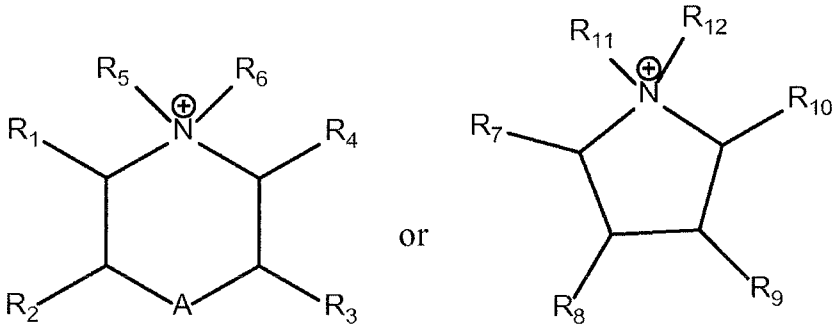
CLAIMS

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 a first organic cation, Q1, having one or both of the two following general structures:



where A is a $>CR_{13}R_{14}$ group, a >C=O group, or an >O group, where R_1, R_2, R_3, R_4, R_7, R_8, R_9, and R_{10} are each independently hydrogen, a hydroxyl group, or a C_1-C_5 hydrocarbon chain, where R_{13} and R_{14} are each independently hydrogen or a C_1-C_5 hydrocarbon chain, where R_5, R_6, R_{11}, and R_{12} are each independently a C_1-C_5 hydrocarbon chain, and where one of the R_5 and R_6 groups can alternately be connected to one of the R_{13} and R_{14} groups to form a C_1-C_5 hydrocarbon linking moiety.

2. The method of claim 1, wherein the at least 3 of the R_1-R_4 groups or the R_7-R_{10} groups are hydrogen, and wherein at least one of the R_5 and R_6 groups or at least one of the R_{11} and R_{12} groups is a methyl and/or ethyl group.

3. The method of ~~any one of claims 1-2~~ claim 1, wherein the first organic cation, Q1, comprises or is a six-membered nitrogen-containing ring, A is a $>CR_{13}R_{14}$ group, all the R_1-R_4 and R_{13}-R_{14} groups are hydrogen, and the R_5 and R_6 groups together

have a number of carbon atoms that sum to between 2 and 6.

4. The method of ~~any one of claims 1-2~~ claim 1, wherein the first organic cation, Ql, comprises or is a six-membered nitrogen-containing ring, A is an >O group, all the R_1-R_4 and R_{13}-R_{14} groups are hydrogen, and the R_5 and R_6 groups together have a number of carbon atoms that sum to between 2 and 6.

5. The method of ~~any one of claims 1-2~~ claim 1, wherein the first organic cation, Ql, comprises or is a six-membered nitrogen-containing ring, A is a $>CR_{13}R_{14}$ group, all but one of the R_1-R_4 groups are hydrogen, the one of the R_1-R_4 groups that is not hydrogen is connected to one of the R_{13}-R_{14} groups, forming a bicyclic ring system, and the other of the R_{13}-R_{14} groups is a C_1-C_5 hydrocarbon.

6. The method of ~~any one of claims 1-2~~ claim 1, wherein the first organic cation, Ql, comprises or is a five-membered nitrogen-containing ring, all the R_7-R_{10} groups are hydrogen, and the R_{11} and R_{12} groups together have a number of carbon atoms that sum to between 2 and 6.

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.

8. The method of claim 7, wherein one or more of the following are satisfied:

a total molar ratio of structure directing agent cation, Ql, to oxide of tetravalent element, Y, in said reaction mixture is from about 0.01 to about 1~~, *e.g.*, from about 0.03 to 0.7~~;

a molar ratio of oxide of tetravalent element, Y, to oxide of trivalent element, X, in general form YO_2/X_2O_3, in said reaction mixture is from about 4 to about 200~~, *e.g.*, from about 8 to about 120~~;

a molar ratio of water to oxide of tetravalent element, Y, in said reaction mixture is from about 5 to about 200~~, *e.g.*, from about 14 to about 50~~;

a molar ratio of hydroxyl group concentration to oxide of tetravalent element, Y, in said reaction mixture is from about 0.05 to about 1~~, *e.g.*, from about 0.15 to~~

~~about 0.75~~;

a molar ratio of alkali or alkaline earth metal, M, to oxide of tetravalent element, Y, in said reaction mixture is from about 0.05 to about 2~~, *e.g.*, from about 0.10 to about 0.90~~; and

seeds of an **MSE** framework type molecular sieve are present in an amount such that a weight ratio of seeds to oxide of tetravalent element, Y, in said reaction mixture is between about 0.001 and about 0.3~~, *e.g.*, from about 0.01 to about 0.08~~.

