

CLAIMS

1. ~~An electrosurgical instrument for delivering radiofrequency (RF) electromagnetic (EM) energy and microwave EM energy for resection and ablation of biological tissue, the instrument comprising:~~

~~an energy conveying cable structure comprising:~~

~~a coaxial transmission line for conveying microwave energy, the coaxial transmission line comprising an inner conductive layer, an outer conductive layer and a dielectric layer separating the inner conductive layer from the outer conductive layer, wherein the inner conductive layer is formed around a hollow longitudinal passage along the cable structure; and~~

~~a transmission line for conveying radiofrequency energy along the hollow longitudinal passage; and~~

~~an instrument tip at a distal end of the energy conveying cable structure, the instrument tip comprising:~~

~~a dielectric tip element extending longitudinally beyond a distal end of the outer conductor, wherein the inner conductor extends longitudinally beyond the distal end of the outer conductor within the dielectric tip element to form a microwave radiator; and~~

~~an active electrode and a return electrode mounted at a distal end of the dielectric tip, wherein the active electrode and the return electrode are connected to the transmission line to support an RF field therebetween at the distal end of the dielectric tip element.~~

2. ~~An electrosurgical instrument according to claim 1, wherein the coaxial transmission line for conveying the microwave energy is a first coaxial transmission line, and the transmission line for conveying the radiofrequency energy is a second coaxial transmission~~

~~line, wherein the second coaxial transmission line comprises an innermost conductive element extending through the longitudinal passage, the inner conductive layer, and an innermost dielectric layer separating the inner conductive layer from the innermost~~
5 ~~conductive element, wherein the active electrode is electrically~~

~~connected to the inner conductive layer and the return electrode is electrically connected to the innermost conductive element, and wherein the innermost conductive element and the outer conductive~~
10 ~~layer are electrically grounded.~~

~~3. An electrosurgical instrument according to claim 2, wherein the innermost conductive element is a conductive wire.~~

15 ~~4. An electrosurgical instrument according to claim 2 or 3, wherein the innermost conductive element includes a control wire for manipulating the instrument tip.~~

~~5. An electrosurgical instrument according to claim 1, wherein the transmission line for conveying the radiofrequency energy is a pair of wires extending through the hollow longitudinal passage.~~
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~~6. An electrosurgical instrument according to claim 5, wherein the pair of wires are encased in an electrically insulating sheath.~~

25 ~~7. An electrosurgical instrument according to any preceding, wherein the energy conveying cable structure is insertable through a flexible insertion tube of a surgical scoping device.~~

~~8. An electrosurgical instrument according to any preceding claim, wherein the energy conveying cable structure has a outer diameter equal to or less than 3 mm.~~

5 ~~9. An electrosurgical instrument according to any preceding claim, wherein the longitudinal passage extends through the dielectric tip element to provide a fluid flow path through the instrument.~~

10 ~~10. An electrosurgical instrument according to any preceding claim, wherein the dielectric tip is ceramic.~~

15 ~~11. An electrosurgical instrument according to any preceding claim having a diplexer connected at a proximal end of the energy conveying cable structure.~~

~~12. An electrosurgical apparatus comprising:~~

~~an electrosurgical generator arranged to supply radiofrequency energy and microwave energy; and~~

20 ~~an electrosurgical instrument according to any preceding claim connected to the electrosurgical generator,~~

~~wherein the energy conveying cable structure is arranged to convey the microwave energy via the coaxial transmission line for conveying microwave energy and the radiofrequency energy via the transmission line for conveying radiofrequency energy.~~

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~~13. An electrosurgical instrument for delivering radiofrequency (RF) electromagnetic (EM) energy and microwave EM energy for resection and ablation of biological tissue, the instrument comprising:~~

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~~a coaxial transmission line for conveying the RF EM energy and the microwave EM energy, the coaxial transmission line comprising an inner conductive layer, an outer conductive layer and a dielectric layer separating the inner conductive layer from the outer conductive layer; and~~

