CLAIMS

1. A system comprising:

a matchbox including a match circuitry;

a radio frequency (RF) generator coupled to the matchbox to supply an RF supply signal to the matchbox via a first portion of an RF supply path, the RF generator coupled to the matchbox to receive an RF return signal via a first portion of an RF return path;

a switch circuit;

a plasma reactor having a first electrode, wherein the first electrode is connected to the switch circuit via a second portion of the RF return path, wherein the plasma reactor includes a second electrode coupled to the match circuitry via a second portion of the RF supply path, wherein the second portion of the RF return path is defined by an RF tunnel that connects to the switch circuit, and the second portion of the RF return path and the second portion of the RF supply path are defined by an RF transmission line; and

a controller coupled to the switch circuit, the controller configured to control the switch circuit coupled to the RF tunnel based on a tune recipe to change an impedance of the RF return path.

2. The system of claim 1, wherein the switch circuit is located within a housing of the matchbox.

3. The system of claim 1, wherein the switch circuit is located outside a housing of the matchbox.

4. The system of claim 1, wherein the switch circuit is configured to change the impedance of the RF return path to achieve an etch rate or a deposition rate.

5. The system of claim 1, wherein the RF generator is configured to supply the RF supply signal to generate plasma within the plasma reactor, wherein the second portion of the RF supply path is defined by an RF rod, wherein the switch circuit is not connected to the RF rod.

6. The system of claim 1, wherein the first portion of the RF supply path includes an RF cable, wherein the second portion of the RF supply path includes an RF rod, wherein the first portion of the RF return path includes an RF cable sheath, wherein the RF tunnel is grounded.

7. The system of claim 1, wherein the matchbox includes a housing, wherein the housing is grounded.

8. The system of claim 1, wherein the match circuitry is configured to match an impedance of the RF generator, the first portion of the RF supply path and the first portion of the RF return path with an impedance of the plasma reactor, the second portion of the RF supply path, and the second portion of the RF return path.

9. The system of claim 1, wherein the switch circuit includes multiple switches and multiple inductors, each inductor coupled in series to each switch.

10. The system of claim 1, wherein the switch circuit includes multiple switches and multiple capacitors, each capacitor coupled in series to each switch.

11. The system of claim 1, wherein the switch circuit includes multiple switches, multiple inductors, and multiple capacitors, each switch coupled in series with each inductor and each capacitor.

12. The system of claim 1, wherein the plasma reactor includes a chuck and an upper electrode, the upper electrode facing the chuck.

13. The system of claim 1, wherein the switch circuit is configured to control the impedance by controlling an inductance, a capacitance, or a combination thereof, of the RF return path.

14. A system comprising:

a matchbox including a match circuitry;

a radio frequency (RF) generator coupled to the matchbox to supply an RF supply signal to the matchbox via a first portion of an RF supply path, the RF generator coupled to the matchbox to receive an RF return signal via a first portion of an RF return path;

a switch circuit;

a plasma reactor coupled to the switch circuit via a second portion of the RF return path, the plasma reactor coupled to the match circuitry via a second portion of the RF supply path; and

a controller coupled to the switch circuit, the controller configured to control the switch circuit based on a tune recipe to change an impedance of the RF return path,

wherein the controller is configured to control the switch circuit based on a value of a parameter measured at a portion of the RF return path.

15. A system comprising:

a radio frequency (RF) transmission line including an RF rod and a grounded RF tunnel;

a plasma reactor including a first electrode and a second electrode;

an impedance match circuitry coupled via the RF transmission line to the plasma reactor, the RF transmission line for supplying an RF supply signal to the first electrode of the plasma reactor via the RF rod and for receiving an RF return signal from the second electrode of the plasma reactor via the grounded RF tunnel; and

a switch circuit coupled between the impedance match circuitry and the plasma reactor, wherein the switch circuit is connected to the grounded RF tunnel of the RF transmission line for controlling an impedance of the RF return signal.

16. The system of claim 15, wherein the plasma reactor includes a C-shroud portion, a bottom electrode housing, a ground ring portion, a return RF strap, and a ground shield portion, the RF return signal received by the switch circuit via the C-shroud portion, the RF return strap, the ground ring portion, a portion of the bottom electrode housing, the ground shield portion, and the grounded RF tunnel.

17. The system of claim 15, wherein the impedance match circuitry is configured to match an impedance of the plasma reactor and the RF transmission line with an impedance of an RF generator and an RF cable system, the RF cable system for coupling the RF generator to the impedance match circuitry, wherein the switch circuit is not connected to the RF rod.

18. The system of claim 15, wherein the switch circuit includes multiple switches and multiple inductors, each inductor coupled in series to each switch.

19. The system of claim 15, wherein the switch circuit includes multiple switches and multiple capacitors, each capacitor coupled in series to each switch.

20. A method comprising:

receiving a radiofrequency (RF) return signal from a plasma reactor via an RF return path portion of an RF transmission line;

modifying an impedance of an RF return path including the RF return path portion to achieve a measurable factor, wherein said modifying is performed to generate a modified RF return signal; and

sending the modified RF return signal via an RF cable sheath to an RF generator.

21. The method of claim 20, wherein the RF return path portion includes a grounded RF tunnel, wherein modifying the impedance includes modifying an inductance, a capacitance, or a combination thereof of the RF return path.

22. The method of claim 20, wherein the measurable factor includes an etch rate of etching a wafer when present within a plasma chamber of the plasma reactor, or a deposition rate of depositing materials on the wafer when present within the plasma chamber, or uniformity in etch rates of etching one or more wafers when present within the plasma chamber, or uniformity in deposition rates of depositing materials on one or more wafers when present within the plasma chamber, or a combination thereof.

23. The method of claim 20, further comprising providing an RF supply signal via an RF supply path to a first electrode of the plasma reactor, wherein said receiving the RF return signal includes receiving the RF return signal from a second electrode of the plasma reactor.

24. The method of claim 20, wherein modifying the impedance is performed using a switch circuit that is connected to a grounded RF tunnel of the RF return path portion, wherein the switch circuit is not connected to an RF rod connected between the plasma reactor and a housing of a matchbox.

25. A system for plasma processing substrates, comprising:

a process chamber having a lower electrode for supporting a substrate when present, a top electrode coupled to ground, and a plasma confinement structure surrounding a processing region defined between the lower electrode and the top electrode;

a transmission line coupled to the lower electrode, the transmission line having a radiofrequency (RF) rod for delivery of RF supply power to the lower electrode and an RF tunnel surrounding the RF rod for receipt of RF return power from the top electrode;

an RF generator;

a match circuitry having an input connected to the RF generator and having an output connected to the RF rod, the match circuitry further having a return connection; and

a switch circuit connected between the return connection of the match circuitry and the RF tunnel of the transmission line for modifying the RF return power.

26. The system of claim 25, wherein the switch circuit is not connected to the RF rod.

27. The system of claim 25, further comprising a housing that encloses the match circuitry, wherein the switch circuit includes multiple inductor straps, wherein a number of the inductor straps for connection between the RF tunnel and the housing is changed to modify the RF return power.

28. The system of claim 25, further comprising a housing that encloses the match circuitry, wherein the switch circuit includes multiple inductors fitted between the housing and the RF tunnel.

29. The system of claim 14, wherein the second portion of the RF supply path includes an RF rod, wherein the switch circuit is not connected to the RF rod.

30. The system of claim 14, wherein the matchbox includes a housing that encloses the match circuitry, wherein the switch circuit includes multiple inductor straps, wherein a number of the inductor straps for connection between the second portion of the RF return path and the housing is changed to modify the impedance of the RF return path.