CLAIMS

1. An apparatus for diagnostics of neutral radicals in plasma, the apparatus comprising:

a portable probe configured to be attached to and extend into a plasma chamber to obtain information from plasma contained in the plasma chamber, the probe comprising

a metallic rod configured to be biased with an alternating current voltage applied to the metallic rod to obtain current measurements;

a transparent dielectric sleeve having a bandgap configured to allow light transmission to obtain optical emission spectra from the plasma;

an insulated thermocouple provided in the metallic rod, the thermocouple configured to measure equilibrium temperature of the probe; and

a computer configured to analyse information obtained by the probe and to determine the type, density and temperature of neutral radicals in the plasma.

2. The apparatus of claim 1, wherein the alternating current voltage is configured to be changeable when obtaining current measurements.

3. The apparatus of claim 1, further comprising a vacuum manipulator configured for attaching the probe to the plasma chamber and for manipulating the position of the probe in the plasma chamber, the vacuum manipulator comprising

a drive shaft configured to be connected to the probe and

a number of flexible bellows connected between the drive shaft and the wall of the vacuum chamber via vacuum gaskets.

4. The apparatus of claim 3, wherein the vacuum manipulator is configured to allow swing, rotation, forward and backward movement of the probe in the plasma chamber without affecting vacuum level of the plasma chamber.

5. The apparatus of claim 1, wherein the computer is further configured to calculate, from current-voltage characteristics obtained via the probe, at least one of: electron and ion currents, electro energy distribution, plasma potential, electron temperature, ion temperature, electron heating, ion heating, ohmic heating and cooling of neutral radicals.

6. The apparatus of claim 5, wherein the computer is further configured to fit cooling of neutral radicals vs temperature of the probe linearly to determine the temperature of the neutral radicals.

7. The apparatus of claim 1, wherein the computer is further configured to, from the optical emission spectra, identify the type of radiative radicals that exist in the plasma and to calculate the density of the neutral radicals.

8. A method of performing diagnostics of neutral radicals in plasma, the method comprising:

(a) obtaining current measurements from the plasma via a metallic rod of a portable probe extended into a plasma chamber containing the plasma,

the metallic rod being biased with an alternating current voltage;

(b) obtaining optical emission spectra from the plasma via a transparent dielectric sleeve of the portable probe, the transparent dielectric sleeve having a-bandgap configured to allow light transmission; and

(c) measuring equilibrium temperature of the probe via an insulated thermocouple provided in the metallic rod; and

(d) determining the type, density and temperature of neutral radicals in the plasma from information obtained by the probe.

9. The method of claim 8, further comprising changing the alternating current voltage when performing step (a).

10. The method of claim 8, wherein step (d) further comprises calculating, from current-voltage characteristics obtained via the probe, at least one of: electron and ion currents, electro energy distribution, plasma potential, electron temperature, ion temperature, electron heating, ion heating, ohmic heating and cooling of neutral radicals.

11. The method of claim 10, wherein step (d) further comprises fitting cooling of neutral radicals vs temperature of the probe linearly to determine the temperature of the neutral radicals.

12. The method of claim 8, wherein step (d) further comprises, from the optical emission spectra, identifying the type of radiative radicals that exist in the plasma and calculating the density of the neutral radicals.