range oligomers. Tetramers or pentamers could also be obtained by the oligomerization of pre-formed dimers with ion exchange resins. Moreover, an ion exchange resin, Amberlyst-15, has been used in the oligomerization of light olefins. Similarly, Amberlyst-35 ion exchange resin affords higher levels of trimers, but dimers are present at 30-40% mass yield, which can ultimately decrease the amount of jet and diesel fuel production, thereby increasing cost.

[0006] Accordingly, there remains a need for improved catalyst technologies that result in greater yields to fuels from light gaseous mono-olefins (e.g., C_2-C_7).

SUMMARY

[0007] Examples of the current subject matter relate to process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons. In some examples, one or more of the following features may optionally be included in any feasible combination.

[0007a] In an aspect, there is provided a process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process comprising contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture, the mixture comprising one or more C_8-C_{24} hydrocarbons at a yield of at least 30%; wherein the one or more catalysts comprise a doped mixed metal oxide.

[0008] In one example, an exemplary process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons can include contacting a feed stream that includes the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture. The mixture includes one or more C_8-C_{24} hydrocarbons at a yield of at least 30%; and the one or more catalysts include a doped mixed metal oxide.

[0009] In some examples, the doped metal oxide can include one or more dopants. The one or more dopants can include nickel, cobalt, yttrium, rhodium, ruthenium, palladium, platinum, ion, lanthanum, silica, alumina, scandium, titanium, niobium, copper, chromium, rhenium, zinc, vanadium, iridium, or any combination thereof. In certain

examples, the nickel can be present in an amount that is from about 0.5 weight percent to 5 weight percent of the one or more catalysts.

[0010] In some examples, the doped mixed metal oxide can include tungsten, zirconium, molybdenum, silica, alumina, or any combination thereof. The tungsten can be present in an amount that is from about 5 weight percent to 25 weight percent of the one or more catalysts.

[0010a] In another aspect, there is provided a process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process comprising contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture, the mixture comprising the one or more C_8-C_{24} hydrocarbons at a yield of at least 30%; wherein the one or more catalysts comprise a first catalyst, the first catalyst comprising nickel doped tungstated zirconium, nickel doped tungstated ɣ-alumina, nickel doped tungstated silica, nickel doped amorphous silica alumina, or nickel doped zeolite.

[0011] In another example, an exemplary process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process can include

contacting a feed stream that includes the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture. The mixture includes the one or more C_8-C_{24} hydrocarbons at a yield of at least 30% and the one or more catalysts includes a first catalyst. The first catalyst can include nickel doped tungstated zirconium, nickel doped tungstated ɣ-alumina, nickel doped tungstated silica, nickel doped amorphous silica alumina, or nickel doped zeolite.

[0012] In some examples, the reactor can be a single bed reactor. The single bed reactor can be a fixed bed reactor or a fluidized bed reactor.

[0013] In some examples, the reactor can be a stacked bed reactor.

[0014] In some examples, nickel can be present in an amount that is from about 0.5 weight percent to 5 weight percent of the first catalyst.

[0015] In some examples, tungsten can be present in an amount that is from about 5 weight percent to 25 weight percent of the first catalyst.

[0016] In some examples, the first catalyst includes nickel doped tungstated zirconium.

[0017] In some examples, the one or more catalysts can further include a second catalyst. The second catalyst can include one or more zeolites or one or more solid acids, or a combination thereof. In some examples, the one or more solid acids can include one or more sulfonic resins.

[0018] In some examples, the one or more zeolites can include one or more doped zeolites.

[0019] In some examples, the one or more C_8-C_{24} hydrocarbons can include one or more C_8-C_{20} hydrocarbons.

[0020] In some examples, the one or more C_8-C_{24} hydrocarbons can include one or more C_8-C_{16} hydrocarbons.

[0021] In some examples, the feed stream can further include a fusel oil, a residual alcohol, corn oil, water, or any combination thereof. The water can be present in the feed stream in an amount of less than 20 ppm.

[0022] In some examples, the process can further include a recycle stream that can include a portion of the one or more C_8-C_{24} hydrocarbons of the mixture.

[0023] In some examples, the one or more C_2-C_7 linear or branched olefins can include ethylene, propylene, butene, pentene, hexene, or any combination thereof.

[0024] In some examples, the process can further include preparing the feed stream, which can include contacting an input stream with one or more catalysts in one or more reactors to form the one or more C_2-C_7 linear or branched olefins. The input stream can include one or more C_1-C_5 linear or branched alcohols. The one or more C1-C5 linear or branched alcohols can include ethanol, propanol, butanol, or any combination thereof.

