CLAIMS

1. A method of producing a hierarchical zeolite composite catalyst comprising:

dissolving, in an alkaline solution and in the presence of a surfactant, a catalyst precursor comprising mesoporous zeolite while heating, stirring, or both to yield a dissolved zeolite solution, where the mesoporous zeolite comprises large pore mordenite, medium pore ZSM-5, or both large pore mordenite and medium pore ZSM-5;

condensing the dissolved zeolite solution to yield a solid zeolite composite from the dissolved zeolite solution, where condensing the dissolved zeolite solution comprises:

adjusting a pH of the dissolved zeolite solution; and

aging the pH adjusted dissolved zeolite solution;

heating the solid zeolite composite to remove the surfactant;

extruding the solid zeolite composite with binder;

impregnating the solid zeolite composite with one or more active metals selected from the group consisting of molybdenum, platinum, rhenium, nickel, and combinations thereof to yield impregnated solid zeolite composite; and

calcining the impregnated solid zeolite composite to produce the hierarchical zeolite composite catalyst, where the hierarchical zeolite composite catalyst has a mesostructure comprising at least one disordered mesophase and at least one ordered mesophase.

2. The method of claim 1 where the binder is an alumina based binder.

3. The method of claim 1 where the mordenite comprises pores formed from 12 membered rings forming a framework of the zeolite and the ZSM-5 comprises pores formed from 10 membered rings forming the framework of the zeolite.

4. The method of claim 1 where the ordered mesophase is a hexagonal mesophase.

5. The method of claim 1 where the aging involves maintaining the pH adjusted dissolved zeolite solution at a temperature of 75 to 125 °C for a duration of 12 to 48 hours.

6. The method of claim 1 where a ratio of mordenite to ZSM-5 is 1:1 to 5:1 by weight.

7. The method of claim 1 further comprising ion exchanging the solid zeolite composite.

8. The method of claim 1 where the surfactant is cetyltrimethyl ammonium bromide which comprises 1 to 8 wt. % of the dissolved zeolite solution.

9. The method of any of claims 1 through 8 where the catalyst precursor further comprises at least one additional mesoporous zeolite selected from the group consisting of ZSM-22, ZSM-12, and combinations thereof.

10. The method of any of claims 1 through 8 where the adjusting of the pH is performed by an acidic solution to adjust the pH to less than 9.

11. The method of any of claims 1 through 8 where a molar ratio of silica to aluminum in the zeolite composite catalyst is from 18 to 500.

12. The method of any of claims 1 through 8 where the alkaline solution is a 0.1 to 0.6 M NaOH solution.

13. A method of converting C_{9+} alkyl aromatic hydrocarbons to a product stream comprising benzene, toluene, and xylene, the method comprising:

reducing a hierarchical zeolite composite catalyst comprising a mesostructure comprising at least one disordered mesophase and at least one ordered mesophase with hydrogen gas at 400 to 500 °C, where the hierarchical zeolite composite catalyst comprises large pore mordenite, medium pore ZSM-5, and one or more impregnated active metals;

contacting a feed comprising C_{9+} alkylaromatic hydrocarbons with the reduced composite zeolite catalyst and hydrogen in a transalkylation zone of a reactor to produce a transalkylation product;

stripping C1-C5 and lighter hydrocarbons and stripping unreacted feed from the transalkylation product; and

collecting at least the xylenes product from the transalkylation product.

14. The method of claim 13 where the transalkylation zone is at a pressure between 1.0 to 3.0 MPa, a temperature of 200 °C to 500 °C, a space velocity of 1.0 to 5.0 h^{-1}, and a hydrogen to hydrocarbon ratio of 1 to 4.

15. A hierarchical zeolite composite catalyst comprising:

a solid zeolite composite mixed with an alumina binder, the solid zeolite composite comprising a large pore mordenite and a medium pore ZSM-5 in a 1:1 to 5:1 weight ratio,

wherein the hierarchical zeolite composite catalyst has a mesostructure comprising at least one disordered mesophase and at least one ordered mesophase.