CLAIMS

1. A method for processing a wafer, comprising:

providing a chamber with an electrode having a support surface and an outer edge region defined therein, the chamber defined for plasma processing of the wafer;

applying a radio frequency (RF) power to the electrode of the chamber, the applied RF power being communicated to the electrode via a conductive delivery connection and a conductive return connection, the conductive delivery connection having a dimension to provide an effective electrical length that causes an impedance transformation at an operating frequency;

setting a capacitance to a first end of the conductive delivery connection, the capacitance being adjustable to cause an opposite impedance adjustment at a second end of the conductive delivery connection, the second end being coupled to a dielectric surround structure that surrounds the electrode, the dielectric surround structure presenting the opposite impedance adjustment near the outer edge region of the electrode, such that increasing the capacitance at the first end causes a corresponding increase of impedance at the second end, the increasing of the impedance at the second end increases a voltage distribution near the outer edge region of the electrode that decreases toward a center of the support surface of the electrode.

2. The method of claim 1, further including dielectric material to a path defined by the conductive delivery connection so as to reduce the dimension of the conductive delivery connection to the effective electrical length, when the dimension of the conductive delivery connection is greater than the effective electrical length,

wherein including the dielectric material to the path enables optimal impedance transformation at the operating frequency of the conductive delivery connection.

3. The method of claim 1, further including conductive metal to a path defined by the conductive delivery connection so as to increase the dimension of the conductive delivery connection to the effective electrical length, when the dimension of the conductive delivery connection is less than the effective electrical length,

wherein including the conductive metal to the path enables optimal impedance transformation at the operating frequency of the conductive delivery connection.

~~4. The method of claim 1, wherein the effective electrical length of the conductive delivery connection is about ¼ wavelength for RF power of 60 MHz.~~

~~5. The method of claim 1, wherein the capacitance set at the first end is between about 50 pico Farads (pF) and about 500 pF.~~

~~6.~~1. An apparatus for processing a wafer, comprising:

a chamber for plasma processing of the wafer, the chamber having an electrode assembly that includes a support surface and an outer edge region surrounding the support surface;

a radio frequency (RF) power source for providing RF power to the electrode assembly;

a matching circuit coupled to the RF power source;

an RF power connection structure coupled between the electrode assembly and an output of the matching circuit ~~RF power source~~, the RF power connection structure including a conductive delivery connection to deliver the RF power to the electrode assembly ~~substrate~~ and a conductive return connection for returning at least some of the RF power from the electrode assembly back to the output of matching circuit ~~substrate~~, the RF power connection structure having a length, a first end, and a second end, the first end coupled to the output of the matching circuit and the second end coupled to the electrode assembly, ~~that extends between a first end at the RF power source and a second end at the electrode assembly,~~ the length is set for an operating frequency, such that the length enables impedance transformation between the first end and the second end; and

a variable capacitor connected between an output of the matching circuit and ~~coupled at~~ the first end of the RF power connection structure, the variable capacitor is not coupled to an inductor to define a resonant circuit, at the output of the matching circuit. ~~wherein changes in the variable capacitor at the first end produces a change in impedance at the first end and an opposite change in impedance at the second end.~~

~~7.~~2. The apparatus of claim ~~6~~1, wherein the length is about ¼ wavelength of the operating frequency.

~~8.~~3. The apparatus of claim ~~7~~2, wherein the operating frequency is 60 MHz.

~~9. The apparatus of claim 6, wherein the RF power source includes,~~

~~a RF generator for generating the RF power; and~~

~~a matching circuit coupled to the RF generator to optimize delivery of the RF power to the substrate, an output of the matching circuit of the RF power source is coupled to the variable capacitor.~~

~~10.~~4. The apparatus of claim ~~6~~1, further includes a capacitor set control module coupled to the variable capacitor to control tuning of the variable capacitor.

~~11.~~5. The apparatus of claim ~~10~~4, wherein the capacitor set control module is coupled to a capacitance-setting user interface of a computing system to electronically adjust the tuning of the capacitance at the first end.

