What is claimed is:

1. A system for measuring the concentration of radicals in a gas stream, comprising:

at least one radical gas generator in communication with at least one gas source, the radical gas generator configured to generate at least one radical gas stream;

at least one processing chamber in fluid communication with the at least one radical gas generator, the at least one processing chamber configured to receive at least a portion of the at least one radical gas stream;

at least one analysis circuit in fluid communication with the at least one radical gas generator, the analysis circuit configured to react at least one reagent with at least one radical gas within a defined volume of the at least one radical gas stream thereby forming at least one chemical species within at least one compound stream, the at least one compound stream located within the at least one analysis circuit;

at least one sampling reaction module positioned within the analysis of circuit and in fluid communication with the at least one radical gas generator, the sampling reaction module having at least one thermal control module in thermal communication with at least one sampling tube, the at least one sampling tube configured to receive a portion of the radical gas stream from the at least one radical gas generator therein and react at least one reagent with at least one radical gas within a defined volume of the at least one radical gas stream thereby forming at least one chemical species within at least one compound stream;

at least one sensor module within the analysis circuit, the sensor module configured to measure a concentration of the at least one chemical species within the at least one compound stream; and

at least one flow measurement module in fluid communication with the sensor module, the at least one flow measurement module configured to measure a volume of the at least one of the at least one radical gas stream and at least one compound stream.

2. The system of claim 1 wherein the at least one analysis circuit comprises at least one sampling module configured to react the at least one reagent with the at least one radical within a defined volume of the at least one radical gas stream thereby forming at least one chemical species within at least one compound stream.

3. The system of claim 2 wherein the at least one reagent comprises carbon-based materials.

4. The system of claim 2 wherein the at least one reagent comprises silicon-based materials.

5. The system of claim 2 wherein the at least one reagent comprises at least one material selected from the group consisting of graphite, silica, carbon fiber, silicon dioxide, and silicon carbide.

6. The system of claim 2 wherein the at least one sampling module includes at least one calorimetry measurement system.

7. The system of claim 2 wherein the at least one sampling module includes at least one titrimetry system.

8. The system of claim 2 wherein the at least one sampling module includes at least one chemisorption system.

9. The system of claim 1 wherein the at least one sensor module comprises at least one Fourier transform infrared spectroscopy system.

10. The system of claim 1 wherein the at least one sensor module comprises at least one tunable filter spectroscopy system.

11. The system of claim 1 wherein at least one flow measurement module includes at least one mass flow meter.

12. The system of claim 1 wherein at least one flow measurement module includes at least one mass flow verifier.

13. The system of claim 1 further comprising at least one processor in communication with at least one of the at least one radical gas generator, at least one analysis circuit, at least one sampling module, at least one sensor module, and at least one flow measurement module, the at least one processor configured to controllably adjust to generation of at least one radical gas stream emitted from the at least one radical gas generator based on data received from at least one of the at least one analysis circuit, at least one sampling module, at least one sensor module, and at least one flow measurement module

~~14. A system for measuring the concentration of radical in a gas stream, comprising:~~

~~at least one radial gas generator in communication with at least one gas source, the radical gas generator configured to generate at least one radical gas stream;~~
~~at least one analysis circuit in fluid communication with the at least one radical gas generator, the analysis circuit having at least one sampling reaction module position therein and configured to react at least one reagent with at least one radical gas within a defined volume of the at least one radical gas stream thereby forming at least one reaction product, wherein the at least one reaction product is indicative of the concentration of the radical gas within the at least one radical gas stream within the at least one analysis circuit;~~

~~at least one sensor module within the analysis circuit, the sensor module configured to measure the at least reaction product; and~~

~~at least one flow measurement module in fluid communication with the sensor module, the at least one flow measurement module configured to measure a volume of the at least one of the at least one radical gas stream and at least one compound stream.~~

~~15. A system of claim 14 for measuring the concentration of radical in a gas stream, wherein the at least one reaction product from reaction of at least one reagent with at least one radical gas is a chemical compound.~~

~~16. A system of claim 14 for measuring the concentration of radical in a gas stream, wherein the at least one reaction product from reaction of at least one reagent with at least one radical gas is an emitted photon.~~

~~17. A system of claim 14 for measuring the concentration of radical in a gas stream, wherein the at least one reaction product from reaction of at least one reagent with at least one radical gas is an released thermal energy.~~

