What is claimed is:

1. A method of starting up a selective hydrogenation reactor, the reactor housing one or more catalyst beds each containing a catalyst suitable for selectively hydrogenating acetylene in a process gas comprising at least 10 mol.% ethylene, at least 1 ppm acetylene, and at least 5 mol.% hydrogen, the method comprising

providing each catalyst bed at no more than a first temperature, the catalyst of the catalyst bed being in contact with a first gas, the first gas being non-reactive in the presence of the catalyst at the first temperature;

in the presence of the first gas, heating each catalyst bed to at least a second temperature, the second temperature being at least 20 °C~~degrees~~ greater than the first temperature, the first gas being non-reactive in the presence of the catalyst at the second temperature; and then

changing the composition of the first gas in contact with the catalyst ~~from the first gas~~ to a flow of the process gas while the catalyst bed is at least at the second temperature; ~~and~~

allowing the process gas to flow through the catalyst bed until a concentration of acetylene at an outlet of the reactor is less than 1 ppm;

wherein the catalyst in each catalyst bed comprises,

a porous support, present in the catalyst in an amount within the range of 90 wt.% to 99.9 wt.%;

palladium, present in the catalyst in an amount within the range of at least 0.02 wt.%, calculated on an elemental mass basis; and

one or more ionic liquids, present in the catalyst in a combined amount up to 10 wt.%,

wherein the catalyst has a BET surface area of no more than 10 m^2/g and a pore volume of at least 0.05 mL/g.

2. The method of claim 1, wherein the catalyst of each catalyst bed has not been contacted in the reactor with carbon monoxide in an amount in excess of 100 ppm, and wherein the method includes refraining from adding carbon monoxide to the process gas.

3. A method of starting up a selective hydrogenation reactor, the reactor housing one or more catalyst beds each containing a catalyst suitable for selectively hydrogenating acetylene in a process gas comprising at least 10 mol.% ethylene, at least 1 ppm acetylene, and at least 5 mol.% hydrogen, the method comprising

providing each catalyst bed at no more than a first temperature, the catalyst of the catalyst bed being in contact with the process gas;

in the presence of the process gas, heating each catalyst bed to at least a second temperature, the second temperature being at least 20 °C ~~degrees~~ greater than the first temperature, the heating of each catalyst bed being performed at a rate in the range of at least 3 °C/hour; ~~and~~

allowing the process gas to flow through the catalyst bed until a concentration of acetylene at an outlet of the reactor is less than 1 ppm;

wherein the catalyst in each catalyst bed comprises,

a porous support, present in the catalyst in an amount within the range of 90 wt.% to 99.9 wt.%;

palladium, present in the catalyst in an amount within the range of at least 0.02 wt.%, calculated on an elemental mass basis; and

one or more ionic liquids, present in the catalyst in a combined amount up to 10 wt.%,

wherein the catalyst has a BET surface area of no more than 10 m^2/g and a pore volume of at least 0.05 mL/g.

4. The method of claim 3, wherein the rate is in the range of 3-20 °C/hour, e.g., 3-15 °C/hour or 3-12 °C/hour.

5. A method of starting up a selective hydrogenation reactor, the reactor housing one or more catalyst beds each containing a catalyst suitable for selectively hydrogenating acetylene in a process gas comprising at least 10 mol.% ethylene, at least 1 ppm acetylene, and at least 5 mol.% hydrogen, the method comprising;

providing the reactor with each catalyst bed having its catalyst in contact with a first gas at a first temperature, the first gas being non-reactive in the presence of the catalyst at the first temperature, wherein the catalyst has not been contacted in the reactor with a carbon monoxide-containing gas having a carbon monoxide concentration in excess of 2000 ppm; ~~and~~

introducing a flow of the process gas to the one or more catalyst beds, and refraining from adding carbon monoxide to the process gas;

wherein the catalyst in each catalyst bed comprises,

a porous support, present in the catalyst in an amount within the range of 90 wt.% to 99.9 wt.%;

palladium, present in the catalyst in an amount within the range of at least 0.02 wt.%, calculated on an elemental mass basis; and

one or more ionic liquids, present in the catalyst in a combined amount up to 10 wt.%,

wherein the catalyst has a BET surface area of no more than 10 m^2/g and a pore volume of at least 0.05 mL/g.

6. The method of claim 5, further comprising raising the catalyst bed temperature of each catalyst bed from the first temperature to at least a second temperature.

7. The method according to any of claims 1-4 and 6, wherein
the first temperature is no more than 40 °C; and
the second temperature is within the range of 40 °C to 140 °C.

