CLAIMS:

What is claimed is:

1. A process for upgrading a hydrocarbon, comprising:

(I) contacting a hydrocarbon-containing feed with a catalyst comprising Pt disposed on a support to effect one or more of dehydrogenation, dehydroaromatization, and dehydrocyclization of at least a portion of the hydrocarbon-containing feed to produce a coked catalyst and an effluent comprising one or more upgraded hydrocarbons and molecular hydrogen:

the hydrocarbon-containing feed comprises one or more of C_2-C_{16} linear or branched alkanes, or one or more of C_4-C_{16} cyclic alkanes, or one or more C_8-C_{16} alkyl aromatics, or a mixture thereof; wherein

the hydrocarbon-containing feed and catalyst are contacted at a temperature in a range from 300°C to 900°C, under a hydrocarbon partial pressure of at least 20 kPa-absolute, wherein the hydrocarbon partial pressure is the total partial pressure of any C_2-C_{16} alkanes and any C_8-C_{16} alkyl aromatics in the hydrocarbon-containing feed;

the catalyst comprises from > 0.025 wt% to 6 wt% of Pt based on the weight of the support; and

the one or more upgraded hydrocarbons comprise at least one of a dehydrogenated hydrocarbon, a dehydroaromatized hydrocarbon, and a dehydrocyclized hydrocarbon;

(II) contacting at least a portion of the coked catalyst with an oxidant to effect combustion of at least a portion of the coke to produce a regenerated catalyst lean in coke and a combustion gas, wherein at least a portion of the Pt in the regenerated catalyst is at a higher oxidized state as compared to the Pt in the catalyst contacted with the hydrocarbon-containing feed;

(IIa) contacting at least a portion of the regenerated catalyst with a reducing gas to produce a regenerated and reduced catalyst, wherein at a least a portion of the Pt in the regenerated and reduced catalyst is reduced to a lower oxidation state as compared to the Pt in the regenerated catalyst; and

(III) contacting an additional quantity of the hydrocarbon-containing feed with at least a portion of the regenerated and reduced catalyst to produce a re-coked catalyst and additional effluent, wherein a cycle time from the contacting the hydrocarbon-containing feed with the catalyst in step (I) to the contacting the additional quantity of the hydrocarbon-containing feed with the regenerated and reduced catalyst in step (III) is no more than 1 hour.

2. The process of claim 1, wherein in step (I), the hydrocarbon-containing feed and catalyst are contacted in the presence of steam at an amount from 0.1 vol% to 30 vol%, based on a total volume of any C_2-C_{16} alkanes, any C_4-C_{16} cyclic alkanes, and any C_8-C_{16} alkyl aromatics in the hydrocarbon-containing feed.

3. The process of claim 1 or claim 2, wherein in step (I), the hydrocarbon-containing feed and the catalyst are contacted in the presence of steam at an amount from 1 vol% to 15 vol%, based on a total volume of any C_2-C_{16} alkanes, any C_4-C_{16} cyclic alkanes, and any C_8-C_{16} alkyl aromatics in the hydrocarbon-containing feed.

4. The process of any of the preceding claims, wherein the hydrocarbon-containing feed comprises propane, wherein the upgraded hydrocarbon comprises propylene, and wherein contacting the hydrocarbon-containing feed with the catalyst in step (I) has a propylene yield of at least 52 %, at a propylene selectivity of ≥ 75%.

5. The process of any of the preceding claims, wherein the hydrocarbon-containing feed comprises ≥ 70 vol% of propane, based on a total volume of the hydrocarbon-containing feed, wherein the hydrocarbon-containing feed and catalyst are contacted under a propane partial pressure of at least 40 kPa-absolute, and wherein contacting the hydrocarbon-containing feed with the catalyst in step (I) has a propylene yield of at least 52 % at a propylene selectivity of ≥ 75%.