[0025] In some examples, the one or more catalysts can include a doped or undoped alumina catalyst including, in neutral or ionic form, one or more of zirconium, titanium, tungsten, or silicon. In some examples, the one or more catalysts can include a doped or undoped zeolite catalyst.

[0026] In some examples, the process can further include preparing the feed stream, which can include deriving the one or more C_2-C_7 linear or branched olefins from petroleum.

[0027] In some examples, the process can further include recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the mixture into the feed stream.

[0028] In some examples, the process can further include hydrogenating the one or more C_8-C_{24} hydrocarbons to produce a product stream.

[0029] In some examples, the process can further include recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the product stream into the feed stream.

[0030] In some examples, the process can further include separating the one or more C_8-C_{24} hydrocarbons from the product stream to produce a renewable jet fuel or a renewable diesel fuel. In some examples, the process can further include blending the renewable jet fuel with an aromatic compound or a fossil-fuel derived compound. In some examples, the process can further include blending the renewable diesel fuel with an aromatic compound or a fossil-fuel derived compound.

[0031] In some examples, the yield of the one or more C_8-C_{24} hydrocarbons can be from about 30% to 99%.

[0032] In some examples, the yield of the one or more C_8-C_{24} hydrocarbons can be at least about 45%.

[0033] In some examples, the yield of the one or more C_8-C_{24} hydrocarbons can be at least about 65%.

[0034] In some examples, the yield of the one or more C_8-C_{24} hydrocarbons can be at least about 80%.

[0035] In some examples, the pressure can be from about 400 psig to 700 psig or from about 600 psig to 800 psig.

[0036] In some examples, the temperature can be from about 150 °C to 300 °C.

[0037] In some examples, the weight hourly space velocity (WHSV) can be from about 1 h^{-1} to about 10 h^{-1} or from about 1 h^{-1} to about 5 h^{-1}.

[0037a] In another aspect, there is a another process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process comprising contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 250 °C to 350 °C, a pressure from about 400 psig to 700 psig, and a weight hourly space velocity (WHSV) of at least 2 h^{-1} to form a mixture, the mixture comprising one or more C_8-C_{24} hydrocarbons at a yield of at least 40%; wherein the one or more catalysts comprise nickel doped tungstated zirconium.

[0038] In another example, an exemplary process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons can include contacting a feed stream that includes the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 250 °C to 350 °C, a pressure from about 400 psig to 700 psig, and a weight hourly space velocity (WHSV) of at least 2 h^{-1} to form a mixture. The mixture includes one or more C_8-C_{24} hydrocarbons at a yield of at least 40% and the one or more catalysts comprise nickel doped tungstated zirconium.

[**0038a**] In another aspect, there is provided a process for converting one or more C_2-C_7 linear or branched olefins into jet fuel or diesel fuel, the process comprising forming, via a single oligomerization step, one or more one or more C_8-C_{24} hydrocarbons, the single oligomerization step comprising contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture, the mixture comprising the one or more C_8-C_{24} hydrocarbons at a yield of at least 30%; wherein the one or more catalysts comprise a first catalyst, the first catalyst comprising nickel doped tungstated zirconium, nickel doped tungstated ɣ-alumina, nickel doped tungstated silica, nickel doped amorphous silica alumina, or nickel doped zeolite.

[0039] In another example, an exemplary for converting one or more C_2-C_7 linear or branched olefins into jet fuel or diesel fuel can include forming, via a single oligomerization step, one or more one or more C_8-C_{24} hydrocarbons. The single oligomerization step includes contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture The mixture includes the one or more C_8-C_{24} hydrocarbons at a yield of at least 30% and the one or more catalysts comprise a first catalyst, the first catalyst comprising nickel

doped tungstated zirconium, nickel doped tungstated ɣ-alumina, nickel doped tungstated silica, nickel doped amorphous silica alumina, or nickel doped zeolite.

[0040] In some examples, the process can further include hydrogenating the one or more C_8-C_{24} hydrocarbons to produce a product stream.

[0041] In some examples, the process can further include recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the product stream into the feed stream.

[0042] In some examples, the process can further include separating the one or more C_8-C_{24} hydrocarbons from the product stream to produce the renewable jet fuel or the renewable diesel fuel.

[0043] In some examples, the process can further include blending the renewable jet fuel with an aromatic compound or a fossil-fuel derived compound.

[0044] In some examples, nickel can be present in an amount that is from about 0.5 weight percent to 5 weight percent of the first catalyst.

[0045] The some examples, tungsten can be present in an amount that is from about 5 weight percent to 25 weight percent of the first catalyst.

[0046] In some examples, the one or more catalysts further include a second catalyst. The second catalyst can include one or more zeolites or one or more solid acids, or a combination thereof.

