WHAT IS CLAIMED IS:

1. A process for the pyrolysis manufacture of acetylene, comprising the steps of:

(a) supplying a first reactant through a first portion of a reactor bed;

(b) supplying at least a second reactant through a second portion of the reactor bed substantially separate from the first portion of the reactor bed; and

(c) combining the supplied first reactant with the second reactant after the first and second reactants have separately traversed at least a portion of the reactor bed, for the first and second reactants to exothermically react with each other;

wherein both of the first and second portions of the reactor bed are utilized to quench a pyrolysis reaction product comprising acetylene, after the combined first and second reactants have reacted with each other.

2. The process of claim 1, wherein the reaction product is a product of pyrolysis of a feed that includes methane.

3. The process of claim 1, wherein the synthesized reaction product is a product of pyrolysis of a feed that includes hydrocarbons other than methane.

4. The process of claim 1, wherein the first reactant is supplied through the reactor bed substantially simultaneously with the supplying of the at least a second reactant through the reactor bed.

5. The process according to any of the preceding claims for the manufacture of acetylene from methane feed using a reverse-flow reactor system, wherein the reactor system includes (i) a first reactor comprising a first end and a second end, and (ii) a second reactor comprising primary end and a secondary end, the first and

second reactors oriented in a series relationship with respect to each other such that the secondary end of the second reactor is proximate the second end of the first reactor, the process comprising the steps of:

(a) supplying a first reactant through a first channel in the first reactor and supplying at least a second reactant through a second channel in the first reactor, such that the first and second reactants are supplied to the first reactor from the first end of the first reactor;

(b) combining the first and second reactants at the second end of the first reactor and reacting the combined reactants to produce a heated reaction product;

(c) passing the heated reaction product through the second reactor to transfer at least a portion of the heat from the reaction product to the second reactor;

(d) thereafter supplying methane through the heated second reactor to the first reactor, to convert at least a portion of the methane into acetylene;

(e) passing the supplied methane and the produced acetylene through the first reactor to quench the methane and the produced acetylene; and

(f) recovering the produced acetylene.

6. The process according to any of the preceding claims, wherein the reverse flow reactor system further comprises a mixer situated intermediate the first reactor and second reactor to combine and react the first reactant with the second reactant.

7. The process according to any of the preceding claims, wherein the first and second reactants are combined at the second end of the first reactor such that at least a majority of the supplied stoichiometrically reactable first and second reactant is reacted exothermically after the supplied first and second reactants exit the first reactor.

8. The process according to any of the preceding claims, further comprising the step of supplying hydrogen in the second reactor to moderate the reaction of the methane.

9. The process according to any of the preceding claims, wherein the first and second reactants exothermically react in at least one of (i) the second end of the first reactor, (ii) intermediate the first and second reactors, and (iii) the secondary end of the second reactor.

10. The process of claim 6, wherein the mixer comprises at least two segments, wherein each segment combines a portion of the supplied first reactant with a portion of the supplied second reactant.

11. The process of claim 6, wherein the mixer is constructed from material able to withstand temperatures in excess of about 1200°C.

12. The process of claim 6, wherein the mixer comprises a ceramic.

13. The process according to any of the preceding claims, wherein the first reactor has a void volume A, and the second reactor has a void volume B, and the mixer has a void volume C, whereby void volume C is less than or equal to about twenty percent of the total of void volumes A plus B plus C.

14. The process according to any of the preceding claims, wherein the first reactant comprises a fuel comprising CO, H_2, hydrocarbons, oxygenates, petrochemicals, or a mixture thereof.

15. The process according to any of the preceding claims, wherein the second reactant comprises oxygen.

16. The process according to any of the preceding claims, further comprising the step of supplying another hydrocarbon feed from the primary end of the second reactor to convert at least a portion of the another hydrocarbon feed to acetylene.

17. The process of claim 5, wherein the heated reaction product heats at least a portion of the second reactor to a temperature of at least about 1500°C.

18. The process according to any of the preceding claims, wherein at least one of the first channel and the second channel comprises a flow path through a porous media.

19. The process of claim 18, wherein the porous media includes at least one of a packed bed, an arrangement of tiles, a permeable solid media, a honeycomb monolith structure and a fibrous arrangement.

20. The process of claim 5, wherein the first reactor and the second reactor each comprise at least one of a packed bed, an arrangement of tiles, a permeable solid media, a honeycomb monolith structure and a fibrous arrangement.

21. The process of claim 5, wherein the second reactor further comprises a reaction catalyst.

22. The process according to any of the preceding claims, further comprising the step of supplying to the first reactor an exhaust gas (EGR) with at least one of the supplied first reactant and second reactant.

23. The process according to any of the preceding claims, further comprising the step of recovering at least one of hydrogen and methane from the quenched methane and produced acetylene mixture.

