CLAIMS:

1. An apparatus for producing acetylene from a feed stream comprising methane comprising:

a supersonic reactor for receiving the methane feed stream and heating the methane feed stream to a pyrolysis temperature;

a reactor shell of the supersonic reactor for defining a reactor chamber;

a combustion zone of the supersonic reactor for combusting a fuel source to provide a high temperature carrier gas passing through the reactor space at supersonic speeds to heat and accelerate the methane feed stream to a pyrolysis temperature;

at least a portion of the reactor shell formed of a material having a relatively high thermal conductivity to conduct heat away from the reactor chamber; and

an active cooling system of at least the portion of the reactor shell to cool the portion of the reactor shell to resist melting thereof due to operating temperatures.

2. The apparatus of claim 1, wherein the active cooling system includes a coolant flowing about at least a portion of the reactor shell.

3. The apparatus of claim 2, wherein the portion of the reactor shell includes passageways and the coolant flows therethrough.

4. The apparatus of claim 3, wherein the passageways include one of at least channels formed in a surface of the reactor shell portion and tunnels formed within the reactor shell portion.

5. The apparatus of claim 3, wherein the portion of the reactor shell has a generally annular configuration and the passageways are elongate passageways extending along the reactor shell.

6. The apparatus of claim 5, wherein the elongate passageways extends helically about the annular reactor shell.

7. The apparatus of claim 3, wherein the reactor shell includes an inner shell and an outer shell and the passageways include a gap between the inner and outer shell.

8. The apparatus of claim 3, wherein the reactor shell includes a coated substrate having an outer substrate portion of the reactor shell and an inner coating portion of the reactor shell

and the passageways are formed between the inner coating portion and the outer substrate portion.

9. The apparatus of claim 3, wherein the coolant is pressurized to between 350 and 3200 psig.

10. The apparatus of claim 3, wherein the coolant is selected from the group consisting of water, steam, hydrogen, and methane.

11. The apparatus of claim 1, wherein the portion of the reactor shell comprises a material having a thermal conductivity of between 200 and 500 W/m-K.

12. The apparatus of claim 1, wherein the portion of the reactor shell comprises at least one of copper and a copper alloy.

13. The apparatus of claim 1, wherein the portion of the reactor shell comprises a material selected from the group consisting of copper chrome, copper chrome zinc, copper chrome niobium, copper nickel and copper nickel tungsten.

14. The apparatus of claim 1, wherein the portion of the reactor shell comprises a material selected from the group consisting of aluminum, zirconium, niobium, silver, and alloys thereof.

15. The apparatus of claim 1 wherein the active cooling system includes an impingement cooling system.

16. The apparatus of claim 3 wherein the passageways further comprise protrusions to increase surface area for cooling.

17. A method for producing acetylene comprising:

introducing a fuel stream into a combustion zone of a supersonic reactor;

combusting the fuel stream to provide a high temperature carrier stream traveling at a supersonic speed;

introducing a feed stream portion of a hydrocarbon stream comprising methane into the supersonic reactor;

mixing the feed stream portion with the carrier stream to form a reactor stream;

expanding the reactor stream to reduce the speed and increase the temperature of the reactor stream to a pyrolysis temperature to pyrolyze the stream;

actively cooling at least a portion of a reactor shell of the supersonic reactor formed of a material having a relatively high thermal conductivity to maintain the temperature of the reactor shell portion below a melting temperature thereof.

18. The method of claim 18, wherein actively cooling includes passing coolant through passageways of the reactor shell to remove heat therefrom.

19. The method of claim 19, wherein actively cooling includes passing cool fluid between an inner shell layer and an outer shell layer of the reactor shell.

The Claims defining the invention are as follows:

1. An apparatus for producing acetylene from a feed stream comprising methane comprising:

a supersonic reactor for receiving the methane feed stream and heating the methane feed stream to a pyrolysis temperature;

a reactor shell of the supersonic reactor for defining a reactor chamber;

a combustion zone of the supersonic reactor for combusting a fuel source to provide a high temperature carrier gas passing through the reactor space at supersonic speeds to heat and accelerate the methane feed stream to the pyrolysis temperature;

the reactor shell formed of a copper or copper alloy material having a relatively high thermal conductivity of between about 200 and about 500 W/m-K to conduct heat away from the reactor chamber; and

an active cooling system of at least the portion of the reactor shell to cool the portion of the reactor shell to resist melting thereof due to operating temperatures wherein the active cooling system comprises passageways in the reactor shell for coolant flowing therethrough, said passageways comprising channels or tunnels.

2. The apparatus of claim 1, wherein the passageways include tunnels formed within the reactor shell.

3. The apparatus of claim 1 or claim 2, wherein the passageways extend helically about the annular reactor shell.

4. The apparatus of any one of the preceding claims, wherein the reactor shell includes an inner shell and an outer shell and the passageways include a gap between the inner and outer shell.

5. The apparatus of any one of the preceding claims, wherein the reactor shell includes a coated substrate having an outer substrate portion of the reactor shell and an inner coating portion of the reactor shell and the passageways are formed between the inner coating portion and the outer substrate portion.

6. The apparatus of any one of the preceding claims, wherein the coolant is pressurized to between 350 and 3200 psig.

7. The apparatus of any one of the preceding claims, wherein the coolant is selected from the group consisting of water, steam, hydrogen, and methane.

8. The apparatus of any one of the preceding claims, wherein the reactor shell further comprises a material selected from the group consisting of aluminum, zirconium, niobium, silver, and alloys thereof.

9. The apparatus of any one of the preceding claims, wherein the active cooling system includes an impingement cooling system.

10. The apparatus of any one of the preceding claims, wherein the passageways further comprise protrusions to increase surface area for cooling.

11. A method for producing acetylene comprising:

introducing a fuel stream into a combustion zone of a supersonic reactor;

combusting the fuel stream to provide a high temperature carrier stream traveling at a supersonic speed;

introducing a feed stream portion of a hydrocarbon stream comprising methane into the supersonic reactor;

mixing the feed stream portion with the carrier stream to form a reactor stream;

expanding the reactor stream to reduce the speed and increase the temperature of the reactor stream to a pyrolysis temperature to pyrolyze the stream;

actively cooling at least a portion of a reactor shell of the supersonic reactor formed of a material having a relatively high thermal conductivity to maintain the temperature of the reactor shell portion below a melting temperature thereof by passing coolant through passageways of the reactor shell to remove heat therefrom.