requiring complicated or bulky cooling structures. The use of highly conductive materials, such as copper, can reduce resistive losses, but the use of copper and similar metals is complicated by the susceptibility of such highly conductive materials to corrosion and melting in the harsh environment of the plasma.

[0008] Third, efficient driving of the conductive loop requires that the loop be part of a resonant structure implemented by placing a tuning capacitor into the coil circuit.

[0009] Capacitors suitable for this purpose are expensive and bulky, and the tuning capacitor may require automated control in order to match the differing load when firstly igniting the plasma and then after stable plasma has been formed, adding further cost and complexity.

Summary of the Invention

[0010] In first embodiment the present invention provides an optical emission spectrometer or a mass spectrometer comprising a plasma generator, the plasma generator comprising a dielectric resonator structure having a central axis and a radiofrequency power source electrically coupled to the dielectric resonator structure to promote an alternating polarization current flow at a natural resonant frequency of the dielectric resonator structure along a circumferential direction about the axis to generate plasma in an adjacent gas.

[0011] A further embodiment the present invention provides a method of analyzing a substance comprising the steps of: generating plasma using a plasma generator including a dielectric resonator structure and a radiofrequency power source electrically coupled to the dielectric resonator structure to promote an alternating polarization current flow at a natural resonant frequency of the dielectric resonator structure along a circumferential direction about the axis to generate plasma in an adjacent gas; introducing a gas into a region adjacent to the dielectric resonator structure; exciting the dielectric resonator structure at a natural resonant frequency to generate plasma in the introduced gas; introducing substance to be analyzed into the plasma; dispersing light emitted by the substance according to the wavelengths of the light or separating ions of the substance created by the plasma according to their mass to charge ratio; detecting either light emitted by the substance according to the wavelengths of the light or ions of the substance created by the plasma according to their mass to charge ratio; and determining the elemental composition of the substance either from the wavelengths of light detected or from the mass to charge ratio of the ions detected.

CLAIMS

We claim:

1. An optical emission spectrometer or a mass spectrometer comprising a plasma generator, the plasma generator comprising:

a dielectric resonator structure having a central axis; and

a radiofrequency power source electrically coupled to the dielectric resonator structure to promote an alternating polarization current flow at a natural resonant frequency of the dielectric resonator structure along a circumferential direction about the axis to generate plasma in an adjacent gas.

2. The optical emission spectrometer or the mass spectrometer of claim 1 wherein the radiofrequency power source is electromagnetically coupled to the dielectric resonator structure.

3. The optical emission spectrometer or the mass spectrometer of any preceding claim wherein the dielectric resonator structure is electrically coupled to the plasma substantially only by induction, there being negligible capacitive coupling.

4. The optical emission spectrometer or the mass spectrometer of any preceding claim wherein the dielectric resonator has a quality factor of greater than 100.

5. The optical emission spectrometer or the mass spectrometer of any preceding claim wherein the dielectric resonator has electrical resistivity greater than 1×10^{10} $\Omega \cdot cm$.

6. The optical emission spectrometer or the mass spectrometer of any preceding claim wherein the dielectric resonator has a melting point greater than a melting point of copper.

7. The optical emission spectrometer or the mass spectrometer of any

30. A method of analyzing a substance comprising the steps of:

generating plasma using a plasma generator including a dielectric resonator structure and a radiofrequency power source electrically coupled to the dielectric resonator structure to promote an alternating polarization current flow at a natural resonant frequency of the dielectric resonator structure along a circumferential direction about the axis to generate plasma in an adjacent gas,

introducing a gas into a region adjacent to the dielectric resonator structure;

exciting the dielectric resonator structure at a natural resonant frequency to generate plasma in the introduced gas;

introducing substance to be analyzed into the plasma;

dispersing light emitted by the substance according to the wavelengths of the light or separating ions of the substance created by the plasma according to their mass to charge ratio;

detecting either light emitted by the substance according to the wavelengths of the light or ions of the substance created by the plasma according to their mass to charge ratio; and

determining the elemental composition of the substance either from the wavelengths of light detected or from the mass to charge ratio of the ions detected.

31. The method of claim 30 wherein in the step of exciting the dielectric resonator structure at a natural resonant frequency to generate plasma in the introduced gas, the plasma is generated in the introduced gas by an electric field wherein the electric field is substantially only coupled by induction, there being negligible capacitive coupling.