[0047] In some examples, the process can further include recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the mixture into the feed stream.

[0048] In some examples, the one or more the one or more C_2-C_7 linear or branched olefins can be derived from C_2-C_5 monohydric alcohols.

[0049] In some examples, the one or more C_8-C_{24} hydrocarbons can include one or more low carbon intensity C_8-C_{24} hydrocarbons.

[0050] In some examples, the one or more C_8-C_{24} hydrocarbons can include one or more zero carbon intensity C_8-C_{24} hydrocarbons.

[0051] In some examples, the one or more C_8-C_{24} hydrocarbons can include one or more negative carbon intensity C_8-C_{24} hydrocarbons.

[0052] The details of one or more examplesof the subject matter described herein are set forth in the accompanying drawings and the description below. Other features and advantages of the subject matter described herein will be apparent from the description and drawings, and from the claims. The claims that follow this disclosure are intended to define the scope of the protected subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0053] The accompanying drawings, which are incorporated into and constitute a part of this specification, show certain implementations of the subject matter disclosed herein and, together with the description, help explain some of the principles associated with the disclosed implementations. In the drawings:

[0054] FIG. 1 is a schematic illustration of an exemplary system for conversion of alcohol(s) to fuel.

[0055] When practical, similar reference numbers denote similar structures, features, or elements.

DETAILED DESCRIPTION

[0056] Certain exemplary implementations will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the systems and processes disclosed herein. One or more examples of these implementations are illustrated in the accompanying drawings. Those skilled in the art will understand that the systems and processes specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary implementations and that the scope of the present invention is not defined solely by the claims. The features illustrated or described in connection with one exemplary implementation may be combined with the features of other implementations. Such modifications and variations are intended to be included within the scope of the present invention.

[0057] Terminology used herein is for the purpose of describing particular implementations and implementations only and is not intended to be limiting. For example, as used herein, the

WHAT IS CLAIMED IS:

1. A process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process comprising:

contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture, the mixture comprising one or more C_8-C_{24} hydrocarbons at a yield of at least 30%;

wherein the one or more catalysts comprise a doped mixed metal oxide.

2. The process of claim 1, wherein the doped metal oxide comprises one or more dopants, the one or more dopants comprising nickel, cobalt, yttrium, rhodium, ruthenium, palladium, platinum, ion, lanthanum, silica, alumina, scandium, titanium, niobium, copper, chromium, rhenium, zinc, vanadium, iridium, or any combination thereof, preferably wherein the nickel is present in an amount that is from about 0.5 weight percent to 5 weight percent of the one or more catalysts; or wherein the doped mixed metal oxide comprises tungsten, zirconium, molybdenum, silica, alumina, or any combination thereof, or wherein the tungsten is present in an amount that is from about 5 weight percent to 25 weight percent of the one or more catalysts.

3. A process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process comprising:

contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture, the mixture comprising the one or more C_8-C_{24} hydrocarbons at a yield of at least 30%;

wherein the one or more catalysts comprise a first catalyst, the first catalyst comprising nickel doped tungstated zirconium, nickel doped tungstated ɣ-alumina, nickel doped tungstated silica, nickel doped amorphous silica alumina, or nickel doped zeolite.

4. The process of any preceding claim, wherein the reactor is a single bed reactor, preferably wherein the single bed reactor is a fixed bed reactor or a fluidized bed reactor, or wherein the reactor is a stacked bed reactor.

5. The process of claim 3 or 4, wherein nickel is present in an amount that is from about 0.5 weight percent to 5 weight percent of the first catalyst, or wherein tungsten is present in an amount that is from about 5 weight percent to 25 weight percent of the first catalyst, or wherein the first catalyst comprises nickel doped tungstated zirconium, or wherein the one or more catalysts further comprises a second catalyst, preferably wherein the second catalyst comprises one or more zeolites, one or more solid acids, or a combination thereof, preferably wherein the one or more solid acids comprise one or more sulfonic acid resins, and preferably wherein the one or more zeolites comprises one or more doped zeolites.

6. The process of any preceding claim, wherein the one or more C_8-C_{24} hydrocarbons comprise one or more C_8-C_{20} hydrocarbons or one or more C_8-C_{16} hydrocarbons.

7. The process of any preceding claim, wherein the feed stream further comprises a fusel oil, a residual alcohol, corn oil, water, or any combination thereof., preferably wherein the water is present in the feed stream in an amount of less than 20 ppm, or the feed stream further comprises a recycle stream comprising a portion of the one or more C_8-C_{24} hydrocarbons of the mixture.

