Claims:

1. A gas-processing apparatus comprising:

a media vessel comprising:

a media vessel inlet end comprising a media vessel inlet,

a media vessel outlet end comprising a media vessel outlet,

a media vessel sidewall extending between the media vessel inlet and the media vessel outlet, and

a media vessel interior defined by the media vessel sidewall, and

a pre-heater on an outer side of the media vessel sidewall, the pre-heater comprising:

a pre-heater sidewall that is external to the media vessel sidewall, and is spaced from the media vessel sidewall to define a pre-heater volume between an outer surface of the media vessel sidewall and an inner surface of the pre-heater sidewall,

a pre-heater inlet, and

a pre-heater outlet in fluid communication with the media vessel inlet.

2. The gas-processing apparatus of claim 1, further comprising heating elements within the pre-heater volume.

3. The gas-processing apparatus of claim 2, wherein the heating elements are heating rods, wherein:

the heating rods extend vertically within the pre-heater volume, and

the heating rods are distributed along a perimeter of the pre-heater volume.

4. The gas-processing apparatus of claim 3, wherein the heating rods are distributed along the perimeter with non-uniform spacings between heating rods.

5. The gas-processing apparatus of claim 3, wherein:

a perimeter of the pre-heater volume has a perimeter length that includes a front-half perimeter length and a back-half perimeter length,

the pre-heater inlet is located centered at the front-half perimeter length,

a front-half group of heating rods is distributed along the front-half perimeter length,

a back-half group of heating rods is distributed along the back-half perimeter length, and

the front-half group has a greater number of heating rods than the back-half group.

6. The gas-processing apparatus of claim 1, further comprising at least one horizontally-extending baffle positioned at within the pre-heater volume.

7. The gas-processing apparatus of claim 6, wherein the baffle has a partially-circular shape and defines a gap between two ends of the baffle.

8. The gas-processing apparatus of claim 6, further comprising heating rods, wherein:

the heating rods extend vertically within the pre-heater volume,

the heating rods extend through apertures in the baffle, and

the heating rods are distributed along a perimeter of the pre-heater volume.

9. The gas-processing apparatus of claim 8, wherein the heating rods are distributed along the perimeter with uniform spacings between heating rods.

10. The gas-processing apparatus of claim 1, wherein the pre-heater comprises:

a pre-heater inlet end adjacent to the media vessel outlet end, and

a pre-heater outlet end adjacent to the media vessel inlet end,

wherein:

the pre-heater inlet is located at the pre-heater inlet end, and

the pre-heater outlet is located at the pre-heater outlet end.

11. The gas-processing apparatus of claim 1, wherein the pre-heater outlet comprises an opening that connects the pre-heater interior with the media vessel interior, and that extends along a length of a perimeter of the pre-heater including on a front side of the pre-heater and on a back side of the pre-heater.

12. The gas-processing apparatus of claim 1, wherein the pre-heater inlet is an opening on a front side of the pre-heater and extends less than 30 degrees of a length of the perimeter of the pre-heater.

13. The gas-processing apparatus of claim 1, wherein the ratio of the area of the pre-heater inlet to the area of the media vessel outlet is from 2:1 to 1:2.

14. The gas-processing apparatus of claim 1, wherein the pre-heater volume has a cylindrical, annular cross-section.

15. The gas-processing apparatus of claim 1, wherein the media vessel containing media that comprises adsorption media or catalyst.

16. The gas-processing apparatus of claim 1, further comprising an inlet end headspace that connects the media vessel inlet and the pre-heater outlet, and comprises a flow path from the pre-heater outlet, through the inlet end headspace, to the media vessel inlet.

17. The gas-processing apparatus of claim 1, wherein:

the pre-heater volume comprises flowpaths of different lengths between the pre-heater inlet and the pre-heater outlet, and

the pre-heater is capable of a higher rate of heat transfer to gas that flows along a shorter flowpath compared to a lower rate of heat transfer to gas that flows along a longer flowpath.

18. A method of using a gas-processing apparatus of claim 1, the method comprising:

flowing a gas through the pre-heater to pre-heat the gas, and

passing the pre-heated gas through the media vessel interior to contact media contained in the media vessel interior.

19. The method of claim 18, wherein the gas is selected from nitrogen, argon, hydrogen, ammonia, carbon dioxide, clean dry air, and oxygen.

20. The method of claim 19, wherein the media comprises catalyst and the gas is a reagent gas selected from nitrogen, argon, hydrogen, carbon dioxide, clean dry air, and oxygen.

21. The method of claim 19, wherein the impurity is a nitrogen oxide, carbon monoxide, or a hydrocarbon.

22. The method of claim 19, wherein the impurity is methane.

23. The method of claim 19, wherein the apparatus does not include a heating element within the media vessel, and the apparatus does not include a heating element external to the pre-heater.