[0008] U.S. Pat. No. 9,840,676 relates to a process for converting ethanol in a three-step process into fuels which can be utilized as full performance or military jet or diesel fuels. However, the process begins with ethylene formation followed by trimerization to hexenes and finally oligomerization to jet and diesel fractions.

[0009] Accordingly, there remains a needs for improved, efficient, and cost effective catalytic processes resulting in the direct conversion of bio-based alcohols to olefinic mixtures.

SUMMARY

[0010] Aspects of the current subject matter relate *inter alia* to systems and processes for converting one or more C_1-C_5 linear or branched alcohols to one or more C_2-C_5 olefins.

[0010a] In an aspect, there is provided a process converting methanol and one or more C_2-C_5 linear or branched alcohols to one or more C_2-C_5 olefins, the process comprising:

contacting an input stream comprising the methanol and one or more C_2-C_5 linear or branched alcohols with at least a first catalyst and a second catalyst in a single bed reactor to form an output stream comprising the one or more C_2-C_5 olefins, the single bed reactor being at a temperature from 350 °C ± 10% to 750 °C ± 10%, a gauge pressure from 0 to 30 bar ± 10%, and a weight hourly space velocity (WHSV) from 0.5 ± 10% to 5.0 ± 10%,

wherein the first catalyst comprises a doped or undoped alumina catalyst, the doped alumina catalyst including, in neutral or ionic form, one or more of zirconium (Zr), titanium (Ti), tungsten (W), or silicon (Si), to form a first mixture; and wherein the second catalyst comprises a doped or undoped zeolite catalyst.

[0010b] In another aspect, there is provided a process for converting methanol and one or more C_2-C_5 linear or branched alcohols to one or more C_2-C_5 olefins, the process comprising: contacting an input stream comprising the methanol and one or more C_2-C_5 linear or branched alcohols with a first catalyst in a stacked bed reactor at a temperature from 350 °C ± 10% to 550 °C ± 10%, a gauge pressure from 0 to 30 bar ± 10%, and a weight hourly space velocity (WHSV) from 1.0 ± 10% to 2.0 ± 10% to form a first mixture, wherein the first catalyst comprises a doped or undoped alumina catalyst, the doped alumina catalyst including, in neutral or ionic form, one or more of zirconium (Zr), titanium (Ti), tungsten (W), or silicon (Si);
contacting the first mixture with at least a second catalyst in the stacked bed reactor to form an output stream comprising the one or more C_2-C_5 olefins, wherein the second catalyst comprises a doped or undoped zeolite catalyst.

[0011] In one exemplary example, process for converting one or more C1-C5 linear or branched alcohols to one or more C2-C5 olefins includes contacting an input stream comprising the one or more C1-C5 linear or branched alcohols with at least a first catalyst and a second catalyst in a single bed reactor to form an output stream. The output stream including the one or more C2-C5 olefins. The single bed reactor being at a temperature from about 350 °C to about 750 °C, a gauge pressure from 0 to about 30 bar, and a weight hourly space velocity (WHSV) from about 0.5 to about 5.0. The first catalyst being a doped or undoped alumina catalyst including, in neutral or ionic form, one or more of zirconium (Zr),

titanium (Ti), tungsten (W), or silicon (Si), to form a first mixture, and the second catalyst being a doped or undoped zeolite catalyst.

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

[0013] In some examples, contacting the input stream can further include contacting the input stream with a third catalyst in the single bed reactor. The third catalyst can include a doped or undoped SiO_2 catalyst.

[0014] In some examples, the C_1-C_5 linear or branched alcohols can be bio-based and produced by fermentative processes. In some examples, the C_1-C_5 linear or branched alcohols can be not derived from petroleum.

WHAT IS CLAIMED IS:

1. A process for converting methanol and one or more C_2-C_5 linear or branched alcohols to one or more C_2-C_5 olefins, the process comprising:

contacting an input stream comprising the methanol and one or more C_2-C_5 linear or branched alcohols with at least a first catalyst and a second catalyst in a single bed reactor to form an output stream comprising the one or more C_2-C_5 olefins, the single bed reactor being at a temperature from 350 °C ± 10% to 750 °C ± 10%, a gauge pressure from 0 to 30 bar ± 10%, and a weight hourly space velocity (WHSV) from 0.5 ± 10% to 5.0 ± 10%,

wherein the first catalyst comprises a doped or undoped alumina catalyst, the doped alumina catalyst including, in neutral or ionic form, one or more of zirconium (Zr), titanium (Ti), tungsten (W), or silicon (Si), to form a first mixture; and wherein the second catalyst comprises a doped or undoped zeolite catalyst.

