

CLAIMS:

1. A method for co-producing lube basestock and transportation fuel from a feedstock of biological origin in a single reactor, the method comprising:
 - a) converting a feedstock of biological origin to a ketone in the presence of a first catalyst and a hydrogen partial pressure of at least 250 psig, wherein the first catalyst comprises a basic catalyst comprising CeO_2 ; and
 - b) hydrogenating the ketone to produce a hydrocarbon in the presence of a second catalyst comprising a hydrogenation catalyst and a hydrothermally stable binder, and wherein the hydrocarbon is a lube basestock and a transportation fuel, and wherein the feedstock of biological origin comprises one or more components selected from the group consisting of a fatty acid, a fatty acid ester, a fatty alcohol, a fatty olefin, a mono-glyceride, a di-glyceride, a tri-glyceride, a phospholipid and a saccharolipid.
2. The method according to claim 1, wherein the step a) is carried out by:
 - a1) converting a feedstock of biological origin to fatty acids; and
 - a2) coupling two or more of the fatty acids to form a ketone.
3. The method according to claim 2, wherein the coupling produces H_2O , CO_2 , and/or a light hydrocarbon and further comprising the removing H_2O , CO_2 and/or a light hydrocarbon.
4. The method according to claim 1, wherein the step b) further comprises a hydroisomerization or cracking step to produce the lube basestock and transportation fuel.
5. The method according to claim 4, wherein the transportation fuel comprises a diesel fuel and a jet fuel.
6. The method according to claim 4, further comprising:
hydrofinishing the lube basestock in the presence of a hydrofinishing catalyst, followed by vacuum distillation.

7. The method according to claim 6, wherein the hydrofinishing catalyst comprises one or more noble metals supported on a support comprising carbon, silica, alumina, MCM-41, or a combination thereof.
8. The method according to claim 1, wherein the hydrothermally stable binder comprises TiO_2 , ZrO_2 , CeO_2 , or a combination thereof.
9. The method according to claim 1, wherein the feedstock of biological origin is selected from the group consisting of rapeseed oil, soy bean oil, palm oil, camelina oil, jatropha oil, jojoba oil, fish oil, lard, beef tallow, and algae oil.
10. The method according to claim 1, comprising providing the feedstock of biological origin as a solution in a hydrocarbon solvent.
11. The method according to claim 1, comprising contacting the feedstock of biological origin sequentially with the first catalyst in a first zone of the reactor and with the hydrogenation catalyst in a second zone of the reactor.
12. The method according to claim 1, wherein the first catalyst has a ratio of CO_2 chemisorption per gram of basic material to NH_3 chemisorption per gram of basic material in the range of 1-100.
13. The method according to claim 1, wherein the hydrogenation catalyst comprises a noble metal supported on a zeolite.
14. The method according to claim 1 wherein the hydrogenation catalyst comprises a metal hydrogenation component, the metal hydrogenation component comprising Ni, Co, Pd, Pt, Ru, Rh, Co--Mo, Ni--Mo, Ni--W, Co--W, or a combination thereof, the metal hydrogenation component being supported on an inorganic support comprising silica, alumina, titania, zirconia, zeolites, or combinations thereof.
15. The method according to claim 13, wherein the hydrogenation catalyst comprises Pt supported on the zeolite.

16. The method according to claim 15, wherein the zeolite comprises framework $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio greater than 50:1.

17. The method according to claim 13, wherein the hydrogenation catalyst comprises beta zeolite, USY family zeolite, mordenite, MCM-41, ZSM-22, ZSM-12, ZSM-23, ZSM-4, ZSM-48, ZSM-50, or a combination thereof.

18. The method according to claim 1,
wherein the hydrogenation catalyst is Pt supported on ZSM-48 or ZSM-48/ NiWO_x ,

wherein the hydrothermally stable binder is TiO_2 , ZrO_2 , or a mixture thereof,
and

wherein both the converting and the hydrogenating are each carried out at a temperature of from 300 to 400°C under an H_2 partial pressure of from 500 to 800 psig.

19. The method according to claim 1, wherein the first catalyst further comprises an acidic material.

20. The method according to claim 19, wherein the acidic material is selected from the group consisting of an acidic clay, alumina, an aluminosilicate, a metalloaluminophosphate and a mixture thereof.

21. The method according to claim 19, wherein the acidic material is selected from the group consisting of an acidic metal oxide, a mixed metal oxide, WO_3/ZrO_2 , $\text{MoO}_3/\text{ZrO}_2$, a zeolite of the faujasite, beta, or MWW family, 10-ring zeolite, 8-ring zeolite, a metalloaluminophosphate comprising Si, Ti, Zr, Fe, Co, Ni, Cu, Zn, Y, La, Ce, Pr, Nd, Sm or Gd.

22. The method according to claim 19, wherein the second catalyst comprises Ni, Co, Pd, Pt, Ru, Rh, Co--Mo, Ni--Mo, Ni--W, Co--W, or a combination thereof supported on silica, alumina, titania, zirconia, a zeolite, or a combination thereof.

23. The method according to claim 22, wherein the second catalyst comprises a hydroisomerization catalyst comprising Pt supported on a zeolite.

24. The method according to claim 19, wherein the acidic material comprises Montmorillonite, bentonite, WO_x/ZrO_2 , or a combination thereof,

wherein the hydrogenation catalyst comprises a) Ni, Pd, or a combination thereof supported on silica, carbon, or a combination thereof; b) Co--Mo, Co--W, or a combination thereof supported on gamma-alumina; or c) Ni--Mo, Ni--W, or a combination thereof supported on gamma-alumina,

wherein the hydrothermally stable binder comprises TiO_2 , ZrO_2 or a mixture thereof, and

wherein both the converting and the hydrogenating are each carried out at a temperature of from 250°C to 350°C under an H_2 partial pressure of from 500 psig to 2,000 psig.