8. A method of starting up a selective hydrogenation reactor, the reactor housing one or more catalyst beds each containing a catalyst suitable for selectively hydrogenating acetylene in a process gas comprising at least 10 mol.% ethylene, at least 1 ppm acetylene, and at least 5 mol.% hydrogen, the method comprising

drying the one or more catalyst beds at a temperature of at least 50 °C; then

cooling each dried catalyst bed to a first temperature less than the drying temperature, in the range of 31-50 °C, and contacting the catalyst of each catalyst with the process gas at the first temperature; then

in the presence of the process gas, heating each catalyst bed to at least a second temperature, the second temperature being at least 20 °C ~~degrees~~ greater than the first temperature; ~~and~~

allowing the process gas to flow through the catalyst bed until a concentration of acetylene at an outlet of the reactor is less than 1 ppm;

wherein the catalyst in each catalyst bed comprises,

a porous support, present in the catalyst in an amount within the range of 90 wt.% to 99.9 wt.%;

palladium, present in the catalyst in an amount within the range of at least 0.02 wt.%, calculated on an elemental mass basis; and

one or more ionic liquids, present in the catalyst in a combined amount up to 10 wt.%,

wherein the catalyst has a BET surface area of no more than 10 m^2/g and a pore volume of at least 0.05 mL/g.

9. A method according to any of claims 1-8, wherein the first temperature is in the range of 31-~~45~~ 40 °C.

10. A method according to any of claims 1-8 wherein the selective hydrogenation is conducted at the second temperature within the range of 40 °C to 140 °C.

11. A method according to any of claims 1-8, wherein the selective hydrogenation is conducted at a gas hourly space velocity of at least 7100 h^{-1}.

12. A method according to any of claims 1-8, wherein ethylene is present in the process gas in an amount of at least 20 mol.% and acetylene is present in the process gas in an amount of at least 500 ppm.

13. A method according to any of claims 1-8, wherein hydrogen is present in the process gas in an amount in the range of 5 mol.% to 35 mol.%.

14. The method according to any of claims 1-8, wherein the process gas contains no more than 5 mol.% of carbon-containing components other than C_1 components (e.g., methane, carbon monoxide, and carbon dioxide), C_2 components (e.g., ethylene, ethane, and acetylene) and C_3 components (e.g., propane, propylene, methyl acetylene, and propadiene).

15. A method according to any of claims 1-8, wherein the catalyst ~~composition~~ comprises a porous support selected from alumina, silica, titania, and mixtures thereof~~, present in the catalyst composition in an amount within the range of 90 wt.% to 99.9 wt.%~~.

~~16. A method according to any of claims 1-8, wherein the catalyst composition comprises palladium in an amount of at least 0.02 wt.%.~~

~~17. A method according to any of claims 1-8, wherein the catalyst composition comprises the at least one ionic liquid in a total amount up to 10 wt.%.~~

~~18~~16. A method according to any of claims 1-8, wherein the at least one ionic liquid is selected from 1-butyl-3-methylimidazolium triflate, 1-ethyl-3-methylpyridinium ethylsulfate, 1-butyl-1-methylpyrrolidinium triflate, 1-butyl-2,3-dimethylimidazolium triflate, 1-butyl-3-methylimidazolium tricyanomethane, 1-butyl-3-methylimidazolium methylsulfate, 1-butyl-3-methylimidazolium octylsulfate, 1-butyl-3-methylimidazolium tetrafluoroborate, 1-ethyl-3-

methylimidazolium ethylsulfate, 1-ethyl-3-methylimidazolium methylphosphonate, 1-ethyl-3-methylimidazolium triflate, 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide, 1-butyl-1-methylpyrrolidinium tetracyanoborate, 1-butyl-1-methylpyrrolidinium tris(pentafluoroethyl)trifluorophosphate, 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 1-butyl-3-methylimidazolium tricyanomethane, 1-ethyl-3-methylpyridinium bis(trifluoromethylsulfonyl)imide, 1-ethyl-3-methylimidazolium tetracyanoborate, 1-ethyl-3-methylimidazolium tris(pentafluoroethyl)trifluorophosphate, 1-methyl-3-octylimidazolium triflate, ethyldimethyl-(2-methoxyethyl)ammonium tris(pentafluoroethyl)trifluorophosphate, tributylmethylammonium dicyanamide, tricyclohexyltetradecylphosphonium tris(pentafluoroethyl)trifluorophosphate, and 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide.

~~19. The method according to any of claims 1-8, wherein the catalyst composition comprises:~~

~~a porous support, present in the composition in an amount within the range of 90 wt.% to 99.9 wt.%;~~

~~palladium, present in the composition in an amount within the range of 0.02 wt.% to 0.5 wt.% (e.g., within the range of 0.03 wt.% to 0.4 wt.%, or 0.04 wt.% to 0.3 wt.%), calculated on an elemental mass basis; and~~

~~one or more ionic liquids, present in the composition in a combined amount up to 10 wt.%.~~

~~20. The method according to any of claims 1-8, wherein the catalyst composition comprises~~

~~a porous support, present in the composition in an amount within the range of 90 wt.% to 99.9 wt.%;~~

~~palladium, present in the composition in an amount within the range of at least 0.02 wt.%, calculated on an elemental mass basis; and~~

~~one or more ionic liquids, present in the composition in a combined amount up to 10 wt.%,~~

~~wherein the hydrogenation catalyst has a BET surface area of no more than 10 m^2/g and a pore volume of at least 0.05 mL/g.~~