24. The process according to any of the preceding claims, further comprising the step of recycling at least a portion of the recovered at least one of hydrogen and methane to the second reactor.

25. The process according to any of claims 5 - 24, comprising the step of actuating at least one of a valve and a flow restrictor to prevent flow of one of the first and second reactants into one of the first portion and second portion of the reactor.

26. The process of claim 25, wherein the step of actuating includes permitting a flow restrictor to close or open in response to pressures within the first reactor.

27. The process of claim 25, wherein the flow restrictor comprises at least one of an actuated valve, a check valve, and a louver-type flow valve.

28. The process according to claim 1 performed using a cyclic reverse flow reactor system for the manufacture of acetylene from methane feed, wherein the reactor system comprises:

(i) a first reactor comprising a first end and a second end;

(ii) a second reactor comprising primary end and a secondary end, the first and second reactors oriented in a series flow path relationship with respect to each other such that the secondary end of the second reactor is proximate the second end of the first reactor;

wherein the first reactor further comprises;

(a) a first channel to supply at least a first reactant from the first end of the first reactor to the second end of the first reactor;

(b) a second channel to supply at least a second reactant from the first end of the first reactor to the second end of the first reactor; and

(c) a product removal line to remove at least one of methane and a produced acetylene from a first end of the first reactor;

wherein the second reactor further comprises;

(i) a flue gas removal line to remove at least a portion of a heated reaction product produced from mixing and reacting the first and second reaction products; and

(ii) a methane feed line to feed methane to the primary end of the second reactor.

29. The reactor system of claim 28, further comprising a mixer situated intermediate the first reactor and second reactor to mix the first reactant with the second reactant.

30. The reactor system of claim 29, wherein the mixer further comprises at least one mixer segment, wherein each segment receives at least a portion of the first and second reactant to mix the at least a portion of the first and second reactant in the respective segment.

31. The reactor system of claim 29, wherein the mixer is constructed from material able to withstand temperatures in excess of about 1700°C.

32. The reactor system of claim 29, wherein the mixer comprises a ceramic.

33. The reactor system of claim 28, wherein the first reactor comprises at least two layers of reactor bed material and the first channel comprises at least one of the at least two layers and the second channel comprises another of the at least two layers.

34. The reactor system of claim 33, wherein a reactant flow path through each of the at least two layers is substantially not in fluid communication with a flow path through an immediately adjacent layer.

35. The reactor system of claim 33, further comprising at least one flow restrictor to control flow into at least one of the at least two layers.

36. The reactor system of claim 35, wherein the flow restrictor comprises at least one of an actuated valve and a passively responsive valve.

37. The reactor system of claim 35, wherein at least one of the flow restrictors is positioned on an end face on a first end of the first reactor.

38. The reactor system according to any of the preceding claims, further comprising a methane supply line to supply methane to the primary end of the second reactor for conversion to acetylene in the second reactor.

39. The reactor system according to any of the preceding claims, further comprising a hydrogen supply line to supply hydrogen to the primary end of the second reactor so that the hydrogen can moderate the conversion of the methane.

40. The reactor system according to any of the preceding claims, further comprising a fuel gas supply line to supply a fuel gas to one of the first channel and the second channel in the first reactor.

41. The reactor system according to any of the preceding claims, wherein the second reactant comprises at least one of (i) a noncombustible gas, and (ii) a mixture of combustible and noncombustible gases.

42. The reactor system according to any of the preceding claims, wherein the second reactant comprises an exhaust gas recycle (EGR).

43. The reactor system according to any of the preceding claims, wherein the first reactor comprises a bed packing whereby at least one of the first channel and the second channel include an average wetted surface area per unit volume that ranges from about 50 ft^{-1} to about 3000 ft^{-1}.

44. The reactor system according to any of the preceding claims, wherein the first reactor comprises a bed packing whereby at least one of the first channel and the second channel include an average volumetric heat transfer coefficient of greater than or equal to 0.02 cal/cm^{3}s°C.

CLAIMS

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(c) combining the supplied first reactant with the second reactant after the first and second reactants have separately traversed at least a portion of the reactor bed, for the first and second reactants to exothermically react with each other;
wherein both of the first and second portions of the reactor bed are utilized to quench a pyrolysis reaction product comprising acetylene, after the combined first and second reactants have reacted with each other.

2. The process of claim 1, wherein the reaction product is a product of pyrolysis of a feed that includes methane.

3. The process of claim 1, wherein the synthesized reaction product is a product of pyrolysis of a feed that includes hydrocarbons other than methane.

4. The process of claim 1, wherein the first reactant is supplied through the reactor bed substantially simultaneously with the supplying of the at least a second reactant through the reactor bed.