~~18. A system of claim 14 for measuring the concentration of radical in a gas stream, wherein the at least one reaction product from reaction of at least one reagent with at least one radical gas is an ion.~~

~~19~~ 14. A method of measuring radicals in a radical gas stream, comprising:

providing at least one radical gas stream having radicals therein;

forming at least one sampling gas stream by directing a defined volume of the at least one radical gas stream to at least one sampling module;

combining within the at least one sampling module at least one reagent with the radicals in the at least one sampling gas stream to form at least one compound stream having at least one chemical species therein;

measuring a concentration of the at least one chemical species within the at least one compound stream using at least one sensor module;

directing a remaining volume of the at least one radical gas stream into at least one processing chamber;

measuring a flow rate of the at least one of the at least one radical gas stream and at least one compound gas stream using at least one flow measurement module in fluid communication with the at least one sensor module; and

calculating a concentration of radicals within the at least one processing chamber by comparing a ratio of the concentration of chemical species within the at least one compound stream per defined volume of the radical gas stream forming the sampling gas stream to the remaining volume of the at least one radical gas stream.

~~20~~ 15. The method of claim ~~19~~ 14 further comprising measuring the concentration of the at least one chemical species within the at least one compound stream using at least one calorimetry system positioned within at least one of the at least one sampling module and at least one sensor module.

~~21~~ 16. The method of claim ~~19~~ 14 further comprising measuring the concentration of the at least one chemical species within the at least one compound stream using at least one titrimetry system positioned within at least one of the at least one sampling module and at least one sensor module.

~~22~~ 17. The method of claim ~~19~~ 14 further comprising measuring the concentration of the at least one chemical species within the at least one compound stream using at least one chemisorption system positioned within at least one of the at least one sampling module and at least one sensor module.

~~23~~ 18. The method of claim ~~19~~ 14 further comprising measuring the concentration of the at least one chemical species within the at least one compound stream using Fourier transform infrared spectroscopy within the at least one sensor module.

~~24~~ 19. The method of claim ~~19~~ 14 further comprising measuring the concentration of the at least one chemical species within the at least one compound stream using tunable filter spectroscopy within the at least one sensor module.

~~25~~ 20. The method of claim ~~19~~ 14 measuring a flow rate of the at least one of the at least one radical gas stream and at least one compound gas stream using at least one mass flow meter within the flow measurement module.

~~26~~ 21. The method of claim ~~19~~ 14 measuring a flow rate of the at least one of the at least one radical gas stream and at least one compound gas stream using at least one mass flow verifier within the flow measurement module.

~~27~~ 22. The method of claim ~~19~~ 14 further comprising;

forming at least one chamber sampling gas stream by directing a defined volume of the at least one radical gas stream from the at least one processing chamber to the at least one sampling module;

combining within the at least one sampling module at least one reagent with the radicals in the at least one chamber sampling gas stream to form at least one chamber compound stream having at least one chemical species therein;

measuring a concentration of chemical species within the at least one chamber compound stream; and

calculating a concentration of radicals within the at least one processing chamber by comparing a ratio of the concentration of chemical species within the at least one chamber compound stream per defined volume of the radical gas stream forming the chamber sampling gas stream to the remaining volume of the at least one radical gas stream.

~~28~~ 23. The method of claim ~~19~~ 14 further comprising;

forming at least one exhaust sampling gas stream by directing a defined volume of the at least one radical gas stream exhausted from the at least one processing chamber to the at least one sampling module;

combining within the at least one sampling module at least one reagent with the radicals in the at least one exhaust sampling gas stream to form at least one exhaust compound stream having at least one chemical species therein;

measuring a concentration of chemical species within the at least one exhaust compound stream; and

calculating a concentration of radicals within the at least one processing chamber by comparing a ratio of the concentration of chemical species within the at least one exhaust compound stream per defined volume of the radical gas stream forming the exhaust sampling gas stream to the remaining volume of the at least one radical gas stream.