~~12. A method for processing a wafer in a chamber with an electrode having a support surface and an outer edge region defined thereon, the chamber defined for plasma processing of the wafer, the method comprising:~~

~~applying a radio frequency (RF) power to the electrode of the chamber, the applied RF power being communicated to the electrode via a conductive delivery connection and a conductive return connection, the conductive delivery connection having a first end, a second end and an associated dimension;~~

~~determining capacitance to be set at the first end based on the RF power, so as to cause an impedance adjustment at the first end and an opposite impedance adjustment at the second end at an operating frequency of the RF power; and~~

~~setting the determined capacitance at the first end of the conductive delivery connection, the capacitance causing the opposite impedance adjustment at the second end of the conductive delivery connection, the opposite impedance adjustment from the second end presented to the outer edge region of the electrode through a dielectric surround structure that surrounds the electrode, such that increasing the capacitance at the first end causes a decrease of impedance at the first end and an increase of impedance at the second end and a corresponding increase in a~~

~~voltage distribution near the outer edge region of the electrode that decreases toward a center of the support surface of the electrode,~~

~~wherein the dielectric surround structure surrounding the electrode is coupled to the second end.~~

~~13. The method of claim 12, wherein the operating frequency is about 60 MHz.~~

~~14. The method of claim 12, further includes,~~

~~when the dimension of the conductive delivery connection is greater than an effective electrical length that enables optimal impedance transformation between the first end and the second end at the operating frequency, adjusting the dimension of the conductive delivery connection to conform to the effective electrical length by including dielectric material to a path defined by the conductive delivery connection .~~

~~15. The method of claim 12, further includes,~~

~~when the dimension of the conductive delivery connection is less than an effective electrical length that enables optimal impedance transformation between the first end and the second end at the operating frequency, adjusting the dimension of the conductive delivery connection to conform to the effective electrical length by including conductive metal to a path defined by the conductive delivery connection.~~

6. The apparatus of claim 1, wherein changes in the variable capacitor at the first end produces a change in impedance at the first end and an opposite change in impedance at the second end.

7. An apparatus for processing a wafer, comprising:

a chamber for plasma processing of the wafer, the chamber having an electrode assembly that includes a support surface and an outer edge region surrounding the support surface;

a radio frequency (RF) generator for providing RF power to the electrode assembly within the chamber;

a matching circuit coupled to the RF generator to provide a matching impedance to the RF power;

an RF power connection structure coupled between the electrode assembly and an output of the matching circuit, the RF power connection structure including a conductive delivery connection to deliver the RF power to the electrode assembly and a conductive return connection for returning at least some of the RF power from the electrode assembly back to the output of the matching circuit, the RF power connection structure having a length, a first end, and a second end, the first end coupled to the output of the matching circuit and the second end coupled to the electrode assembly, the length is set for an operating frequency, such that the length enables impedance transformation between the first end and the second end; and

a tunable capacitor disposed between an output of the matching circuit and the first end of the RF power connection structure, wherein changes in the tunable capacitor at the first end produces a change in impedance at the first end and an opposite change in impedance at the second end and wherein the tunable capacitor at the output of the matching circuit is not part of a resonant circuit.

8. The apparatus of claim 7, further includes a computing device that is communicatively connected to the RF generator and the tunable capacitor, the computing device configured to electronically control RF power supplied by the RF generator to the electrode assembly and to electronically adjust a capacitance value provided by the tunable capacitor at the first end.

9. The apparatus of claim 7, further includes a capacitance adjusting mechanism to control capacitance value of the tunable capacitor.

10. The apparatus of claim 7, wherein the length between the first end and the second end is adjusted by addition of a dielectric material or a conductive metal to a path defined by the conductive delivery connection so as to conform with an effective electrical length, when the length of the conductive delivery connection is greater or less than the effective electrical length, wherein the effective electrical length enables optimal impedance transformation at the operating frequency of the conductive delivery connection.

11. The apparatus of claim 10, wherein the effective electrical length of the conductive delivery connection is about ¼ wavelength of the operating frequency for RF power of 60 MHz.

12. The apparatus of claim 10, wherein the tunable capacitor is configured to set the capacitance at the first end to be between about 50 pico Farads (pF) and about 500 pF.