25. A method for co-producing lube basestock and transportation fuel from a feedstock of biological origin in a single reactor, comprising

a1) converting a feedstock of biological origin to a fatty acids, wherein the feedstock of biological origin comprises one or more components selected from the group consisting of a fatty acid, a fatty acid ester, a fatty alcohol, a fatty olefin, a mono-glyceride, a di-glyceride, a tri-glyceride, a phospholipid and a saccharolipid;

a2) coupling two or more of the fatty acids to form a ketone in the presence of a first catalyst, wherein the first catalyst comprises a basic catalyst comprising CeO_2 ; and

b) deoxygenating the ketone to produce a hydrocarbon in the presence of a second catalyst comprising a hydrogenation catalyst and a hydrothermally stable binder, and wherein the hydrocarbon is a lube basestock and a transportation fuel,

wherein steps a1) and a2) are carried out at a hydrogen partial pressure of at least 250 psig.

26. The method according to claim 25, wherein the step b) further comprises a hydroisomerization or cracking step to produce the lube basestock and transportation fuel.

27. The method according to claim 25, wherein the method further produces H₂O, CO₂, and/or a light hydrocarbon and further comprising removing the H₂O, CO₂ and/or a light hydrocarbon.

28. The method according to claim 25, wherein the first catalyst further comprises an acidic catalyst selected from the group consisting of WO₃/ZrO₂; MoO₃/ZrO₂; a large pore zeolite selected from the group consisting of faujasite, beta and MWW families; 8- to 10-ring zeolite having a framework of MFI, CHA, MOR, or a combination thereof; and a metalloaluminophosphate comprising Si, Ti, Zr, Fe, Co, Ni, Cu, Zn, Y, La, Ce, Pr, Nd, Sm or Gd.

29. The method according to claim 25, wherein the hydrothermally stable binder comprises TiO₂, ZrO₂, CeO₂, or a combination thereof.

30. The method according to claim 25, wherein the second catalyst comprises a metal hydrogenation component selected from the group consisting of Ni, Co, Pd, Pt, Ru, Rh, Co--Mo, Ni--Mo, Ni--W, and Co--W and wherein the metal hydrogenation component is supported on a zeolite selected from the group consisting of MCM-41, ZSM-22, ZSM-12, ZSM-23, ZSM-4, ZSM-48 and ZSM-50.

31. A lube base stock prepared from a biologically derived oil having a viscosity of 4 to 100 cSt at 100°C, a viscosity index of 90 to 160, an oxygen content of less than 10 ppm and a pour point of less than 0°C, the lube base stock prepared by a method comprising:

a) converting a feedstock of biological origin to a ketone in the presence of a first catalyst and a hydrogen partial pressure of at least 250 psig, wherein the first catalyst comprises a basic catalyst comprising CeO₂; and

b) hydrogenating the ketone to produce a hydrocarbon in the presence of a second catalyst comprising a hydrogenation catalyst and a hydrothermally stable binder, and wherein the hydrocarbon is a lube basestock, and wherein the feedstock of biological origin comprises one or more components selected from the group consisting of a fatty acid, a fatty acid ester, a fatty alcohol, a fatty olefin, a mono-

glyceride, a di-glyceride, a tri-glyceride, a phospholipid and a saccharolipid, wherein steps a) and b) are carried out in a single reactor.

32. A jet fuel prepared from a biologically derived oil having a freezing point of less than -40°C , a smoke point greater than 25 mm, an oxygen content of less than 10 ppm, and a heat of combustion of at least 43 kJ/g, the jet fuel prepared by a method comprising:

a) converting a feedstock of biological origin to a ketone in the presence of a first catalyst and a hydrogen partial pressure of at least 250 psig, wherein the first catalyst comprises a basic catalyst comprising CeO_2 ; and

b) hydrogenating the ketone to produce a hydrocarbon in the presence of a second catalyst comprising a hydrogenation catalyst and a hydrothermally stable binder, and wherein the hydrocarbon is a jet fuel, and wherein the feedstock of biological origin comprises one or more components selected from the group consisting of a fatty acid, a fatty acid ester, a fatty alcohol, a fatty olefin, a mono-glyceride, a di-glyceride, a tri-glyceride, a phospholipid and a saccharolipid, wherein steps a) and b) are carried out in a single reactor.

33. The jet fuel of claim 32, wherein the jet fuel comprises 1 to 25% aromatics, 20 to 40% naphthenes, and 40 to 80% paraffins.

34. A diesel fuel prepared from a biologically derived oil having a cloud point of less than -10°C , a cetane number greater than 50, an oxygen content of less than 10 ppm, and a heat of combustion of at least 40 kJ/g, the diesel fuel prepared by a method comprising:

a) converting a feedstock of biological origin to a ketone in the presence of a first catalyst and a hydrogen partial pressure of at least 250 psig, wherein the first catalyst comprises a basic catalyst comprising CeO_2 ; and

b) hydrogenating the ketone to produce a hydrocarbon in the presence of a second catalyst comprising a hydrogenation catalyst and a hydrothermally stable binder, and wherein the hydrocarbon is a diesel fuel, and wherein the feedstock of biological origin comprises one or more components selected from the group consisting of a fatty acid, a fatty acid ester, a fatty alcohol, a fatty olefin, a mono-

glyceride, a di-glyceride, a tri-glyceride, a phospholipid and a saccharolipid, wherein steps a) and b) are carried out in a single reactor.

35. The diesel fuel of claim 34, wherein the diesel fuel comprises 1 to 25% aromatics, 20 to 40% naphthenes, and 40 to 80% paraffins.