CLAIMS

1. A hierarchically ordered crystalline microporous material having long-range mesoporous ordering of hexagonal symmetry comprising mesopores having walls of crystalline microporous material and a mass of mesostructure between mesopores of crystalline microporous material, in which the long-range ordering of hexagonal mesophase symmetry is defined by presence of secondary peaks at 2θ angle less than 6º in an X-ray diffraction (XRD) pattern and is observable by microscopy including mesopore periodicity repeating over a length of greater than 50 nm.

2. A hierarchically ordered crystalline microporous material having well-defined long-range mesoporous ordering of hexagonal symmetry comprising mesopores having walls of crystalline microporous material and a mass of mesostructure between mesopores of crystalline microporous material, in which at least a portion of the mesopores contain micelles of supramolecular templates shaped to induce mesoporous ordering of hexagonal symmetry, and in which the supramolecular templates possess one or more dimensions larger than dimensions of micropores of the crystalline microporous material to constrain diffusion into micropores of the crystalline microporous material, in which the dimensions relate to a head group of a supramolecular template, a tail group of a supramolecular template, or a co-template arrangement that constrain diffusion into micropores of the crystalline microporous material, and in which if the crystalline microporous material possesses micropores of various dimensions, the one or more dimensions of the supramolecular templates are larger than the largest micropores of the crystalline microporous material.

3. A hierarchically ordered crystalline microporous material according to Claim 2, further comprising an ionic co-solute.

4. A hierarchically ordered crystalline microporous material according to Claim 2 or 3, in which the supramolecular template is characterized by a surfactant packing parameter g in the range of 0.4-0.6, in which

$g = V/a_0l$

in which

V = total volume of surfactant tails of the supramolecular template,

a_0 = area of the head group of the supramolecular template, and

l = length of surfactant tail of the supramolecular template.

5. A hierarchically ordered crystalline microporous material according to Claim 3 or 4, in which the ionic co-solute comprises SO_4^{-2}.

6. A hierarchically ordered crystalline microporous material according to Claim 3, 4 or 5, in which a molar ratio of supramolecular template to co-solute is in the range of 0.8-1.3.

7. A hierarchically ordered crystalline microporous material according to any preceding claim, in which the hexagonal mesophase possesses p6m, p6mm or P63/mmc symmetry.

8. A hierarchically ordered crystalline microporous material according to Claims 1 to 6, in which the hexagonal mesophase possesses p6mm symmetry and secondary peaks in XRD are present at (11) and/or (20) reflections.

9. A hierarchically ordered crystalline microporous material according to Claims 1 to 6, in which the hexagonal mesophase possesses p6mm symmetry and long-range ordering is observable by microscopy viewing an electron beam perpendicular to mesopores down a [110] zone axis or parallel to mesopores down a [001] zone axis.

10. A hierarchically ordered crystalline microporous material according to any preceding claim, in which the crystalline microporous material comprises a zeolite or zeolite-type material selected from the group consisting of aluminophosphates, silicon-substituted aluminophosphates, metal-containing aluminophosphates and zeolitic siliceous only framework material.

11. A hierarchically ordered crystalline microporous material according to any of Claims 1 to 9, in which the crystalline microporous material is a zeolite having a framework selected from the group consisting of AEI, *BEA, CHA, FAU, MFI, MOR, LTL, LTA and MWW.

12. A hierarchically ordered crystalline microporous material according to any of Claims 1 to 9, in which the crystalline microporous material is a zeolite having FAU framework.

13. A hydrocracking catalyst comprising the hierarchically ordered crystalline microporous material according to Claim 10, 11 or 12, an inorganic oxide component as a binder, and an active metal component comprising one or more metals selected from the Periodic Table of the Elements IUPAC Groups 6, 7, 8, 9 or 10.

14. A hydrocracking catalyst according to Claim 13, in which the hierarchically ordered crystalline microporous material comprises 0.1-99, 0.1-90, 0.1-80, 0.1-70, 0.1-50, 0.1-40, 2-99, 2-90, 2-80, 2-70, 2-50, 2-40, 20-100, 20-90, 20-80, 20-70, 20-50, or 20-40 wt% of the hydrocracking catalyst.

15. A hydrocracking catalyst according to Claim 13 or 14, in which the inorganic oxide component is selected from the group consisting of alumina, silica, titania, silica-alumina, alumina-titania, alumina-zirconia, alumina-boria, phosphorus-alumina, silica-alumina-boria, phosphorus-alumina-boria, phosphorus-alumina-silica, silica-alumina-titania, silica-alumina-zirconia, alumina-zirconia-titania, phosphorous-alumina-zirconia, alumina-zirconia-titania and phosphorus-alumina-titania.

16. A hydrocracking catalyst according to Claim 13 or 14, in which the inorganic oxide component comprises alumina.

17. A hydrocracking catalyst according to Claim 16, in which the crystalline microporous material comprises FAU zeolite.

18. A hydrocracking catalyst according to Claim 17, in which the active metal component comprises one or more of Mo, W, Co or Ni (oxides or sulfides).

19. A method for hydrocracking hydrocarbon oil, comprising hydrocracking hydrocarbon oil with a hydrocracking catalyst according to any of Claims 13 to 18.

20. A method according to Claim 19, in which the hydrocarbon oil comprises a recycle stream obtained from hydrocracking of VGO, straight run VGO or pre-treated straight run VGO.