2. The process of claim 1, wherein the single bed reactor is a fixed bed reactor.

3. The process of claim 1, wherein the single bed reactor is a fluidized bed reactor.

4. The process of any one of the preceding claims, wherein contacting the input stream further comprises contacting the input stream with a third catalyst in the single bed reactor.

5. The process of claim 4, wherein the third catalyst comprises a doped or undoped SiO_2 catalyst.

6. The process of any of the preceding claims, wherein the C_1-C_5 linear or branched alcohols are bio-based and produced by fermentative processes.

7. The process of any of the preceding claims, wherein the C_1-C_5 linear or branched alcohols are not derived from petroleum.

8. The process of any of the preceding claims, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 80 wt. %.

9. The process of any of claims 1 to 8, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 85 wt. %.

10. The process of any of claims 1 to 8, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 90 wt. %.

11. The process of any of claims 1 to 8, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 95 wt. %.

12. The process of any of the preceding claims, wherein the output stream comprises one or more aromatic (C_{7+}) compounds in an amount from 2 wt. % ± 10% to 10 wt. % ± 10%.

13. The process of any of the preceding claims, wherein the output stream comprises one or more aromatic (C_{7+}) compounds in an amount that does not exceed 10 wt. %.

14. The process of any of the preceding claims, wherein the process further comprises removing at least a portion of C_2 olefins from the output stream.

15. The process of any of the preceding claims, wherein the process further comprises removing at least a portion of C_4 olefins from the output stream.

16. The process of any of the preceding claims, wherein the process further comprises removing at least a portion of C_5 olefins from the output stream.

17. The process of any of the preceding claims, wherein the temperature is from 550 °C ± 10% to 750 °C ± 10%.

18. The process of any of claims 1 to 17, wherein the temperature is from 350 °C ± 10% to 550 °C ± 10%.

19. The process of any of the preceding claims, wherein the WHSV is from 0.5 ± 10% to 1.0 ± 10%.

20. The process of any of claims 1 to 18, wherein the WHSV is from 2.0 ± 10% to 5.0 ± 10%.

21. A process for converting methanol and one or more C_2-C_5 linear or branched alcohols to one or more C_2-C_5 olefins, the process comprising:

contacting an input stream comprising the methanol and one or more C_2-C_5 linear or branched alcohols with a first catalyst in a stacked bed reactor at a temperature from 350 °C ± 10% to 550 °C ± 10%, a gauge pressure from 0 to 30 bar ± 10%, and a weight hourly space velocity (WHSV) from 1.0 ± 10% to 2.0 ± 10% to form a first mixture, wherein the first catalyst comprises a doped or undoped alumina catalyst, the doped alumina catalyst including, in neutral or ionic form, one or more of zirconium (Zr), titanium (Ti), tungsten (W), or silicon (Si);

contacting the first mixture with at least a second catalyst in the stacked bed reactor to form an output stream comprising the one or more C_2-C_5 olefins, wherein the second catalyst comprises a doped or undoped zeolite catalyst.

22. The process of claim 21, wherein the stacked bed reactor is a fixed bed reactor.

23. The process of claim 21, wherein the stacked bed reactor is a fluidized bed reactor.

24. The process of any of claims 21 to 23, wherein contacting the first mixture further comprises contacting the first mixture with a third catalyst in the stacked bed reactor.

25. The process of claim 24, wherein the third catalyst a doped or undoped SiO_2 catalyst.

26. The process of any of claims 21 to 25, wherein the C_1-C_5 linear or branched alcohols are bio-based and produced by fermentative processes.

27. The process of any of claims 21 to 26, wherein the C_1-C_5 linear or branched alcohols are not derived from petroleum.

28. The process of any of claims 21 to 27, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 80 wt. %.

29. The process of any of claims 21 to 27, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 85 wt. %.

30. The process of any of claims 21 to 27, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 90 wt. %.

31. The process of any of claims 21 to 27, wherein the one or more C_2-C_5 olefins are present in the output stream in an amount that is at least 95 wt. %.

32. The process of any of claims 21 to 31, wherein the output stream comprises one or more aromatic (C_{7+}) compounds in an amount from 2 wt. % ± 10% to 10 wt. % ± 10%.

33. The process of any of claims 21 to 32, wherein the output stream comprises one or more aromatic (C_{7+}) compounds in an amount that does not exceed 10 wt. %.

34. The process of any of claims 21 to 33, wherein the process further comprises removing at least a portion of C_2 olefins from the output stream.

35. The process of any of claims 21 to 34, wherein the process further comprises removing at least a portion of C_4 olefins from the output stream.

36. The process of any of claims 21 to 35, wherein the process further comprises removing at least a portion of C_5 olefins from the output stream.