~~29~~ 24. A method of measuring radicals in a radical gas stream, comprising:

providing at least one radical gas stream having radicals therein;

forming at least one upstream sampling gas stream by directing a defined volume of the at least one radical gas stream to at least one upstream sampling module; directing a remaining volume of the at least one radical gas stream into at least one processing chamber;

forming at least one chamber sampling gas stream by directing a defined volume of the at least one radical gas stream from the at least one processing chamber to at least one chamber sampling module;

exhausting a remaining volume of the at least one radical gas stream from the at least one processing chamber thereby forming at least one exhaust gas stream; forming at least one exhaust sampling gas stream by directing a defined volume of the at least one exhaust gas stream to at least one exhaust sampling module; combining within the at least one of the upstream sampling module, chamber sampling module, and exhaust sampling module at least one reagent with the radicals in at least one of the at least one upstream sampling module, at least one chamber sampling module, and at least one exhaust sampling module to form at least one upstream compound stream, chamber compound stream, and exhaust compound stream having at least one chemical species therein;

measuring a quantity of chemical species within the at least one of the at least one at least one upstream compound stream, chamber compound stream, and exhaust compound stream compound stream; and

calculating a concentration of radicals within the at least one processing chamber by comparing a ratio of the concentration of chemical species within the at least one of the at least one upstream compound stream, chamber compound stream, and exhaust compound stream per defined volume of the radical gas stream forming the upstream sampling gas

stream, chamber sampling gas stream, and exhaust sampling gas stream to the remaining volume of the at least one radical gas stream.

~~30~~ 25. A multi-sensor gas detection system for use in a wafer processing system, comprising:

an upstream sampling module in fluid communication with a radical gas stream emitted from at least one source of radical gas source, the upstream sampling module configured to receive a controlled volume of the at least one radical gas stream from the radical gas source and react with the controlled volume of the at least one radical gas stream with at least one reagent to produce an upstream compound stream;

at least one chamber sampling module in fluid communication with the at least one radical gas stream present within at least one processing chamber, the chamber sampling module configured to receive a controlled volume of the at least one radical gas stream and react with the controlled volume of the at least one radical gas stream with at least one reagent to produce a chamber compound stream;

at least one exhaust sampling module in fluid communication with the at least one radical gas stream present exhausted from the at least one processing chamber, the exhaust sampling module configured to receive a controlled volume of the at least one radical gas stream and react with the controlled volume of the at least one radical gas stream with at least one reagent to produce an exhaust compound stream;

at least one sensor module in communication with at least one of the upstream sampling module, chamber sampling module, and exhaust sampling module, the at least one sensor module configured to measure the concentration of at least one of the upstream compound stream, chamber compound stream, and exhaust compound stream; and

at least one flow module in communication with at least one of the upstream sampling module, chamber sampling module, exhaust sampling module, and sensor module, the at least one flow module configured to control the flow rate of at least one of the upstream compound stream, chamber compound stream, and exhaust compound stream.

~~31~~ 26. A sampling reaction module for use in a reactive gas processing system, comprising:

at least one analysis fixture having an analysis fixture body, the analysis fixture body defining at least one fluid channel therein;

at least one fluid inlet port and fluid outlet port formed in the analysis fixture body, the at least one fluid inlet port and outlet port in fluid communication with the fluid channel formed in the analysis fixture body;

at least one coupling body extending from the analysis fixture body, the at least one coupling body having at least one coupling passage formed therein;

at least one sampling tube traversing through the analysis fixture body, the at least one sampling tube positioned within the at least one coupling passage of the at least one coupling body; and

at least one module body defining at least one vacuum passage therein, the at least one module body configured to have at least one analysis fixture attached thereto and having at least one sampling tube receiver formed therein, the sampling tube receiver in fluid communication with the at least one vacuum passage.

~~32~~ 27. The sampling reaction module of claim ~~31~~ 26 wherein the at least one sampling tube is thermally isolated from the at least one coupling body.

~~33~~ 28. The sampling reaction module of claim ~~31~~ 26 wherein the at least one sampling tube is manufactured from a carbon-based material.

~~34~~ 29. The sampling reaction module of claim ~~31~~ 26 wherein the at least one sampling tube is manufactured from a silicon-based material.

~~35~~ 30. The sampling reaction module of claim ~~31~~ 26 wherein the at least one sampling tube is manufactured from at least one material selected from the group consisting of graphite, silica, carbon fiber, silicon dioxide, and silicon carbide.

~~36~~ 31. The sampling reaction module of claim ~~36~~ 26 further comprising at least one thermal control module positionable within the at least one analysis fixture body, the at least one thermal control module positioned proximate to the at least one sampling tube.

~~37~~ 32. The sampling reaction module of claim ~~36~~ 31 wherein the at least one thermal control module comprises a thermoelectric cooler.

~~38~~ 33. The sampling reaction module of claim 31 wherein the at least one thermal control module comprises a thermistor.