6. The process of any of the preceding claims, wherein at least a portion of the Pt in the regenerated catalyst is at a higher oxidized state as compared to the Pt in the catalyst contacted with the hydrocarbon-containing feed; the process further comprising, after step (II) and before step (III), the following step:

(IIa) contacting at least a portion of the regenerated catalyst with a reducing gas to produce a regenerated and reduced catalyst, wherein at a least a portion of the Pt in the regenerated and reduced catalyst is reduced to a lower oxidation state as compared to the Pt in the regenerated catalyst, and wherein the additional quantity of the hydrocarbon-containing feed is contacted with at least a portion of the regenerated and reduced catalyst.

7. The process of claim 6, wherein in step (IIa), at least one of the following is met:

(i) the regenerated catalyst and reducing gas are contacted at a temperature in a range from 450°C to 900°C; and

(ii) the regenerated catalyst and reducing gas are contacted at a reducing agent partial pressure of 20 kPa-absolute to 10,000 kPa-absolute.

8. The process of any of the preceding claims, wherein the hydrocarbon-containing feed further comprises an inert gas, e.g., Ar, Ne, He, N_2, CH_4, or a mixture thereof.

9. The process of any of the preceding claims, wherein in step (I), at least one of the following is met:

(i) the hydrocarbon-containing feed and catalyst are contacted at a temperature in a range from 600°C to 900°C; and

(ii) the hydrocarbon-containing feed and catalyst are contacted under a hydrocarbon partial pressure in a range from 20 kPa-absolute to 10,000 kPa-absolute.

10. The process of any of the preceding claims, wherein in step (II), at least one of the following is met:

(i) the coked catalyst and oxidant are contacted at a temperature in a range from 600°C to 1,100°C, preferably from 650°C to 1,000°C; and

(ii) the coked catalyst and oxidant are contacted under an oxidant partial pressure of 20 kPa-absolute to 10,000 kPa-absolute.

11. The process of any of the preceding claims, wherein the catalyst further comprises a promoter.

12. The process of claim 11, wherein the promoter comprises one or more of the following elements: Sn, Ga, Zn, Ge, In, Re, Ag, Au, Cu, a combination thereof, or a mixture thereof.

13. The process of claim 11 or claim 12, wherein the catalyst comprises up to 10 wt% of the promoter based on the total weight of the support.

14. The process of any of the preceding claims, wherein the catalyst further comprises an alkali metal element disposed on the support.

15. The process of claim 11, wherein the alkali metal element comprises one or more of the following: Li, Na, K, Rb, Cs, a combination thereof, or a mixture thereof.

16. The process of claim 14 or claim 15, and wherein the catalyst comprises up to 5 wt% of the alkali metal element based on the total weight of the support.

17. The process of any of the preceding claims, wherein the support comprises

at least one of: w wt% of a Group 2 element, x wt% of a Group 4 element, y wt% of a Group 12 element, and z wt% of an element having an atomic number of 21, 39, or 57-71 based on the weight of the support, wherein w, x, y, and z are independently in a range from 0 to 100, wherein:

any Group 2 element is associated with a wt% m based on the weight of the support,

any Group 4 element is associated with a wt% n based on the weight of the support,

any group 12 element is associated with a wt% p based on the weight of the support, and

any element having an atomic number of 21, 39, or 57-71 is associated with a wt% q based on the weight of the support,

m, n, p, and q are independently a number that is in a range from 1 to 100, and

wherein a sum of $w/m + x/n + y/p + z/p$ is ≥ 1, based on the weight of the support.

18. The process of claim 17 wherein m, n, p, and q are each equal to 1, 15, or 30, or wherein m = 1, n = 15, p = 15, and q = 1.

19. The process of claim 17 or claim 18, wherein a molar ratio of a combined amount of any Group 2 element, any Group 4 element, any Group 12 element, and any element having an atomic number of 21, 39, or 57-71 to the Pt is at least 0.18.

20. The process of any of claims 17 to 19, wherein the support further comprises at least one compound comprising at least one metal element or metalloid element selected from Groups 5, 6, 7, 11, 13, 14, 15, and 16.

21. The process of any of the preceding claims, wherein the cycle time is from 0.1 seconds to 30 minutes, e.g., from 5 seconds to 10 minute.

