CLAIMS

1. A process for making SSZ-39 zeolite, comprising,

forming an aqueous reaction mixture comprising:

at least one oxide of silicon;

faujasite;

at least one organic structure directing agent (OSDA) for making SSZ-39 zeolite,

wherein the at least one OSDA for making SSZ-39 zeolite is one or a mixture of two or more selected from PIPPY (PIPPY = N,N-dimethyl-3,5-dimethylpiperidinium hydroxide), cis-PIPPY, trans-PIPPY, one or more 2,6-dimethyl-N,N-dialkylpiperidinium, wherein the alkyl groups may be the same or different and range from 1-4 carbon atoms, and tetraethyl phosphonium hydroxide;

at least one pore filling agent (PFA) that is not an OSDA for making SSZ-39 zeolite,

wherein the at least one PFA comprises one or a mixture of two or more selected from

4,4-dimethylmorpholinium hydroxide,

tetraethylammonium hydroxide (TEAH),

benzyltrimethylammonium hydroxide (BnTMAH),

diethyldimethylammonium hydroxide (DEDMAH),

diisopropyldimethylammonium hydroxide (DiPDMAH,

dimethyldipropylammonium hydroxide (DMDPAH),

methyltriethylammonium hydroxide (MTEAH),

tetrabutylammonium hydroxide (TBAH),

methyltributylammonium hydroxide (MTBAH),

methyltripropylammonium hydroxide (MTPAH),

tetrapropylammonium hydroxide (TPAH),

1,1-diethylpyrrolidinium hydroxide,

1,1-dipropylpyrrolidinium hydroxide,

1-butyl-1-methylpiperidinium hydroxide,
tetrapropylphosphonium hydroxide (TPPOH),
or a mixture of any two or more thereof;

an alkali metal hydroxide; and

water; and

hydrothermally treating the reaction mixture under crystallization conditions sufficient to form crystals of the SSZ-39 zeolite,

wherein the SSZ-39 zeolite contains an amount of zeolites other than SSZ-39 of less than 10 wt.%, based on the total amount of all zeolites formed.

2. The process of claim 1, wherein the at least one OSDA for making SSZ-39 zeolite is present in the aqueous reaction mixture in an amount that is less than an amount that would be required to form the SSZ-39 zeolite in absence of the PFA.

3. The process of claim 2, wherein the amount of the OSDA for making SSZ-39 is found by determining a first amount of the at least one OSDA that would be used for making the SSZ-39 zeolite when combined under the crystallization conditions with the at least one source of silicon oxide and the faujasite and an alkali metal hydroxide or salt in the water without the at least one pore filling agent (PFA); and

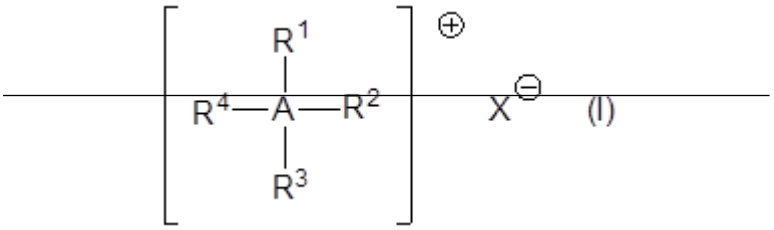
forming the aqueous reaction mixture with a second amount of the at least one OSDA that is less than the first amount of the at least one OSDA together with the at least one pore filling agent (PFA) in an amount determined based on the difference between the first amount and the second amount of the at least one OSDA.

~~4. The process according to claim 1 wherein the at least one OSDA for making SSZ-39 zeolite is one or a mixture of two or more selected from PIPPY, cis-PIPPY, trans-PIPPY, one or more 2,6-dimethyl-N,N-dialkylpiperidinium, wherein the alkyl groups may be the same or different and range from 1-4 carbon atoms, and tetraethyl phosphonium hydroxide.~~

~~5~~4. The process according to claim 1 wherein the at least one OSDA for making

SSZ-39 zeolite is a mixture of cis-PIPPY and trans-PIPPY with a content of the trans-PIPPY of greater than 20 wt.%.

