

CLAIMS

1. A microwave antenna apparatus for use in radiating microwave energy into surface tissue of a uterine cervix, the microwave antenna apparatus comprising:
5 an electrically conductive ground element defining an aperture;
 an electrically conductive elongated element extending through the aperture and terminating at a distal end; and
 one or more dielectric elements,
 wherein one or more of the dielectric elements electrically insulate the
10 elongated element and the ground element from one another.
2. The microwave antenna apparatus as claimed in claim 1, wherein the ground element and the elongated element may be co-axial.
- 15 3. The microwave antenna apparatus as claimed in claim 1 or 2, wherein one or more of the dielectric elements define an outer surface for engagement with a surface of the uterine cervix.
- 20 4. The microwave antenna apparatus as claimed in any preceding claim, wherein one or more of the dielectric elements cover the distal end of the elongated element and/or wherein one or more of the dielectric elements cover a distal portion of the elongated element.
- 25 5. The microwave antenna apparatus as claimed in any preceding claim, wherein the elongated element extends axially beyond the ground element by a predetermined length.
- 30 6. The microwave antenna apparatus as claimed in claim 5, wherein one or more of the dielectric elements cover a proportion of the predetermined length of the elongated element or one or more of the dielectric elements cover the whole of the predetermined length of the elongated element.
7. The microwave antenna apparatus as claimed in any preceding claim, wherein one or more of the dielectric elements are configured so as to prevent the elongated

element from coming into contact with the surface of the uterine cervix when the microwave antenna apparatus is in use.

- 5 8. The microwave antenna apparatus as claimed in any preceding claim, wherein one or more of the dielectric elements are configured to separate the ground element and/or the elongated element from the tissue of the surface of the uterine cervix by a desired predetermined distance, for example wherein one or more of the dielectric elements have a desired predetermined thickness.
- 10 9. The microwave antenna apparatus as claimed in any preceding claim, wherein the one or more dielectric elements fill the aperture defined by the ground element.
- 15 10. The microwave antenna apparatus as claimed in any preceding claim, wherein the one or more dielectric elements define a central distal feature for centring the antenna with respect to an axis of a cervical os of the uterine cervix.
- 20 11. The microwave antenna apparatus as claimed in claim 10, wherein the central distal feature is configured for radiating microwave energy into a proximal section of the cervical os.
- 25 12. The microwave antenna apparatus as claimed in claim 10 or 11, wherein the one or more dielectric elements define a cupping feature for cupping a proximal ectocervix region of the uterine cervix and preventing excessive insertion of the central distal feature into the cervical os of the uterine cervix.
- 30 13. The microwave antenna apparatus as claimed in any preceding claim, wherein one or more of the dielectric elements cover at least part of the ground element.
14. The microwave antenna apparatus as claimed in any preceding claim, wherein one or more of the dielectric elements cover at least part of a distal surface of the ground element.
- 35 15. The microwave antenna apparatus as claimed in any preceding claim, wherein the microwave antenna apparatus defines an axis and the microwave antenna apparatus is cylindrically symmetrical about the axis.

16. The microwave antenna apparatus as claimed in claim 15, wherein the elongated element is rod-like, cylindrical and/or conical.
- 5 17. The microwave antenna apparatus as claimed in claim 15 or 16, wherein a radial extent of the ground element may be more than or less than a radial extent of the one or more dielectric elements by a predetermined radial offset.
- 10 18. The microwave antenna apparatus as claimed in any one of claims 15 to 17, wherein at least one of:
- the ground element is annular or generally annular;
 - the ground element is planar or generally planar;
 - the ground element is curved;
 - the ground element is shaped in the form of a cup or a bowl with an opening of
- 15 the cup or the bowl directed towards the distal end of the elongated element; and
- the ground element is shaped in the form of an inverted cup or an inverted bowl with an opening of the inverted cup or the inverted bowl directed away from the distal end of the elongated element.
- 20 19. The microwave antenna apparatus as claimed in any preceding claim, comprising an electrically conductive cap element at or adjacent the distal end of the elongated conductor.
- 25 20. The microwave antenna apparatus as claimed in claim 19, wherein a distal end of an outer surface of the microwave antenna apparatus is defined by one or more of the dielectric elements and the electrically conductive cap element is located between the distal end of the elongated conductor and the distal end of the outer surface of the microwave antenna apparatus.
- 30 21. The microwave antenna apparatus as claimed in claim 19, wherein the electrically conductive cap element defines a distal end of the outer surface of the microwave antenna apparatus.
- 35 22. The microwave antenna apparatus as claimed in any preceding claim, wherein the microwave antenna apparatus is disposable or re-useable.

23. The microwave antenna apparatus as claimed in any preceding claim, wherein the microwave antenna apparatus is configured for use in radiating microwave energy into the surface tissue of the uterine cervix for at least one of:
- 5 so as to provide a therapeutic effect in one or more regions, such as one or more regions of the cervix infected with human papillomavirus (HPV) and/or diagnosed with cervical intraepithelial neoplasia (CIN);
- so as to create the correct biological response in one or more regions, such as one or more regions of the cervix infected with human papillomavirus (HPV) and/or
- 10 diagnosed with cervical intraepithelial neoplasia (CIN);
- localized non-ablative hyperthermia of the surface tissue of the uterine cervix;
- localized ablation of the surface tissue of the uterine cervix; and
- cauterisation of the surface tissue of the uterine cervix.
- 15 24. A plurality of microwave antenna apparatus as claimed in any preceding claim, wherein each microwave antenna apparatus has a different configuration selected to provide a corresponding different radiation pattern.
25. A microwave assembly for use in radiating microwave energy into surface
- 20 tissue of a uterine cervix, the microwave assembly comprising the microwave antenna apparatus as claimed in any preceding claim and a shaft connected to the microwave antenna apparatus.
26. The microwave assembly as claimed in claim 25, comprising a connection
- 25 arrangement connecting the shaft and the microwave antenna apparatus, wherein the connection arrangement is configured to vary an angle between an axis of the microwave antenna apparatus and an axis of the shaft.
27. The microwave assembly as claimed in claim 26, wherein the connection
- 30 arrangement comprises at least one of a pivot arrangement, a hinge, a flexible joint, and a ball and socket joint.
28. The microwave assembly as claimed in claim 26 or 27, wherein the connection
- 35 arrangement is configured to detachably attach the microwave antenna apparatus to the shaft thereby allowing the fitting of a different microwave antenna apparatus to the

