31	W
10.16 +/- 0.29	VW - W
9.15 +/- 0.26	VW - W
8.19 +/- 0.23	VW
4.58 +/- 0.13	W
4.54 +/- 0.13	W
4.44 +/- 0.12	W
4.32 +/- 0.12	VW
4.23 +/- 0.12	VW
4.10 +/- 0.12	VS
4.06 +/- 0.12	M
3.98 +/- 0.11	W
3.88 +/- 0.11	M

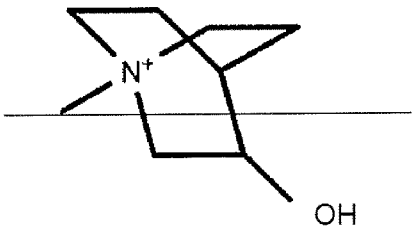
3.80 +/- 0.11	VW
3.40 +/- 0.10	VW
3.24 +/- 0.09	W
2.90 +/- 0.08	VW.

~~15. A dication of the structure R_1-R_3-R_2, where R_1 is an N-alkylpiperidinium group of the formula~~



~~(I)~~

~~where R_2 is a quinuclidinium group of the formula~~



~~(II)~~

~~where R_3 is an polymethylene group of the formula $(CH_2)_n$, where n is from 4 to 6, and where R_4 is an alkyl group having 1 to 4 carbon atoms.~~

~~16. A dication according to claim 15, which is a 3-hydroxy-1-(4-(1-methylpiperidin-1-ium-1-yl)butyl)quinuclidin-1-ium dication of Formula (III) or a 3-hydroxy-1-(5-(1-methylpiperidin-1-ium-1-yl)pentyl)quinuclidin-1-ium dication of Formula (IV).~~

~~17. A 1,1'-((3a*s*,6a*s*)-octahydropentalene-2,5-diyl)bis(1-methylpiperidin-1-ium) dication.~~