Claims

1. A method for optimizing a layered catalytic process, comprising (i) contacting a model compound capable of (a) being hydrocracked, (b) being demetalized, (c) hydrodenitrogenation, and at least one of hydrogenation, hydrosulfurization and hydrodenitrogenation to a plurality of catalysts to determine an optimal catalyst for each of (b) and (c) followed by (ii) layering the optimal catalyst for each of (b) and (c) in a reaction chamber based on their activity reacting with said model compound, wherein said catalyst capable of demetallizing said model compound is placed at top of said reaction chamber, and (c) contacting a hydrocarbon containing feedstock for which double bond equivalence (DBE) has been determined to the layered catalysts under condition favoring formation of lower weight hydrocarbon from said hydrocarbon containing feedstock, wherein said model compound boils in the range of 180°C – 520°C and is selected from the group consisting of methylnaphthalene, dibenzothiophene, and alkylated or naphtalated derivative thereof, a basic nitrogen compound and a carbazole molecule, wherein each of said plurality of catalysts is suitable for hydrocracking a substance with a DBE of said hydrocarbon containing feedstock.

2. The method of Claim 1, further comprising contacting said model compound to a second plurality of catalysts suitable for hydrogenating, hydrodesulfurizing, or hydrodenitrogenating a substance with a DBE value less than said feedstock to determine an optimal, second catalyst.

3. The method of Claim 1, wherein said hydrocarbons contained in said feedstock have a double bond equivalency of 24 or less.

4. The method of Claim 1, wherein said feedstock has a double bond equivalency of 24 or less, and at least one of said plurality of catalysts is a VGO hydrocracking catalyst.

5. The method of Claim 1, wherein said feedstock has a double bond equivalency of 25 or more, and at least one of said catalysts is a catalyst designed for heavy feedstock.

6. The method of Claim 1, comprising contacting said hydrocarbon containing feedstock to said reaction chamber at a temperature of from 350°C to 450°C.

7. The method of Claim 1, comprising contacting said hydrocarbon containing feedstock to said reaction chamber at a hydrogen feed rate less than 2500 liters per liter of feedstock.

8. The method of Claim 1, comprising contacting said hydrocarbon containing feedstock to said reaction vessel at a pressure of from 100 bars to 200 bars.

9. The method of Claim 1, wherein at least one of said catalysts contains a metal from the IUPAC Group 4-10 of the periodic table, or is a noble metal.

10. The method of Claim 9, wherein said metal is Co, Ni, W, Mo, Pt, or Pd.

11. The method of Claim 1, wherein at least one of said catalysts contains amorphous alumina, silica-alumina, titania, Y zeolite, or at least one a transition metal inserted Y zeolite.

12. The method of Claim 11, wherein said transition metal is one of Zr, Ti, or Hf and combinations thereof.

13. The method of Claim 1, wherein said molecule is capable of being at least two of hydrogenated, hydrodesulfurized, and hydrodenitrogenated.

14. The method of Claim 1, wherein said feedstock has an asphaltene content of 500 ppmw or less.

15. The method of Claim 1, wherein said catalyst capable of demetallizing said model compound comprises one or more of the following properties: (i) maximum metal loading capacity of 50-100 w% based on fresh catalyst weight; (ii) at least one active phase metal at a concentration of from about 1% to about 20% by weight of said catalyst, (iii) a diameter for particles of said catalyst of from about 1 to about 3 mm; a surface area of about 60 to about 400 m^2/g to about 150 m^2/g, and a total pore volume of about 0.5 cm^3/g to about 100 cm^3/g.

16. The method of claim 1, wherein said catalyst capable of demetallizing said model compound capacity for 100 w% of metal relative to weight of said demetallizing catalyst.

17. The method of claim 16, wherein said catalyst capable of demetallizing catalyst is mesoporous.

18. The method of claim 17, wherein said catalyst capable of demetallizing catalyst comprises alumina or silica.

19. The method of claim 18, wherein said catalyst capable of demetallizing catalyst further comprises Ni, Mo, or both.

20. The method of claim 19, wherein said Ni, Mo, or both comprises 2-5 w% of said demetallizing catalyst.

21. The method of claim 1, wherein said catalyst capable of demetallizing catalyst have pores of from 100 – 600 Angstrom diameter.