CLAIMS:

What is claimed is:

1. A catalyst composition, comprising a support, a Group 8-10 element, and a promoter, wherein:

the Group 8-10 element and the promoter are disposed through a volume of the support;

the promoter comprises Sn, Cu, Au, Ag, Ga, a combination thereof, or a mixture thereof;

the support comprises a mixed Mg/Al metal oxide; and

the promoter is distributed substantially homogeneously throughout the volume of the support, as determined by energy-dispersive x-ray spectroscopy analysis.

2. The catalyst composition of claim 1, wherein the Group 8-10 element comprises Pt and the promoter comprises Sn.

3. The catalyst composition of claim 1, wherein:

a weight ratio of the Mg to the Al in the mixed Mg/Al metal oxide is in a range from 0.001 to 1,000;

the catalyst composition comprises up to 6 wt% of the Group 8-10 element and up to 10 wt% of the promoter, based on the weight of the support; and

the catalyst composition is in the form of particles having a size and a particle density that is consistent with a Geldart A or Geldart B definition of a fluidizable solid.

4. A process for making a catalyst composition, comprising:

forming a mixture comprising a Group 8-10 element-containing compound, a promoter-containing compound, a carboxylic acid, a liquid medium, and a support comprising a mixed Mg/Al metal oxide, wherein the promoter comprises Sn, Cu, Au, Ag, Ga, a combination thereof, or a mixture thereof; and

heating the mixture to produce the catalyst composition comprising the Group 8-10 element and the promoter disposed through a volume of the support.

5. The process of claim 4, wherein:

the liquid medium comprises water,

the Group 8-10 element-containing compound, the promoter-containing compound, and the carboxylic acid are combined with the water to produce an aqueous solution, and

the aqueous solution is contacted with the support to form the mixture.

6. The process of claim 4, wherein the liquid medium comprises water, the process further comprising:

forming a first aqueous mixture comprising the Group 8-10 element-containing compound and a first portion of the water;

forming a second aqueous mixture comprising the promoter-containing compound and a second portion of the water;

forming a third aqueous mixture comprising the carboxylic acid and a third portion of the water;

combining the first, second, and third aqueous mixtures with one another to produce a combined aqueous mixture, and

contacting the support with the combined aqueous mixture to form the mixture comprising the Group 8-10 element-containing compound, the promoter-containing compound, the carboxylic acid, the liquid medium, and the support.

7. The process of claim 4, wherein the Group 8-10 element-containing compound comprises Pt and the promoter-containing compound comprises Sn.

8. The process of claim 4, wherein the Group 8-10 element-containing compound comprises chloroplatinic acid hexahydrate, tetraammineplatinum(II) nitrate, platinum(II) acetylacetonate, platinum(II) bromide, platinum(II) iodide, platinum(II) chloride, platinum(IV) chloride, platinum(II)diammine dichloride, ammonium tetrachloroplatinate(II), tetraammineplatinum(II) chloride hydrate, tetraammineplatinum(II) hydroxide hydrate, platinum (II) oxalate, or any mixture thereof; and

wherein the promoter-containing compound comprises tin(IV) chloride pentahydrate, tin(II) chloride dihydrate, tin(II) bromide, tin(IV) bromide, tin(II) acetylacetonate, tin(II) acetate, tin(IV) acetate, tin(II) oxalate, tin(IV) oxalate, copper(II) nitrate, gold(III) nitrate, silver(I) nitrate, gallium(III) nitrate, or a mixture thereof.

9. The process of claim 4, wherein the carboxylic acid:

comprises one, two, or three carboxylic acid functional groups;

is present in an amount sufficient to provide a molar ratio of carboxylic acid functional groups in the carboxylic acid to the Sn in the Sn-containing compound of at least 3:1; or

comprises citric acid.

10. The process of claim 4, wherein:

the mixture is heated to a temperature of 350°C to 900°C in the presence of oxygen to produce the catalyst composition; or

wherein the mixture is heated for a time period in a range from 30 minutes to 24 hours to produce the catalyst composition.

11. The process of claim 4, wherein a weight ratio of the Mg to the Al in the mixed Mg/Al metal oxide is in a range from 0.001 to 1,000; and wherein a weight ratio of the liquid medium to the support is in a range from 0.2:1 to 2:1.

12. The process of claim 4, wherein the catalyst composition comprises up to 6 wt% of the Group 8-10 element and up to 10 wt% of the Sn, based on the weight of the support.

13. The process of claim 4, wherein the promoter is distributed substantially homogeneously throughout the volume of the support, as determined by energy-dispersive x-ray spectroscopy analysis; and wherein the support is in the form of a plurality of particles.

14. A process for upgrading a hydrocarbon, comprising:

contacting a hydrocarbon-containing feed with a catalyst composition comprising a support, a Group 8-10 element, and a promoter 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 composition 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 composition are contacted at a temperature in a range of from 300°C to 900°C, for a time period of ≤ 3 hours, 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 support comprises a mixed Mg/Al metal oxide,

the Group 8-10 element and the promoter are disposed through a volume of the support,

the promoter comprises Sn, Cu, Au, Ag, Ga, a combination thereof, or a mixture thereof, and

the promoter is distributed substantially homogeneously throughout the volume of the support, as determined by energy-dispersive x-ray spectroscopy analysis.

15. The process of claim 14, further comprising:

contacting at least a portion of the coked catalyst composition with an oxidant to effect combustion of at least a portion of the coke to produce a regenerated catalyst composition lean in coke and a combustion gas; and

contacting an additional quantity of the hydrocarbon-containing feed with at least a portion of the regenerated catalyst composition to produce a re-coked catalyst composition and additional effluent, wherein a cycle time from contacting the hydrocarbon-containing feed with the catalyst composition to contacting the additional quantity of the hydrocarbon-containing feed with the regenerated catalyst composition is ≤ 5 hours.