8. The process of any preceding claim, wherein the one or more C_2-C_7 linear or branched olefins comprises ethylene, propylene, butene, pentene, hexene, or any combination thereof.

9. The process of any preceding claim, further comprising preparing the feed stream, preferably wherein preparing the feed stream comprises contacting an input stream comprising one or more C_1-C_5 linear or branched alcohols with one or more catalysts in one or more reactors to form the one or more C_2-C_7 linear or branched olefins, preferably wherein the one or more catalysts comprise a doped or undoped alumina catalyst including, in neutral or ionic form, one or more of zirconium, titanium, tungsten, or silicon, or a doped or undoped zeolite catalyst, preferably wherein the one or more C_1-C_5 linear or branched alcohols comprises ethanol, propanol, butanol, or any combination thereof, and preferably wherein preparing the feed stream comprises deriving the one or more C_2-C_7 linear or branched olefins from petroleum.

10. The process of any preceding claim, further comprising recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the mixture into the feed stream, or further comprising hydrogenating the one or more C_8-C_{24} hydrocarbons to produce a product stream, preferably

further comprising recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the product stream into the feed stream, preferably further comprising separating the one or more C_8-C_{24} hydrocarbons from the product stream to produce a renewable jet fuel or a renewable diesel fuel, preferably furthering comprising blending the renewable jet fuel with an aromatic compound or a fossil-fuel derived compound; or preferably furthering comprising blending the renewable diesel fuel with an aromatic compound or a fossil-fuel derived compound.

11. The process of any preceding claim, wherein the yield of the one or more C_8-C_{24} hydrocarbons is from about 30% to 99%; or at least about 45%, or at least about 65%; or at least about 80%.

12. The process of any preceding claim, wherein the pressure is from about 400 psig to 700 psig or from about 600 psig to 800 psig, or wherein the temperature is from about 150 °C to 300 °C, or wherein the weight hourly space velocity (WHSV) is from about 1 h^{-1} to about 10 h^{-1} or from about 1 h^{-1} to about 5 h^{-1}.

13. A process for converting one or more C_2-C_7 linear or branched olefins to one or more C_8-C_{24} hydrocarbons, the process comprising:

contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 250 °C to 350 °C, a pressure from about 400 psig to 700 psig, and a weight hourly space velocity (WHSV) of at least 2 h^{-1} to form a mixture, the mixture comprising one or more C_8-C_{24} hydrocarbons at a yield of at least 40%;

wherein the one or more catalysts comprise nickel doped tungstated zirconium.

14. A process for converting one or more C_2-C_7 linear or branched olefins into jet fuel or diesel fuel, the process comprising:

forming, via a single oligomerization step, one or more one or more C_8-C_{24} hydrocarbons, the single oligomerization step comprising:

contacting a feed stream comprising the one or more C_2-C_7 linear or branched olefins with one or more catalysts in a reactor at a temperature from about 100 °C to 400 °C, a pressure from about 200 psig to 1000 psig, and a weight hourly space velocity (WHSV) of at least 0.5 h^{-1} to form a mixture, the mixture comprising the one or more C_8-C_{24} hydrocarbons at a yield of at least 30%;

wherein the one or more catalysts comprise a first catalyst, the first catalyst comprising nickel doped tungstated zirconium, nickel doped tungstated ɣ-alumina, nickel doped tungstated silica, nickel doped amorphous silica alumina, or nickel doped zeolite.

15. The process of claim 14, further comprising hydrogenating the one or more C_8-C_{24} hydrocarbons to produce a product stream, preferably further comprising recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the product stream into the feed stream, preferably further comprising separating the one or more C_8-C_{24} hydrocarbons from the product stream to produce the renewable jet fuel or the renewable diesel fuel, preferably further comprising blending the renewable jet fuel with an aromatic compound or a fossil-fuel derived compound, or wherein nickel is present in an amount that is from about 0.5 weight percent to 5 weight percent of the first catalyst, or wherein tungsten is present in an amount that is from about 5 weight percent to 25 weight percent of the first catalystor wherein the one or more catalysts further comprises a second catalyst, preferably wherein the second catalyst comprises one or more zeolites or one or more solid acids, or a combination thereof, preferably further comprising recycling a portion of the one or more C_8-C_{24} hydrocarbons present in the mixture into the feed stream.

16. The process of any preceding claim, wherein the one or more C_2-C_7 linear or branched olefins are derived from C_2-C_5 monohydric alcohols, or wherein the one or more C_8-C_{24} hydrocarbons comprise one or more low carbon intensity C_8-C_{24} hydrocarbons, zero carbon intensity C_8-C_{24} hydrocarbons, or negative carbon intensity C_8-C_{24} hydrocarbons.