22. The process of any of the preceding claims, wherein the Pt is disposed on the support such that the Pt is the active component of the catalyst that effects the one or more of dehydrogenation, dehydroaromatization, and dehydrocyclization in step (I).

23. The process of any of the preceding claims, wherein the catalyst is in a fixed bed when contacted with the hydrocarbon-containing feed.

24. The process of any of claims 1 or 4 to 23, wherein the hydrocarbon-containing feed is contacted with catalyst in the absence of any steam or in the presence of less than 0.1 vol% of steam based on a total volume of any C_2-C_{16} alkanes, any C_4-C_{16} cyclic alkanes, and any C_8-C_{16} alkyl aromatics in the hydrocarbon-containing feed.

25. The process of any of claims 17 to 24, wherein the catalyst comprises the Group 3 element, and where the hydrocarbon-containing feed comprises 0.1 vol% to 50 vol% of steam, based on a total volume of any C_2-C_{16} alkanes, any C_4-C_{16} cyclic alkanes, and any C_8-C_{16} alkyl aromatics in the hydrocarbon-containing feed.

26. The process of any of claims 1 to 25, wherein the support comprises a Group 2 element.

27. The process of any of claims 1 to 26, wherein the support comprises at least 3 wt% of a Group 2 element.

28. The process of any of claims 1 to 27, wherein the support comprises at least 11 wt% of a Group 2 element based on the weight of the support, and wherein the Group 2 element comprises Mg.

29. The process of any claims 1 to 28, wherein the support is produced by calcining hydrotalcite.

30. A process for upgrading a hydrocarbon, comprising:

(I) contacting a hydrocarbon-containing feed with a catalyst comprising Pt disposed on a support to effect one or more of dehydrogenation, dehydroaromatization, and dehydrocyclization of at least a portion of the hydrocarbon-containing feed to produce a coked catalyst and an effluent comprising one or more upgraded hydrocarbons and molecular hydrogen, wherein:

the hydrocarbon-containing feed comprises one or more of C_2-C_{16} linear or branched alkanes, or one or more of C_4-C_{16} cyclic alkanes, or one or more C_8-C_{16} alkyl aromatics, or a mixture thereof;

the hydrocarbon-containing feed and catalyst are contacted at a temperature in a range from 300°C to 900°C-under a hydrocarbon partial pressure of at least 20 kPa-absolute, wherein the hydrocarbon partial pressure is the total partial pressure of any C_2-C_{16} alkanes and any C_8-C_{16} alkyl aromatics in the hydrocarbon-containing feed;

the catalyst comprises from > 0.025 wt% to 6 wt% of Pt based on the weight of the support;

the support comprises at least 3 wt% of a Group 2 element,

the Group 2 element comprises Mg; and

the one or more upgraded hydrocarbons comprise at least one of a dehydrogenated hydrocarbon, a dehydroaromatized hydrocarbon, and a dehydrocyclized hydrocarbon;

(II) contacting at least a portion of the coked catalyst with an oxidant to effect combustion of at least a portion of the coke to produce a regenerated catalyst lean in coke and a combustion gas, wherein at least a portion of the Pt in the regenerated catalyst is at a higher oxidized state as compared to the Pt in the catalyst contacted with the hydrocarbon-containing feed;

(IIa) contacting at least a portion of the regenerated catalyst with a reducing gas to produce a regenerated and reduced catalyst, wherein at a least a portion of the Pt in the regenerated and reduced catalyst is reduced to a lower oxidation state as compared to the Pt in the regenerated catalyst; and

(III) contacting an additional quantity of the hydrocarbon-containing feed with at least a portion of the regenerated and reduced catalyst to produce a re-coked catalyst and additional effluent, wherein a cycle time from the contacting the hydrocarbon-containing feed with the

catalyst in step (I) to the contacting the additional quantity of the hydrocarbon-containing feed with the regenerated and reduced catalyst in step (III) is no more than 1 hour.

31. The process of claim 30, wherein the support comprises at least 6 wt% of the Group 2 element.