9. The method of claim 8, wherein one or more of the following are satisfied:

a total molar ratio of structure directing agent cation, Ql, to oxide of tetravalent element, Y, in said reaction mixture is from about 0.03 to about 0.7;

a molar ratio of oxide of tetravalent element, Y, to oxide of trivalent element, X, in general form YO_2/X_2O_3, in said reaction mixture is from about 8 to about 120;

a molar ratio of water to oxide of tetravalent element, Y, in said reaction mixture is from about 14 to about 50;

a molar ratio of hydroxyl group concentration to oxide of tetravalent element, Y, in said reaction mixture is from about 0.15 to about 0.75;

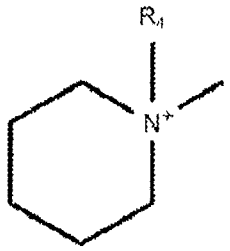
a molar ratio of alkali or alkaline earth metal, M, to oxide of tetravalent element, Y, in said reaction mixture is from about 0.10 to about 0.9; and

seeds of an **MSE** framework type molecular sieve are present in an amount such that a weight ratio of seeds to oxide of tetravalent element, Y, in said reaction mixture is between about 0.01 and about 0.08.

~~9.~~10. The method of ~~any one of the previous claims~~ claim 1, which further comprises a source of a second organic cation, Q2, having the following general structure:

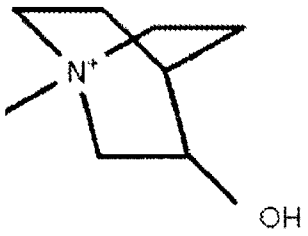
$$R_1\text{-}R_3\text{-}R_2$$

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 ~~(e.g., is 4 or 5)~~, 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 ~~(e.g., a methyl group)~~.

11. The method of claim 10, wherein R_4 of Q2 is a methyl group and where n is 4 or 5.

~~10.~~12. The method of ~~any one of the previous claims~~ claim 1, which further comprises a source of a second organic cation, Q2, having a hindered piperazine structure similar to the six-membered ring, Ql, but where A is instead an $>N\text{-}R_{15}$ group, and where R_{15} is a C_4-C_{12} cyclic, branched, and/or hydroxy-functionalized hydrocarbon moiety.

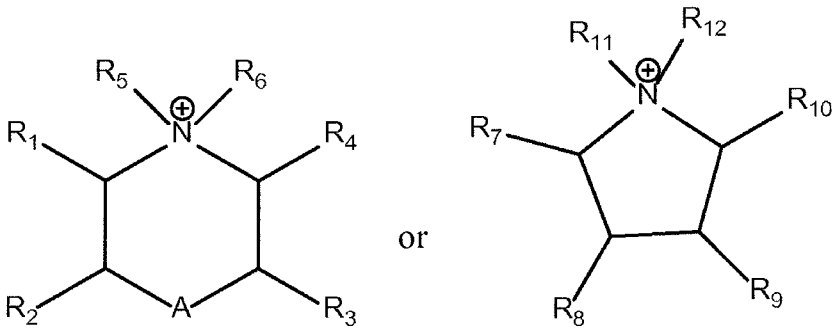
~~11.~~13. The method of claim ~~10~~ 12, wherein the first organic cation, Ql, and the second organic cation, Q2, are present in the reaction mixture in a molar ratio from about 1:5 to about 99:1.

~~12.~~14. The method of ~~any one of the previous claims~~ claim 1, wherein the tetravalent

element, Y, comprises silicon, the trivalent element, X, comprises aluminum, and the alkali or alkaline earth metal, M, comprises potassium.

~~13.~~15. The method of ~~any one of the previous claims~~ claim 14, wherein the alkali or alkaline earth metal, M, comprises substantially no sodium.

~~14.~~16. A crystalline molecular sieve having an MSE framework type and containing within its pore structure a single-nitrogen-containing organic cation, Ql, having one or both of the two following general structures:



where A is a $>CR_{13}R_{14}$ group, a >C=O group, or an >O group, where R_1, R_2, R_3, R_4, R_7, R_8, R_9, and R_{10} are each independently hydrogen, a hydroxyl group, or a C_1-C_5 hydrocarbon chain, where R_{13} and R_{14} are each independently hydrogen or a C_1-C_5 hydrocarbon chain, where R_5, R_6, R_{11}, and R_{12} are each independently a C_1-C_5 hydrocarbon chain, and where one of the R_5 and R_6 groups can alternately be connected to one of the R_{13} and R_{14} groups to form a C_1-C_5 hydrocarbon linking moiety.

~~15.~~17. The crystalline molecular sieve of claim ~~14~~ 16, wherein the single-nitrogen-containing organic cation, Ql, comprises an N,N-dialkyl-piperidinium cation, an N-alkyl-quinuclidinium cation, an N,N-dialkyl-morpholinium cation, an N,N-dialkyl-pyrrolidinium cation, or a combination thereof.