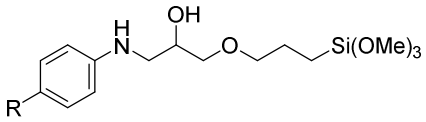
CLAIMS

1. A method of forming mesoporous zeolites with tunable physical properties, the method comprising:

mixing a silicon-containing material, an aluminum-containing material, and at least a quaternary amine to produce a zeolite precursor solution;

pre-crystallizing the zeolite precursor solution at a pre-crystallization temperature of greater than 125 °C and autogenous pressure to form a pre-crystallized zeolite precursor solution represented by the formation of an amorphous phase in pseudo-steady-state where solid and solution phases approach equilibrium and silicate and aluminosilicate anion distributions are established;

combining an organosilane mesopore template with the pre-crystallized zeolite precursor solution to produce a zeolite precursor gel, wherein the organosilane mesopore template comprises compounds in accordance with 

, wherein R is an aliphatic, aromatic, or heteroatom-containing group;

crystallizing the zeolite precursor gel to produce a crystalline zeolite intermediate; and

calcining the crystalline zeolite intermediate to produce the mesoporous zeolite, wherein the method does not comprise a discrete functionalization step of the zeolite precursor gel before crystallizing the zeolite precursor gel.

2. The method of claim 1, wherein R is H, R is Ph, or R is CH=CHPh.

3. The method of claim 1, wherein the silicon-containing material comprises SiO_2, sodium silicate, tetramethylsiloxane, tetraethylsiloxane, silicon salt, silicon alkoxide, or combinations thereof.

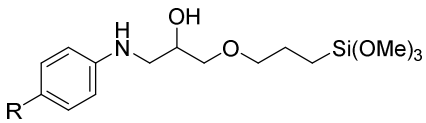
4. The method of claim 1, wherein the aluminum-containing material comprises aluminum nitrate, aluminum sulfate, aluminum alkoxide, other aluminum salts, or combinations thereof.

5. The method of claim 1, wherein the mesoporous zeolite comprises a Beta zeolite.

6. The method of claim 1, wherein the quaternary amine comprises tetraethylammonium hydroxide.

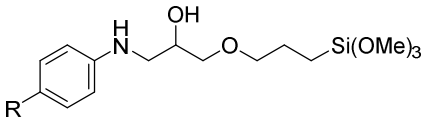
7. The method of claim 1, wherein the organosilane mesopore template has a total loading of 0.5 mol % to 25 mol % with respect to the silicon-containing material.

8. The method of claim 1, wherein the crystallization is completed at a crystallization temperature greater than 140°C.

9. An organosilane mesopore template, the organosilane mesopore template comprising a structure in accordance with 

, wherein R is an aliphatic, aromatic, or heteroatom-containing group.

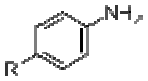
10. The organosilane mesopore template of claim 9, wherein R is H, R is a phenyl (Ph) group, or R is CH=CHPh.

11. A method of forming an organosilane mesopore template comprising a structure in accordance with 

, wherein R is an aliphatic, aromatic, or heteroatom-containing group, the method comprising:

combining one equivalent of an aniline derivative with 1 to 1.5 equivalents of 3-glycidoxypropyltrimethoxysilane in the presence of ethanol to form a reaction mixture; and

stirring and heating the reaction mixture;

wherein the aniline derivative comprises a structure in accordance with 

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12. The method of claim 11, wherein the stirring and heating the reaction mixture is completed in a Schlenk flask by stirring the reaction mixture at reflux for 4 to 24 hours.

13. The method of claim 11, wherein the stirring and heating the reaction mixture is completed in a sealed vessel by stirring the reaction mixture at 130 to 220 °C for 5 to 90 minutes.

14. The method of claim 11, wherein R is H, R is a phenyl group (Ph), or R is CH=CHPh.