CLAIMS

1. A surgical snare comprising:

an elongate probe comprising a coaxial cable for conveying radiofrequency (RF) and/or microwave frequency electromagnetic (EM) energy, and a probe tip connected at the distal end of the coaxial cable for receiving the RF and/or microwave energy;

a gas passage for conveying gas through the elongate probe to the probe tip; and

a retractable loop mounted at the probe tip for encircling an area containing biological tissue beyond the probe tip,

wherein the coaxial cable comprises an inner conductor, an outer conductor and a dielectric material separating the inner conductor from the outer conductor,

wherein the probe tip comprising a first electrode connected to the inner conductor of the coaxial cable and a second electrode connected to the outer conductor of the coaxial cable, and

wherein the first electrode and the second electrode are arranged to produce an electric field from the received RF and/or microwave frequency EM energy across a flow path of gas received from the gas passage to produce a thermal plasma or a non-thermal plasma in the area encircled by the retractable loop.

2. A surgical snare according to claim 1, wherein the first electrode and the second electrode are movable relative to each other into a second configuration in which the first electrode extends distally beyond the second electrode to form a radiating structure for emitting a microwave EM field outwardly from the probe tip.

3. A surgical snare according to claim 2 including a snare base at a distal end for the coaxial cable, the snare base having a pair of feed channels, each feed channel receiving a length of the conductive material that forms the retractable loop, wherein, in the second configuration, the first electrode comprises a distal portion that protrudes into the area encircled by the retractable loop to act as a radiating microwave monopole antenna, and a proximal portion

that extends through the snare base alongside the pair of feed channels.

4. A surgical snare according to any preceding claim, wherein the elongate probe comprises a sleeve surrounding the coaxial cable, the gas passage being a space between an inside surface of the sleeve and an outside surface of the coaxial cable.

5. A surgical snare according to claim 4, wherein the second electrode is formed on the distal end of the sleeve, and the sleeve is retractable relative to the coaxial cable.

6. A surgical snare according to any preceding claim, wherein the first electrode is a radiating microwave monopole antenna structure coupled to receive RF and/or microwave EM energy from the coaxial cable.

7. A surgical snare according to claim 6, wherein the radiating microwave monopole antenna structure comprises a cylinder of dielectric material having a hemispherical distal end surrounding a length of the inner conductor of the coaxial cable which protrudes beyond the outer conductor and extends through the cylinder of dielectric material to protrude at its hemispherical distal end.

8. A surgical snare according to claim 7, wherein the end of the length of inner conductor that protrudes from the hemispherical distal end of the cylinder is shaped into a hemisphere.

9. A surgical snare according to claim 3, wherein the first electrode and the second electrode or the length of conductive material that forms the retractable loop form active and return electrodes for an RF signal conveyed by the coaxial cable.

10. A surgical snare according to claim 2, wherein the outer conductor of the coaxial cable is connected to the second electrode by a gas permeable conductive structure that is slidable relative to the second electrode or outer

conductor of the coaxial cable and permits gas to flow through it.

11. A surgical snare according to claim 10, wherein the gas permeable conductive structure is any one of:

a conductive mesh;

a cage of radially extending conductive wires or springs; and

a plurality of circumferentially spaced radially protruding dents.

12. A surgical snare according to claim 10 or 11, wherein the gas permeable conductive structure is soldered or crimped to the second electrode.

13. A surgical snare according to any preceding claim, wherein the probe is insertable through an instrument channel of an endoscope.

14. A surgical snare according to claim 4, wherein the sleeve comprises a rotatable braided cable to permit adjustment of a orientation of the plane of the retractable loop.

15. A surgical snare according to any preceding claim, wherein the retractable loop comprises a wire that extends beyond the distal end of the coaxial cable, the wire being arranged to naturally adopt a looped shape between two ends located at the distal end of the coaxial cable.

16. A surgical snare according to claim 15, wherein the retractable loop is adjustable to vary the length of wire between the two ends.

17. Electrosurgical apparatus comprising:

a radiofrequency (RF) signal generator for generating RF electromagnetic (EM) radiation having a first frequency;

a microwave signal generator for generating microwave EM radiation having a second frequency that is higher than the first frequency;

a surgical snare according to any preceding claim connected to receive the RF EM radiation and the microwave EM radiation;

a feed structure for conveying the RF EM radiation and the microwave EM radiation to the probe, the feed structure comprising an RF channel for connecting the elongate probe to the RF signal generator, and a microwave channel for connecting the elongate probe to the microwave signal generator,

a gas feed connected to supply gas to the surgical snare,

wherein the apparatus is operable to deliver a thermal plasma or a non-thermal plasma in the area encircled by its retractable loop.

18. Electrosurgical apparatus according to claim 17, wherein the first electrode and the second electrode are movable relative to each other into a second configuration in which the first electrode extends distally beyond the second electrode to form a radiating structure for emitting a microwave EM field outwardly from the probe tip, and

wherein the apparatus is operable to emit a non-ionising electric field outwardly from the probe tip when the first electrode and the second electrode are in the second configuration without gas supplied thereto.

19. Electrosurgical apparatus according to claim 17 or 18 comprising a strike signal generation circuit arranged to cause a pulse of RF EM energy to be delivered to the probe to generate an electric field across the flow path for striking the plasma, wherein the strike signal generation circuit includes control circuitry arranged to use a detectable characteristic of a pulse of microwave EM energy on the microwave channel to trigger generation of the pulse of RF EM energy.

20. Electrosurgical apparatus according to any one of claims 17 to 19 comprising:

a microwave signal detector for sampling forward and reflected power on the microwave channel and generating therefrom a microwave detection signal indicative of the microwave power delivered by the probe; and

a controller in communication with the microwave signal detector to receive the microwave detection signal,

wherein the controller is operable to select an energy delivery profile for the microwave EM energy, the energy delivery profile for the microwave EM energy being for coagulation of tissue,

wherein the controller comprises a digital microprocessor programmed to output a microwave control signal for the microwave signal generator, the microwave control signal being for setting the energy delivery profile for the microwave EM energy, and

wherein the controller is arranged to determine a state for the microwave control signal based on the received microwave detection signal.

21. Electrosurgical apparatus according to claim 20, wherein the controller is operable to select an energy delivery profile for the RF EM energy from:

a strike pulse for generating an/the electric field across the flow path for striking the plasma; and

a continuous wave waveform for cutting biological tissue.

22. Electrosurgical apparatus according to claim 20 or 21 including a movement mechanism for causing relative movement between the first electrode and second electrode, wherein the controller is arranged to communicate a control signal to the movement mechanism based on the received microwave detection signal.

23. Electrosurgical apparatus according to claim 22, wherein the movement mechanism comprises any one of a linear motor, a stepper motor, a piezoelectric actuator, and a magnetostrictive actuator.

24. Electrosurgical apparatus according to claim 22 or 23, wherein the controller is arranged to adjustably control the movement mechanism to maintain a return loss from the probe at a value of at least 10 dB.

25. Electrosurgical apparatus according to claim 19, wherein the controller is arranged to cause the microwave

signal generator to deliver a strike pulse of microwave EM energy to the probe to generate the electric field across the flow path for striking the plasma.