~~6. The process according to claim 1 wherein the at least one PFA is a quaternary ammonium or phosphonium hydroxide having a general formula (I):~~



~~wherein, in general formula (I),~~

~~A is N or P,~~

~~each of R^1, R^2, R^3 and R^4 is independently selected from C_1-C_{18}-alkyl, and C_6-C_{10} aromatic, which may be unsubstituted or substituted with C_1-C_6 alkyl, provided that the PFA remains soluble in the aqueous reaction mixture, any two of R^1, R^2, R^3 and R^4 may form a 5- or 6-membered ring which may contain one or more O and/or N heteroatom, and~~

~~X^- is an anion selected from fluoride, chloride, bromide, iodide, hydroxide, sulfate, nitrate, phosphate, sulfonate, formate, acetate, pivalate, and propionate.~~

~~7. The process according to claim 1 wherein the at least one PFA comprises one or a mixture of two or more selected from~~
~~4,4-dimethylmorpholinium hydroxide,~~
~~tetraethylammonium hydroxide (TEAH),~~
~~benzyltrimethylammonium hydroxide (BnTMAH),~~
~~diethyldimethylammonium hydroxide (DEDMAH),~~
~~diisopropyldimethylammonium hydroxide (DiPDMAH,~~
~~dimethyldipropylammonium hydroxide (DMDPAH),~~
~~methyltriethylammonium hydroxide (MTEAH),~~
~~choline hydroxide,~~
~~tetrabutylammonium hydroxide (TBAH),~~

~~methyltributylammonium hydroxide (MTBAH),~~
~~methyltripropylammonium hydroxide (MTPAH),~~
~~tetrapropylammonium hydroxide (TPAH),~~
~~1,1-diethylpyrrolidinium hydroxide,~~
~~1,1-dipropylpyrrolidinium hydroxide,~~
~~1-butyl-1-methylpiperidinium hydroxide,~~
~~tetrapropylphosphonium hydroxide (TPPOH),~~
~~or a mixture of any two or more thereof.~~

~~8~~5. The process according to claim 1 wherein the aqueous reaction mixture further comprises a seed quantity of SSZ-39 zeolite, in an amount between 0.1% and 10% based on weight of silica and faujasite used in the aqueous reaction mixture.

~~9~~6. The process according to claim 1 wherein the at least one oxide of silicon comprises one or a mixture of two or more of tetraethyl orthosilicate (TEOS), sodium silicate, silica hydrogel, silicic acid, fumed silica, colloidal silica, a tetra-lower-(C_1-C_4)-alkyl orthosilicates other than TEOS, and silica hydroxide.

~~10~~7. A composition comprising:

at least one oxide of silicon;

faujasite;

at least one organic structure directing agent (OSDA) for making SSZ-39 zeolite, wherein the at least one OSDA for making SSZ-39 zeolite is one or a mixture of two or more selected from PIPPY (PIPPY = N,N-dimethyl-3,5-dimethylpiperidinium hydroxide), cis-PIPPY, trans-PIPPY, one or more 2,6-dimethyl-N,N-dialkylpiperidinium, wherein the alkyl groups may be the same or different and range from 1-4 carbon atoms, and tetraethyl phosphonium hydroxide;

at least one pore filling agent (PFA) that is not an OSDA for making SSZ-39 zeolite, wherein the at least one PFA comprises one or a mixture of two or more selected from:

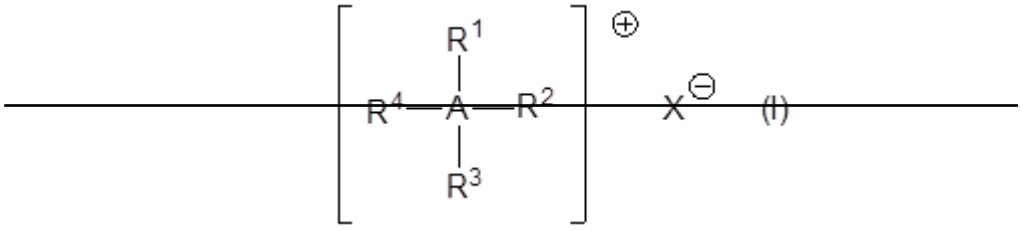
4,4-dimethylmorpholinium hydroxide,

tetraethylammonium hydroxide (TEAH),
benzyltrimethylammonium hydroxide (BnTMAH),
diethyldimethylammonium hydroxide (DEDMAH),
diisopropyldimethylammonium hydroxide (DiPDMAH,
dimethyldipropylammonium hydroxide (DMDPAH),
methyltriethylammonium hydroxide (MTEAH),
tetrabutylammonium hydroxide (TBAH),
methyltributylammonium hydroxide (MTBAH),
methyltripropylammonium hydroxide (MTPAH),
tetrapropylammonium hydroxide (TPAH),
1,1-diethylpyrrolidinium hydroxide,
1,1-dipropylpyrrolidinium hydroxide,
1-butyl-1-methylpiperidinium hydroxide,
tetrapropylphosphonium hydroxide (TPPOH),
or a mixture of any two or more thereof;
an alkali metal hydroxide; and
water,
wherein the composition contains an amount of zeolites other than SSZ-39 of less than 10 wt.%, based on the total amount of all zeolites formed.

