CLAIMS

1. A method of making a heat generating catalyst for hydrocarbon cracking, the method comprising:

providing at least one mordenite framework-inverted (MFI) zeolite catalyst having a Si/Al molar ratio of 15 or greater;

providing at least one metal oxide precursor, where the metal oxide precursor is a hydrate of a metal salt of nitric acid;

dispersing the at least one metal oxide precursor within a microstructure of the MFI zeolite catalyst, where dispersing the metal oxide precursor within the microstructure of the MFI zeolite catalyst comprises dissolving the metal oxide precursor in water to generate an acidic mixture and adding the acidic mixture drop-wise to the MFI zeolite; and

calcining the heat generating catalyst with the at least one metal oxide precursor dispersed within the microstructure of the MFI zeolite catalyst to form at least one metal oxide in situ,

where the ratio of the MFI zeolite catalyst to the metal oxide is in the range of 70:30 to 85:15 on a weight basis.

2. The method of claim 1 where the at least one metal oxide precursor is dispersed within the microstructure of the MFI zeolite catalyst via at least one of wet impregnation, precipitation, electrolysis deposition, deposition-precipitation, chemical vapor deposition, and flame spray pyrolysis.

3. The method of claim 1 where the at least one metal oxide is at least one of an oxide of iron, copper, zinc, chromium, molybdenum, vanadium, cerium, manganese, bismuth, silver, cobalt, zirconium, tungsten, magnesium, and their combinations.

4. The method of claim 3 where the at least one metal oxide comprises copper oxide.

5. The method of claim 1 where the metal oxide precursor is copper nitrate trihydrate ($Cu(NO_3)_2 \cdot 3H_2O$), cobalt (II) nitrate hexahydrate ($Co(NO_3)_2 \cdot 6H_2O$), or chromium (III) nitrate nonahydrate ($Cr(NO_3)_3 \cdot 9H_2O$).

6. The method of claim 1 where the at least one metal oxide is chemically bonded to the microstructure of the MFI zeolite catalyst.

7. The method of claim 1 where the MFI zeolite catalyst is crushed ZSM-5 catalyst having an average particle size of 5 to 850 nanometers.

8. The method of claim 7 where the ZSM-5 catalyst is an H-ZSM-5 catalyst.

9. The method of claim 1 where the heat generating catalyst further comprises a promoter, where the promoter is at least one of an alkali metal, an alkaline earth metal, a rare earth metal, a transition metal, phosphorous, and their combinations.

10. A method of using a heat generating catalyst in a hydrocarbon cracking process, the method comprising:

providing a catalyst bed reactor,

where the catalyst bed reactor includes a catalyst bed of the heat generating catalyst disposed in the catalyst bed reactor,

the heat generating catalyst comprising:

at least one mordenite framework-inverted (MFI) zeolite catalyst having a Si/Al molar ratio of 15 or greater, and

at least one metal oxide dispersed within a microstructure of the MFI zeolite catalyst,

where the ratio of the MFI zeolite catalyst to the metal oxide is in the range of 70:30 to 85:15 on a weight basis;

introducing a hydrocarbon feed to the catalyst bed reactor; and

cracking the hydrocarbon feed to produce a cracking product.

11. The method of claim 10 where the catalyst bed reactor comprises a fluidized bed reactor or a fixed-bed reactor.

12. The method of claim 11 where the catalyst bed reactor is a fixed-bed reactor and the catalyst bed of the heat generating catalyst comprises a layer of the heat generating catalyst disposed before a layer of MFI zeolite catalyst based on flow direction through the catalyst bed, a layer of heat generating catalyst disposed after a layer of MFI zeolite catalyst based on flow direction through the catalyst bed, or at least one layer of heat generating catalyst disposed between at least two layers of MFI zeolite catalyst based on flow direction through the catalyst bed.

13. The method of claim 10 where the at least one metal oxide is chemically bonded to the microstructure of the MFI zeolite catalyst.

14. The method of claim 10 where the heat generating catalyst further comprises a promoter, where the promoter is at least one of an alkali metal, an alkaline earth metal, a rare earth metal, a transition metal, phosphorous, and their combinations.

15. The method of claim 10 where the MFI zeolite catalyst is a ZSM-5 catalyst.