shaft, wherein the different microwave antenna apparatus features an alternative configuration, for example an alternative shape and/or size, to the microwave antenna apparatus.

- 5 29. The microwave assembly as claimed in any one of claims 25 to 28, wherein the shaft is disposable or the shaft is re-useable.
- 10 30. The microwave assembly as claimed in any one of claims 25 to 29, comprising a hand grip or hand piece at or adjacent a proximal end thereof, for example, at or adjacent a proximal end of the shaft.
- 15 31. The microwave assembly as claimed in claim 30, wherein the hand grip or hand piece is detachably attached to the shaft.
- 20 32. The microwave assembly as claimed in claim 30 or 31, wherein the hand grip or hand piece is disposable or reusable.
- 25 33. The microwave assembly as claimed in any one of claims 25 to 32, comprising an electrical switch which is configurable between an on state in which the switch allows the transmission of microwave energy from a microwave generator to the microwave antenna apparatus and an off state in which the switch prevents the transmission of microwave energy from the microwave generator to the microwave antenna apparatus.
- 30 34. The microwave assembly as claimed in claim 33 when dependent on any one of claims 30 to 32, wherein the hand grip or hand piece comprises a manual control element such as a button or the like for reconfiguring the electrical switch between the on and off states.
- 35 35. A microwave system for use in radiating microwave energy into surface tissue of a uterine cervix, the system comprising:
 a microwave assembly as claimed in any one of claims 25 to 34;
 a microwave generator; and
 a microwave waveguide,

wherein the microwave waveguide electrically connects the microwave generator and the microwave assembly.

36. The microwave system as claimed in claim 35, wherein the microwave waveguide comprises a microwave cable such as a flexible and/or a co-axial microwave cable.

37. The microwave system as claimed in claim 36, wherein the microwave waveguide is housed in the shaft.

38. A method for use in radiating microwave energy into surface tissue of a uterine cervix, the method comprising:

engaging a surface of the uterine cervix with a distal surface of the microwave antenna apparatus as claimed in any one of claims 1 to 23; and
using the microwave antenna apparatus to apply microwave energy to the uterine cervix.

39. The method as claimed in claim 38, comprising selecting one or more characteristics of the microwave energy so as to:

provide a desired predetermined radiation pattern when the microwave antenna apparatus is located remotely from any other object so that the desired predetermined radiation pattern is unperturbed by the proximity of any other object; or

provide a desired predetermined radiation pattern when the microwave antenna apparatus is located remotely from the surface of the uterine cervix so that the desired predetermined radiation pattern is unperturbed by the proximity of the surface of the uterine cervix.

40. The method as claimed in claim 39, comprising selecting one or more of the frequency, frequency spectrum, power, power density, energy, energy density, intensity, strength, amount, magnitude, exposure time, dose, pulse duration, pulse repetition rate and the like of the microwave energy so as to provide the desired predetermined radiation pattern.

41. The method as claimed in any one of claims 38 to 40, comprising selecting one or more characteristics of the microwave energy so as to provide a therapeutic effect

when the microwave antenna apparatus is used to apply microwave energy to the uterine cervix in one or more regions, such as one or more infected regions of the cervix, such as one or more regions that are infected with human papillomavirus (HPV) and/or diagnosed with cervical intraepithelial neoplasia (CIN).

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42. The method as claimed in any one of claims 38 to 41, comprising selecting one or more characteristics of the microwave energy so as to cause localized non-ablative hyperthermia of the surface tissue of the uterine cervix.

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43. The method as claimed in any one of claims 38 to 42, comprising selecting one or more characteristics of the microwave energy so as to create a biological response in one or more regions of the surface tissue of a uterine cervix, such as one or more regions that are infected with human papillomavirus HPV and/or diagnosed with cervical intraepithelial neoplasia (CIN).

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44. The method as claimed in any one of claims 38 to 43, comprising selecting one or more characteristics of the microwave energy so as to cause localized ablation of the surface tissue of the uterine cervix.

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45. The method as claimed in any one of claims 38 to 44, comprising selecting one or more characteristics of the microwave energy so as to cauterise the surface tissue of the uterine cervix.

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46. The method as claimed in any one of claims 41 to 45, comprising selecting the one or more characteristics from the spatial distribution, frequency, frequency spectrum, power, power density, energy, energy density, intensity, strength, amount, magnitude, exposure time, dose, pulse duration, pulse repetition rate and the like of the microwave energy.

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47. The method as claimed in any one of claims 38 to 46, comprising matching or substantially matching the relative permittivity of the microwave antenna apparatus to the relative permittivity of the cervix tissues for one or more given characteristics of the microwave energy, for example wherein the method comprises selecting a relative permittivity of the microwave antenna apparatus which differs by less than 50%, less

than 10%, less than 1% or less than 0.1% of the relative permittivity of the cervix tissues for one or more given characteristics of the microwave energy.