when operating these catalysts as double bond isomerization catalysts alone for the production of the terminal olefin from the interior olefin.

[0005] Some attempts have been made to improve the performance of magnesium oxide catalysts. For example, U.S. Patent No. 6,875,901 discloses improvements to the deactivation rate of magnesium oxide isomerization catalysts by limiting certain impurities, such as phosphorous, sulfur, transition metals, etc. Deactivation in the presence of oxygenates, however, remains problematic.

SUMMARY OF THE CLAIMED EMBODIMENTS

[0006] Catalysts have now been found that may be used in isomerization and/or combined isomerization / metathesis processes that are tolerant to poisons that may be present in the feed, including oxygenates.

[0007] Embodiments disclosed herein relate to a process for the double-bond isomerization of olefins, the process including: contacting a fluid stream comprising olefins with a fixed bed comprising an isomerization catalyst, that is tolerant to oxygenate poisons, to convert at least a portion of the olefin to its isomer. In an aspect, there is provided a process for the isomerization of olefins, the process comprising: contacting in a reaction zone at least one olefin-containing feed with a catalyst having activity for the double bond isomerization of the olefin to form an isomerized olefin product, wherein the catalyst comprises a γ-alumina-titania catalyst having a surface area of greater than 200 m^2/g; wherein the contacting is performed in the presence of oxygenates in the olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm. In another aspect, there is provided a catalyst useful for the double-bond isomerization of olefins, comprising a γ-alumina-titania mixture having a surface area of greater than 200 m^2/g; wherein the double bond isomerization of olefins is performed in the presence of oxygenates in an olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

[0008] Embodiments disclosed herein relate to a process for the double-bond isomerization of olefins, and simultaneous dehydration of alcohols. The simultaneous isomerization and dehydration may occur with a single catalyst and may occur in one or more reactors or reactor beds.

Embodiments disclosed herein relate to a process for the production of propylene, including: fractionating a hydrocarbon stream comprising n-butenes, isobutene, paraffins, and alcohols into at least two fractions including a light C_4 fraction comprising isobutene and a heavy C_4 fraction comprising n-butenes and paraffins; feeding ethylene and the heavy C_4 fraction to a fixed bed reactor comprising a metathesis catalyst and an isomerization catalyst, that is tolerant tooxygenate poisons, contacting the heavy C_4 fraction with the isomerization catalyst to convert at least a portion of the 1-butene to 2-butene while converting at least a portion of alcohols into additional olefins; and contacting ethylene and at least a portion of the 2-butene with a metathesis catalyst to form a metathesis product comprising propylene, paraffins, any unreacted ethylene, any unreacted alcohols, and any unreacted 1-butene and 2-butene.

In yet another aspect, there is provided a system for the production of olefins, the system comprising: an inlet for receiving an olefin-containing hydrocarbon feed; a reaction zone comprising at least one bed of catalyst, the at least one bed containing a γ-alumina-titania catalyst having a surface area of greater than 200 m^2/g and having activity for the double bond isomerization of the olefin to form an isomerized olefin product; and an outlet for recovering an effluent comprising the isomerized olefin product; wherein the olefin-containing hydrocarbon is fed in the presence of oxygenates, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

Another aspect relates to a process for the isomerization of olefins, the process comprising: contacting in a reaction zone at least one C4-C7 olefin-containing feed with a catalyst having activity for the double bond isomerization of the olefin to form an isomerized olefin product, wherein the catalyst comprises a γ-alumina-titania catalyst having 10 wt% to 40 wt% titania and a surface area of greater than 350 m^2/g; wherein the contacting is performed in the presence of oxygenates in the olefin-

containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

Yet another aspect relates to a catalyst for the double-bond isomerization of C4-C7 olefins, comprising a γ-alumina-titania mixture having 10 wt% to 40 wt% titania and a surface area of greater than 350 m^2/g; where the double-bond isomerization of olefins is performed in the presence of oxygenates in the olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

Yet another aspect relates to a system for the production of olefins, the system comprising: an inlet for receiving a C4-C7 olefin-containing hydrocarbon feed; a reaction zone comprising at least one bed of catalyst, the at least one bed containing a γ-alumina-titania catalyst having 10 wt% to 40 wt% titania and a surface area of greater than 350 m^2/g and having activity for the double bond isomerization of the olefin to form an isomerized olefin product; and an outlet for recovering an effluent comprising the isomerized olefin product; wherein the olefin-containing hydrocarbon is fed in the presence of oxygenates, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

CLAIMS

What is claimed:

1. A process for the isomerization of olefins, the process comprising:

   contacting in a reaction zone at least one olefin-containing feed with a catalyst having activity for the double bond isomerization of the olefin to form an isomerized olefin product,

   wherein the catalyst comprises a γ-alumina-titania catalyst having a surface area of greater than 200 m^2/g;

   wherein the contacting is performed in the presence of oxygenates in the olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and

   wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

2. The process of claim 1, wherein the catalyst comprises from about 0.01 wt% to about 50 wt% titania.
3. The process of claim 1, wherein the catalyst comprises from about 10 wt% to about 40 wt% titania.
4. The process of claim 1, wherein the catalyst also has activity for the dehydration of alcohols to form olefins.
5. The process of claim 1, wherein the reaction zone is maintained at a temperature in the range from about 5°C to about 500°C, and at a pressure is in the range from atmospheric pressure to about 2000 psig, and optionally under an inert atmosphere.
6. The process of claim 1, wherein the reaction zone comprises a first bed containing the γ-alumina-titania catalyst and a second bed containing a basic metal oxide isomerization catalyst.
7. The process of claim 1, further comprising contacting the isomerized olefin product with a metathesis catalyst to convert the isomerized olefin product to a metathesized olefin product.
8. The process of claim 9, wherein the metathesis catalyst is disposed in a downstream reactor.
9. A catalyst useful for the double-bond isomerization of olefins, comprising a γ-alumina-titania mixture having a surface area of greater than 200 m^2/g; where the double-bond isomerization of olefins is performed in the presence of oxygenates in an olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.
10. The catalyst of claim 9, wherein the catalyst comprises from about 0.01 wt% to about 50 wt% titania.
11. The catalyst of claim 9, wherein the catalyst comprises from about 10 wt% to about 40 wt% titania.

12. The catalyst of claim 11, wherein the catalyst also has activity for the dehydration of alcohols to form olefins.

13. A system for the production of olefins, the system comprising:

an inlet for receiving an olefin-containing hydrocarbon feed;

a reaction zone comprising at least one bed of catalyst, the at least one bed containing a γ-alumina-titania catalyst having a surface area of greater than 200 m^2/g and having activity for the double bond isomerization of the olefin to form an isomerized olefin product; and

an outlet for recovering an effluent comprising the isomerized olefin product; wherein the olefin-containing hydrocarbon is fed in the presence of oxygenates, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and

wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

14. The system of claim 13, wherein the catalyst comprises from about 0.01 wt% to about 50 wt% titania.

15. The system of claim 13, wherein the catalyst comprises from about 10 wt% to about 40 wt% titania.

16. The system of claim 16, wherein the catalyst also has activity for the dehydration of alcohols to form olefins.

17. The system of claim 13, the reaction zone further comprising at least one catalyst bed containing a basic metal oxide isomerization catalyst located downstream of the at least one bed containing the γ-alumina-titania catalyst.

18. The system of claim 13, the reaction zone further comprising a metathesis catalyst.

19. The system of claim 18, wherein the metathesis catalyst is contained in a bed downstream of the bed containing the γ-alumina-titania catalyst.

20. The system of claim 18, wherein the metathesis catalyst is admixed with the γ-alumina-titania catalyst or is admixed with a basic metal oxide isomerization catalyst.

21. A process for the isomerization of olefins, the process comprising:

contacting in a reaction zone at least one C4-C7 olefin-containing feed with a catalyst having activity for the double bond isomerization of the olefin to form an isomerized olefin product,

wherein the catalyst comprises a γ-alumina-titania catalyst having 10 wt% to 40 wt% titania and a surface area of greater than 350 m^2/g;

wherein the contacting is performed in the presence of oxygenates in the olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and

wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

22. A catalyst for the double-bond isomerization of C4-C7 olefins, comprising a γ-alumina-titania mixture having 10 wt% to 40 wt% titania and a surface area of greater than 350 m^2/g;

where the double-bond isomerization of olefins is performed in the presence of oxygenates in the olefin-containing feed, oxygenates formed in-situ, or both, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and

wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.

23. A system for the production of olefins, the system comprising:

an inlet for receiving a C4-C7 olefin-containing hydrocarbon feed;

a reaction zone comprising at least one bed of catalyst, the at least one bed containing a γ-alumina-titania catalyst having 10 wt% to 40 wt% titania and a surface area of greater than 350 m^2/g and having activity for the double bond isomerization of the olefin to form an isomerized olefin product; and

an outlet for recovering an effluent comprising the isomerized olefin product;

wherein the olefin-containing hydrocarbon is fed in the presence of oxygenates, said oxygenates being at a concentration in the range from 100 ppm to 1000 ppm; and

wherein the catalyst is resistant to poisoning by oxygenates at concentrations from 100 ppm to 1000 ppm.