CLAIMS

1. A hydrocarbon conversion process, comprising:

(a) providing a first mixture comprising ≥ ~~0.5~~ 90 wt. % ~~hydrocarbon~~ natural gas and ≥ 4.0 ppmw mercaptan based on the weight of the first mixture; and

(b) pyrolysing the first mixture in a first region under pyrolysis conditions which include exposing a the first mixture to a temperature ≥ 1.20 x 10^3°C, ~~in a first region under pyrolysis conditions~~ to convert at least a portion of the ~~hydrocarbon~~ natural gas and ≥ 90.0 wt.% of the first mixture's mercaptan based on the weight of mercaptan in the first mixture to produce a second mixture, the second mixture comprising ≥ 1.0 wt.% C_2 unsaturates, ≤ 20.0 wt.% CO_x, wherein x is 1 or 2, ≤ 1.0 ppmw mercaptan, and ≤ 1.0 ppmw thiophene based on the weight of the second mixture.

2. The process of claim 1, wherein the first mixture comprises ≥ 20.0 wt.% methane and ≥ 10.0 ppmw methyl mercaptan based on the weight of the first mixture; the first mixture being obtained from a natural gas with no intervening mercaptan-removal steps, and wherein the second mixture comprises ≤ 0.05 ppmw methyl mercaptan based on the weight of the second mixture.

3. The process of ~~claims 1 or 2~~ claim 1, wherein the first mixture further comprises hydrogen sulfide in an amount in the range of 50.0 ppmw to 5 wt.% based on the weight of the first mixture.

4. The process of ~~any of claims 1-3~~ claim 1, wherein the first mixture is exposed to a temperature ≥ 1.45x10^3°C during the ~~pyrolysis~~ pyrolysing.

5. The process of any of claims 1-4, further comprising (c) separating hydrogen sulfide from the second mixture to produce a third mixture.

6. The process of claim 5, further comprising:

(d) combining first and second reactants in a second region to produce a fourth mixture, the first and second regions being at least partially coextensive; and

(e) at least partially oxidizing the fourth mixture in ~~a~~ the second region to produce a fifth mixture; wherein

(i) the ~~pyrolysis~~ pyrolyzing and the oxidizing occur at substantially different times, and

(ii) at least a portion of the temperature of the first region during the ~~pyrolysis~~ pyrolyzing is derived from heat generated during the oxidizing in the second region.

7. The process of claim 6, wherein

(i) step (e) further comprising oxidizing at least a portion of any combustible non-volatiles located in the first region; and

(ii) the fifth mixture comprises $\leq$ 10.0 ppmw SO_y, y being in the range of from 2 to 4; the ppmw being based on the weight of the fifth mixture.

8. The process of ~~any of claims 1-7~~ claim 1, wherein $\geq$ 95.0 wt.% of the first mixture's mercaptan is converted to non-thiophenic, non-mercaptan sulfur compounds during the pyrolysis.

9. The process of ~~any of claims 1-8~~ claim 1, further comprising converting at least a portion of the second mixture's acetylene to ethylene.

10. The process of claim 9, further comprising polymerizing at least a portion of the ethylene.

11. A methane conversion process, comprising:

(a) providing a first mixture comprising $\geq$ 90.0 wt.% methane and $\geq$ 4.0 ppmw mercaptan based on the weight of the first mixture; and

(b) thermally pyrolysing the first mixture under thermal pyrolysis conditions which include exposing the first mixture ~~under thermal pyrolysis conditions~~ to a temperature $\geq 1.20 \times 10^3$°C sufficient for converting

(i) $\geq$ 10.0 wt.% of the first mixture's methane to unsaturated hydrocarbon based on the weight of the methane in the first mixture and

(ii) ≥ 90.0 wt.% of the first mixture's mercaptan to non-mercaptan, non-thiophenic sulfur compounds based on the weight of the first mixture

to produce a second mixture comprising ≥ 1.0 wt.% C_2 unsaturates and ≤ 1.0 ppmw mercaptan based on the weight of the second mixture.

