CLAIMS

What is claimed is:

1. A partial pressure detector, comprising:

a thermal conductivity sensor configured to sense a pressure of a mixture of gases within a vacuum chamber;

an input configured to receive a total pressure reading from a species-independent pressure sensor of the mixture of gases in the vacuum chamber; and

a controller configured to provide an output proportional to a partial pressure of a species of gas in the vacuum chamber as a function of the pressure as sensed by the thermal conductivity sensor and the received total pressure reading, the controller having a resolution scaled to a range of expected partial pressures of the species.

2. The partial pressure detector of claim 1, wherein the function includes a difference in pressure between the pressure as sensed by the thermal conductivity sensor and the received total pressure reading.

3. The partial pressure detector of claim 2, wherein the function is according to the following:

$$\Delta TP = TP_{PG} - TP = xPP_S$$

where ΔTP represents a weighted partial pressure of the species; TP_{PG} is the pressure as sensed by the thermal conductivity sensor, TP is the total pressure reading as received from the species-independent pressure sensor, x is a species-dependent factor, and PP_S is the partial pressure of the species.

4. The partial pressure detector of claim 3, wherein the output is the partial pressure of the species (PP_S).

5. The partial pressure detector of claim 3, wherein the species is water and x is 0.4.

6. The partial pressure detector of any one of claims 1-5, wherein the controller is further configured to provide a second output, the second output representing a total pressure of the mixture of gases within the vacuum chamber as sensed by the thermal conductivity sensor.

7. The partial pressure detector of any one of claims 1-6, wherein the thermal conductivity sensor is a Pirani gauge.

8. The partial pressure detector of any one of claims 1-7, wherein the species-independent sensor is a capacitance diaphragm gauge.

9. The partial pressure detector of any one of claims 1-8, further comprising an input port configured to connect to an output of the species-independent pressure sensor.

10. The partial pressure detector of any one of claims 1-9, further comprising the species-independent pressure sensor.

11. The partial pressure detector of any one of claims 1-10, further comprising a trigger configured to zero the output of the controller.

12. The partial pressure detector of any one of claims 1-11, wherein the controller is further configured to adaptively average the output.

13. A partial pressure detector, comprising:

a housing;

a thermal conductivity sensor at least partially contained within the housing and configured to sense a thermal response of a sensor wire to a mixture of gases within a vacuum chamber; and

a controller, contained within the housing, configured to:

determine a pressure of the mixture of gases within the vacuum chamber based on the sensed thermal response of the thermal conductivity sensor,

receive a total pressure reading from a species-independent pressure sensor of the mixture of gases in the vacuum chamber, and

provide an output proportional to a partial pressure of a species of gas in the vacuum chamber as a function of the determined pressure and the received total pressure reading.

14. The partial pressure detector of claim 13, wherein the function includes a difference in pressure between the determined pressure and the received total pressure reading.

15. The partial pressure detector of claim 14, wherein the function is according to the following:

$$\Delta TP = TP_{PG} - TP = xPP_S$$

where ΔTP represents a weighted partial pressure of the species; TP_{PG} is the pressure as sensed by the thermal conductivity sensor, TP is the total pressure reading as received from the species-independent pressure sensor, x is a species-dependent factor, and PP_S is the partial pressure of the species.

16. The partial pressure detector of claim 15, wherein the output is the partial pressure of the species (PP_S).

17. The partial pressure detector of claim 15, wherein the species is water and x is 0.4.

18. The partial pressure detector of any one of claims 13-17, wherein the controller has a resolution scaled to a range of expected partial pressures of the species.

19. The partial pressure detector of any one of claims 13-18, wherein the controller is further configured to provide a second output, the second output representing a total pressure of the mixture of gases within the vacuum chamber as determined based on the sensed thermal response of the thermal conductivity sensor.

20. The partial pressure detector of any one of claims 13-19, wherein the thermal conductivity sensor is a Pirani gauge.

21. The partial pressure detector of any one of claims 13-20, wherein the species-independent pressure sensor is a capacitance diaphragm gauge.

22. The partial pressure detector of any one of claims 13-21, further comprising an input port configured to connect to an output of the species-independent pressure sensor.

23. The partial pressure detector of any one of claims 13-22, further comprising the species-independent pressure sensor.

24. The partial pressure detector of claim 23, wherein the species-independent pressure sensor is contained within the housing.

25. The partial pressure detector of any one of claims 13-24, further comprising a trigger configured to zero the output of the controller.

26. The partial pressure detector of any one of claims 13-25, wherein the controller is further configured to adaptively average the output.

27. A method of detecting a partial pressure of a gas species, comprising:

with a thermal conductivity sensor, sensing a pressure of a mixture of gases within a vacuum chamber;

with a species-independent pressure sensor, sensing a total pressure of the mixture of gases within the vacuum chamber; and

providing an output proportional to a partial pressure of a species of gas in the vacuum chamber as a function of the pressure as sensed by the thermal conductivity sensor and the total pressure as sensed by the species-independent pressure sensor, the output provided by a controller having a resolution scaled to a range of expected partial pressures of the species.

28. The method of claim 27, wherein the function includes a difference in pressure between the pressure as sensed by the thermal conductivitysensor and the total pressure as sensed by the species-independent pressure senor.

29. The method of claim 28, wherein the function is according to the following:

$$\Delta TP = TP_{PG} - TP = xPP_S$$

where ΔTP represents a weighted partial pressure of the species; TP_{PG} is the pressure as sensed by the thermal conductivity sensor, TP is the total pressure as sensed by the species-independent pressure sensor, x is a species-dependent factor, and PP_S is the partial pressure of the species.

30. The method of claim 29, wherein the output is the partial pressure of the species (PP_S).

31. The method of claim 29, wherein the species is water and x is 0.4.

32. The method of any one of claims 27-31, further comprising providing a second output, the second output representing a total pressure of the mixture of gases within the vacuum chamber as sensed by the thermal conductivity sensor.

33. The method of any one of claims 27-32, wherein the species is a solvent of a sample undergoing lyophilization in the vacuum chamber.

34. The method of any one of claims 27-33, wherein the mixture of gases is binary.

35. The method of any one of claims 27-34, wherein the thermal conductivity sensor is a Pirani gauge.

36. The method of any one of claims 27-35, wherein the species-independent sensor is a capacitance diaphragm gauge.

37. The method of any one of claims 27-36, further comprising calibrating the controller to the species-independent pressure sensor.

38. The method of claim 37, further comprising zeroing an output of the controller.

39. The method of any one of claims 27-38, further comprising adaptively averaging the output.

40. A partial pressure detector, comprising:

a species-dependent sensor configured to sense a pressure of a mixture of gases within a vacuum chamber;

an input configured to receive a total pressure reading from a species-independent pressure sensor of the mixture of gases in the vacuum chamber; and

a controller configured to provide an output representing an amount of a species of gas in the vacuum chamber as a function of the pressure as sensed by the species-dependent sensor and the received total pressure reading, the controller having a resolution scaled to a range of expected partial pressures of the species.