

What is claimed is:

1. A method for igniting a process plasma, the method comprising:
 - flowing an ignition gas into a plasma chamber;
 - providing at least one self-resonating device disposed relative to the plasma chamber and a power transformer coupled to the plasma chamber;
 - using the at least one self-resonating device to form at least one ignition plasma within the plasma chamber, the at least one ignition plasma causing at least partial ionization of the ignition gas; and
 - using the power transformer to inductively couple power to the plasma chamber, including to the at least one ignition plasma in the plasma chamber, and ignite the process plasma within the plasma chamber,
 - wherein the at least one self-resonating device enables the at least partial ionization of the ignition gas using reduced power during ignition of the process plasma.
2. The method of claim 1 wherein the self-resonating device resonates with a radio frequency or microwave frequency.
3. The method of claim 1 further comprising positioning the at least one self-resonating device adjacent to a plasma generation volume, the plasma generation volume being a region within which the process plasma forms.
4. The method of claim 3 further comprising positioning a first self-resonating device of the at least one self-resonating device at an inlet of the plasma chamber and a second self-resonating device at an outlet of the plasma chamber.
5. The method of claim 3 further comprising positioning a first self-resonating device of the at least one self-resonating device and a second self-resonating device at an equidistance along the plasma chamber.
6. The method of claim 1 further comprising operating the at least one self-resonating device at a frequency between 100 megahertz and 10 gigahertz.

7. The method of claim 1 further comprising operating the at least self-resonating device at a frequency between 300 megahertz and 3 gigahertz.
8. The method of claim 1 wherein the at least one self-resonating device is a coaxial resonator, ring resonator, or any combination thereof.
9. The method of claim 1 wherein the at least one self-resonating device is a microstrip resonator, stripline resonator, or any combination thereof.
10. The method of claim 1 wherein the process plasma is ignited with an average field between approximately 1 to 10 kilovolts per meter.
11. The method of claim 1 wherein the ignition plasma is sustained with a voltage less than 100 Vrms.
12. The method of claim 1 wherein a peak voltage of the ignition plasma is less than 300 Vrms.
13. The method of claim 1 further comprising supplying the at least one self-resonating device a power less than 50 Watts.
14. The method of claim 1 wherein a pressure within the plasma chamber is less than 50 torr.
15. The method of claim 1, further comprising positioning the at least one self-resonating device in or adjacent to the plasma chamber.
16. A plasma source for generating a plasma, the plasma source comprising:
 - a plasma ignition gas source that flows a plasma ignition gas into a plasma chamber;
 - at least one self-resonating device disposed relative to the plasma chamber, the at least one self-resonating device generates at least one ignition plasma within the plasma chamber, the at least one ignition plasma causing at least partial ionization of the plasma ignition gas;

a power source in direct electrical communication with the plasma chamber; and
a power transformer coupled to the plasma chamber configured to ignite the process plasma within the plasma chamber by coupling power from the power source to the plasma chamber, including to the at least one ignition plasma in the plasma chamber,
wherein the at least one self-resonating device enables the at least partial ionization of the plasma ignition gas using reduced power during ignition of the process plasma.

17. The plasma source of claim 16 wherein the at least one self-resonating device is positioned adjacent to a plasma generation volume, the plasma generation volume being a region within which the process plasma forms.

18. The plasma source of claim 17 wherein a first self-resonating device of the at least one self-resonating device and a second self-resonating device are positioned an equidistance along the plasma generation volume.

19. The plasma source of claim 17 wherein a first self-resonating device of the at least one self-resonating device is positioned at an inlet of the plasma chamber and a second self-resonating device is positioned at an outlet of the plasma chamber.

20. The plasma source of claim 16 wherein the at least one self-resonating device operates at a microwave frequency or a radio frequency.

21. The plasma source of claim 16 wherein the at least one self-resonating device operates at a frequency between 100 megahertz and 10 gigahertz.

22. The plasma source of claim 16 wherein the at least one self-resonating device operates at a frequency between 300 megahertz and 3 gigahertz.

23. The plasma source of claim 16 wherein the at least one self-resonating device is a coaxial resonator, ring resonator, or any combination thereof.

24. The plasma source of claim 16 wherein the process plasma is ignited with an average field of 10 kilovolts per meter.
25. The plasma source of claim 16 wherein the one or more ignition plasmas is sustained with a voltage less than 100 Vrms.
26. The plasma source of claim 16 wherein a peak voltage of the ignition plasma is less than 300 Vrms.
27. The plasma source of claim 17 wherein the at least one self-resonating device is supplied a power less than 50 Watts.
28. The plasma source of claim 17 wherein a pressure within the plasma chamber is less than 50 torr.
29. The plasma source of claim 16 wherein the at least one self-resonating device is disposed in or adjacent to the plasma chamber.