12. The process of claim 11, wherein the first mixture further comprises ≥ 10.0 ppmw hydrogen sulfide based on the weight of the first mixture.

13. The process of ~~claims 11 or 12~~ claim 11, wherein (i) ≥ 90.0 wt.% of the mercaptan converted in step (b) is converted to hydrocarbon and hydrogen sulfide based on the weight of mercaptan converted in step (b) and (ii) ≤ 10.0 wt. % of the second mixture's hydrogen sulfide reacts with the second mixture's C_2 unsaturates, based on the weight of the hydrogen sulfide in the second mixture.

14. The process of ~~any of claims 11-13~~ claim 11, further comprising separating hydrogen sulfide from the second mixture.

15. The process of ~~any of claims 11-14~~ claim 11, wherein the second mixture (i) comprises ≤ 1.0 ppmw methyl mercaptan based on the weight of the second mixture and (ii) has a CO_x:C_2 unsaturates molar ratio ≤ 0.3, wherein x is 1 or 2.

16. The process of ~~any of claims 11-15~~ claim 11, wherein the second mixture comprises ≤ 2.0 wt.% CO_x, wherein x is 1 or 2, based on the weight of the second mixture.

~~17. The process of any of claims 11-16, wherein the exposing temperature is ≥ 1.20 x 10^3°C.~~

~~18.~~17. The process of ~~any of claims 11-16~~ claim 11, wherein the ~~exposing~~ temperature to which the first mixture is exposed is ≥ 1.40 x 10^3°C, and the thermal ~~pyrolysis~~ pyrolyzing is conducted for a residence time ≤ 0.05 seconds.

~~19.~~18. The process of ~~any of claims 11-16~~ claim 11, wherein the ~~exposing~~ temperature to which the first mixture is exposed is $\geq 1.60 \times 10^3$°C.

~~20.~~19. The process of ~~any of claims 11-19~~ claim 11, wherein the second mixture comprises ≤ 0.1 ppmw thiophene based on the weight of the second mixture.

~~21.~~20. A method for treating natural gas, comprising

(a) providing a first mixture comprising ≥ 90.0 wt.% of natural gas, the natural gas comprising ≥ 1.0 wt.% methane, ≥ 1.0 ppmw hydrogen sulfide, and ≥ 4.0 ppmw mercaptan based on the weight of the natural gas;

(b) thermally pyrolysing the first mixture under thermal pyrolysis conditions which include exposing the first mixture ~~under thermal pyrolysis conditions~~ to a temperature $\geq 1.20 \times 10^3$°C sufficient for converting

(i) $\geq$ 10.0 wt.% of the first mixture's methane to unsaturated hydrocarbon and molecular hydrogen, based on the weight of the methane in the first mixture, and

(ii) $\geq$ 90.0 wt.% of the first mixture's mercaptan to non-mercaptan, non-thiophenic sulfur based on the weight of the first mixture,

to produce a second mixture comprising $\geq$ 1.0 ppmw hydrogen sulfide, ~~and~~ $\geq$ 1.0 wt.% C_2 unsaturates and $\leq$ 1.0 ppmw mercaptan based on the weight of the second mixture; and

(c) separating at least a portion of the hydrogen sulfide from the second mixture~~;~~, wherein the natural gas is provided to the first mixture with no intervening mercaptan-removal steps.

~~22.~~21. The method of claim ~~21~~ 20, wherein the natural gas comprises $\geq$ 50.0 ppmw mercaptan based on the weight of the natural gas.

~~23.~~22. The method of ~~claims 21 or 22~~ claim 20, wherein the natural gas comprises $\geq$ 50.0 ppmw hydrogen sulfide based on the weight of the natural gas.

~~24. The method of any of claims 21-23, wherein the exposing temperature is $\geq 1.20 \times 10^3$°C.~~

~~25.~~23. The method of ~~any of claims 21-24~~ claim 20, wherein the second mixture (i) comprises $\leq$ 1.0 ppmw methyl mercaptan based on the weight of the second mixture and (ii) has a CO_x:C_2 unsaturates molar ratio $\leq$ 0.3, wherein x is 1 or 2.