~~11~~8. The composition of claim ~~10~~7, wherein the at least one OSDA for making SSZ-39 zeolite is present in the composition in an amount that is less than an amount that would be required to form the SSZ-39 zeolite in absence of the PFA.

~~12~~9. The composition of claim ~~11~~7, wherein the amount of the PFA in the composition is approximately equal to an amount that represents a difference between (1) the amount of the OSDA that would be required to form the SSZ-39 zeolite in the absence of the PFA, and (2) the amount of the OSDA that is actually present in the composition.

~~13. The composition according to claim 10 wherein the at least one PFA is a quaternary ammonium or phosphonium hydroxide having a general formula (I):~~



wherein, in general formula (I),

A is N or P,

each of R^1, R^2, R^3 and R^4 is independently selected from C_1-C_{18}-alkyl, and C_6-C_{10} aromatic, which may be unsubstituted or substituted with C_1-C_6 alkyl, provided that the PFA remains soluble in the aqueous reaction mixture, any two of R^1, R^2, R^3 and R^4 may form a 5- or 6-membered ring which may contain one or more O and/or N heteroatom, and

X^- is an anion selected from fluoride, chloride, bromide, iodide, hydroxide, sulfate, nitrate, phosphate, sulfonate, formate, acetate, pivalate, and propionate..

14. The composition according to claim 10 wherein the at least one quaternary ammonium or phosphonium hydroxide comprises one or a mixture of two or more selected from:
4,4-dimethylmorpholinium hydroxide,
tetraethylammonium hydroxide (TEAH),
benzyltrimethylammonium hydroxide (BnTMAH),
diethyldimethylammonium hydroxide (DEDMAH),
dimethyldipropylammonium hydroxide (DMDPAH),
diisopropyldimethylammonium hydroxide (DiPDMAH,
methyltriethylammonium hydroxide (MTEAH),
choline hydroxide,
tetrabutylammonium hydroxide (TBAH),
methyltributylammonium hydroxide (MTBAH),
methyltripropylammonium hydroxide (MTPAH),
tetrapropylammonium hydroxide (TPAH),

~~1,1-diethylpyrrolidinium hydroxide,~~
~~1,1-dipropylpyrrolidinium hydroxide,~~
~~1-butyl-1-methylpiperidinium hydroxide,~~
~~tetrapropylphosphonium hydroxide (TPPOH),~~
~~or mixtures of two or more thereof.~~

~~15. The composition according to claim 10 wherein the at least one OSDA for making SSZ-39 zeolite is one or a mixture of two or more selected from PIPPY, cis-PIPPY, trans-PIPPY, one or more 2,6-dimethyl-N,N-dialkylpiperidinium, wherein the alkyl groups may be the same or different and range from 1-4 carbon atoms, and tetraethyl phosphonium hydroxide.~~

~~16~~10. The composition according to claim ~~10~~ 7 wherein the at least one OSDA for making SSZ-39 zeolite is a mixture of cis-PIPPY and trans-PIPPY with a content of the trans-PIPPY of greater than 20 wt.%.

~~17. The composition according to claim 10 wherein the aqueous reaction mixture further comprises a seed quantity of SSZ-39 zeolite, in an amount between 0.1% and 10% based on weight of silica and faujasite used in the aqueous reaction mixture.~~

~~18~~11. The composition according to claim ~~10~~ 7 wherein the at least one oxide of silicon comprises one or a mixture of two or more of tetraethyl orthosilicate (TEOS), sodium silicate, silica hydrogel, silicic acid, fumed silica, colloidal silica, a tetra-lower-(C_1-C_4)-alkyl orthosilicates other than TEOS, and silica hydroxide.

~~19~~12. The composition according to claim ~~10~~7, wherein the amount of the OSDA for making SSZ-39 is a reduced amount, in which the reduced amount is based on a determination of a first amount of the at least one OSDA that would be used for making the SSZ-39 zeolite when combined under the crystallization conditions with the at least one source of silicon oxide and the faujasite and an alkali metal hydroxide or salt in the water without the at least one pore filling agent (PFA); and

the aqueous reaction mixture contains a second amount of the at least one OSDA that is less than the first amount of the at least one OSDA together with the at least one pore filling agent (PFA) in an amount determined based on the difference between the first amount and the second amount of the at least one OSDA.