CLAIMS

1. A method for producing a mesoporous zeolite, the method comprising:

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

combining a nanocellulose mesopore template with the zeolite precursor solution to produce a zeolite precursor gel;

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

calcining the crystalline zeolite intermediate to produce the mesoporous zeolite.

2. The method of claim 1, further comprising removing at least a solvent from the precursor gel prior to the crystallizing.

3. The method of claim 1 or 2, wherein the crystallization comprises contacting the zeolite precursor gel with steam.

4. The method of claim 1 or 2, wherein the crystalline zeolite intermediate is calcined by exposure to a temperature of at least 500 °C.

5. The method of claim 1 or 2, wherein the nanocellulose mesopore template comprises at least one of cellulose nanocrystals, nanocellulose fibers, or combinations thereof.

6. The method of claim 1 or 2, wherein the silicon-containing material comprises SiO_2, sodium silicate, tetramethylsiloxane, tetraethylsiloxane, silicon salt, silicon alkoxide, or combinations thereof.

7. The method of claim 1 or 2, wherein the aluminum-containing material comprises aluminum nitrate, aluminum sulfate, aluminum alkoxide, other aluminum salts, or combinations thereof.

8. The method of claim 1 or 2, wherein the quaternary amine comprises tetraethylammonium hydroxide, tetraethylammonium alkoxide, tetrapropylammonium alkoxide, other alkaline materials comprising ammonium, or combinations thereof.

9. The method of claim 1 or 2, wherein the at least one base comprises an alkali metal hydroxide or an alkaline earth metal hydroxide.

10. The method of claim 1 or 2, wherein the mesoporous zeolite has a crystallinity of at least 50% as measured using x-ray diffraction.

11. The method of claim 1 or 2, wherein the mesoporous zeolite comprises:
a surface area of greater than or equal to 400 cm^2/g;
a micropore volume of greater than 0.1 mL/g; and
a mesopore volume of greater than 0.3 mL/g.

12. The method of claim 1 or 2, wherein the mesoporous zeolite comprises an average mesopore size of greater than 3 nanometers.

13. The method of claim 1 or 2, wherein the mesoporous zeolite comprises an MFI framework type, a FAU framework type, an MOR framework type, or a BEA framework type.

14. The method of claim 1 or 2, wherein the mesoporous zeolite is a zeolite Y, a ZSM-5 zeolite, a TS-1 zeolite, a mordenite zeolite or a silicalite-I zeolite.

15. The method of claim 1 or 2, wherein the mesoporous zeolite comprises an aluminosilicate material and has a molar ratio of Si to Al of greater than or equal to 10.