~~a ball-shaped instrument tip at a distal end of the energy conveying cable structure, the instrument tip comprising:~~

~~a first conductive hemisphere electrically connected to the inner conductive layer;~~

~~a second conductive hemisphere electrically connected to the outer conductive layer; and~~

~~a planar dielectric layer located in a physical separation gap between the first conductive hemisphere and the second conductive hemisphere,~~

~~wherein the first conductive hemisphere and the second conductive hemisphere are configured to:~~

~~radiate the microwave EM energy as a substantially spherical field, and~~

~~provide respectively an active electrode and a return electrode on opposing sides of the separation gap for delivering the RF EM energy.~~

~~14. An electrosurgical instrument according to claim 13, wherein the ball-shaped instrument tip has a diameter equal to or less than 3 mm.~~

~~15. An electrosurgical instrument according to claim 13 or 14, wherein the first conductive hemisphere and the second conductive hemisphere are symmetrically mounted on the planar dielectric layer.~~

~~16. An electrosurgical instrument according to any one of claims 13 to 15 including:~~

~~a first electrical connector mounted on a first surface of the planar dielectric layer, the first electrical connector electrically connecting the inner conductive layer to the first conductive hemisphere; and~~

~~a second electrical connector mounted on a second surface of the planar dielectric layer opposite to the first surface, the second electrical connector electrically connecting the outer conductive layer to the second conductive hemisphere.~~

~~17. An electrosurgical instrument according to any one of claims 13 to 16, wherein the coaxial transmission line includes a fluid flow passage for conveying a fluid to the instrument tip.~~

~~18. An electrosurgical instrument according to claim 17, wherein the instrument tip includes a fluid flow outlet connected to the fluid flow passage.~~

~~19. An electrosurgical instrument according to claim 18, wherein the fluid passage is through the planar dielectric layer.~~

1. An electrosurgical instrument for delivering radiofrequency (RF) electromagnetic (EM) energy and microwave EM energy for resection and ablation of biological tissue, the instrument comprising:

a coaxial transmission line for conveying the RF EM energy and the microwave EM energy, the coaxial transmission line comprising an inner conductive layer, an outer conductive layer and a dielectric layer separating the inner conductive layer from the outer conductive layer; and

a ball-shaped instrument tip at a distal end of the energy conveying cable structure, the instrument tip comprising:

a first conductive hemisphere electrically connected to the inner conductive layer;

5 a second conductive hemisphere electrically connected to the outer conductive layer; and

a planar dielectric layer located in a physical separation gap between the first conductive hemisphere and the second conductive hemisphere,

10 wherein the first conductive hemisphere and the second conductive hemisphere are configured to:

radiate the microwave EM energy as a substantially spherical field, and

15 provide respectively an active electrode and a return electrode on opposing sides of the separation gap for delivering the RF EM energy.

2. An electrosurgical instrument according to claim 1, wherein the ball-shaped instrument tip has a diameter equal to or
20 less than 3 mm.

3. An electrosurgical instrument according to claim 1 or 2, wherein the first conductive hemisphere and the second conductive hemisphere are symmetrically mounted on the planar dielectric layer.

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4. An electrosurgical instrument according to any one of claims 1 to 3 including:

a first electrical connector mounted on a first surface of the planar dielectric layer, the first electrical connector electrically
30 connecting the inner conductive layer to the first conductive hemisphere; and

a second electrical connector mounted on a second surface of the planar dielectric layer opposite to the first surface, the second electrical connector electrically connecting the outer conductive layer to the second conductive hemisphere.

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5. An electrosurgical instrument according to any one of claims 1 to 4, wherein the coaxial transmission line includes a fluid flow passage for conveying a fluid to the instrument tip.

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6. An electrosurgical instrument according to claim 5, wherein the instrument tip includes a fluid flow outlet connected to the fluid flow passage.

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7. An electrosurgical instrument according to claim 6, wherein the fluid flow passage is through the planar dielectric layer.