CLAIMS

What is claimed is:

1. An implantable neurological probe comprising:

an elongated shaft having a distal end and an internal lumen;

a support cylinder slidingly disposed in only a distal portion of the internal lumen;

a plurality of shafts coupled to the support cylinder and arranged to be selectively extended from the distal end of the elongated shaft;

a plurality of microelectrode elements disposed on each of the plurality of shafts, the microelectrode elements formed on a conductive film and comprising a planar substrate having ~~an insulative layer and~~ a plurality of conductive traces embedded within two ~~disposed on the~~ insulative layers~~layer~~,

a stylet removably disposed in the internal lumen and configured to contact the support cylinder to selectively extend the plurality of shafts during implantation; and

a pull wire coupled to the support cylinder to selectively retract the support cylinder and plurality of shafts within the internal lumen.

2. The implantable neurological probe of claim 1, comprising a push-pull rod which comprises the pull wire and the stylet.

3. The implantable neurological probe of claim 1 or 2, wherein the elongated shaft is configured for insertion into a human body using an accepted procedure for insertion of deep brain stimulation leads.

4. The implantable neurological probe of any one of claims 1 to 3, wherein the diameter of the elongated shaft is between 1 mm and 3 mm.

5. The implantable neurological probe of any one of claims 1 to 4, wherein at least one of the plurality of microelectrode elements is a stimulating electrode and at least one of the plurality of microelectrode elements is a detecting electrode.

6. The implantable neurological probe of any one of claims 1 to 4, wherein at least one of the plurality of microelectrodes elements is both a stimulating electrode and a detecting electrode.

~~7. The implantable neurological probe of claim 1, wherein each microelectrode element is formed on a conductive film, and wherein each microelectrode element is embedded within two isolating substrates.~~

~~8~~7. The implantable neurological probe of any one of claims ~~7~~1 to 6, wherein the ~~microelectrode embedded substrate is~~ insulative layers are formable into a cylindrical assembly.

~~9~~8. The implantable neurological probe of claim ~~8~~7, where the protruding shafts can be formed to bend radially from the longitudinal axis of the cylindrical assembly.

~~10~~9. The implantable neurological probe of claim ~~8~~7, where one of the protruding shafts extends and is centered along the longitudinal axis of the cylindrical assembly.

~~11~~10. The implantable neurological probe of claim ~~9~~8, where the protruding shafts are stiffened by a supporting member.

~~12~~11. The implantable neurological probe of claim ~~10~~9, where the longitudinal protruding shaft is stiffened by a supporting member.

~~13~~12. An implantable neurological probe comprising:

an elongated shaft having a distal end and an internal lumen;

a plurality of shafts arranged to be selectively extended from the distal end of the elongated shaft; and

a plurality of microelectrode elements disposed on each of the plurality of shafts, the microelectrode elements formed on a conductive film and comprising a planar substrate having ~~an insulative layer and~~ a plurality of conductive traces ~~disposed on the~~ embedded within two insulative layers~~layer~~,

wherein the plurality of shafts define a ~~substantially~~ cylindrical volume when fully extended.

~~14~~13. The implantable neurological probe of claim ~~13~~12, wherein the elongated shaft is configured for insertion into a human body using an accepted procedure for insertion of deep brain stimulation leads.

~~15~~14. The implantable neurological probe of claim ~~13~~12 or 13, wherein the diameter of the elongated shaft is between 1 mm and 3 mm.

~~16~~15. The implantable neurological probe of any one of claims ~~13~~12 to 14, wherein at least one of the plurality of microelectrode elements is a stimulating electrode and at least one of the plurality of microelectrode elements is a detecting electrode.

~~17~~16. The implantable neurological probe of any one of claims ~~13~~12 to 14, wherein at least one of the plurality of microelectrodes elements is both a stimulating electrode and a detecting electrode.

~~18. The implantable neurological probe of claim 13, wherein each microelectrode element is formed on a conductive film, and wherein each microelectrode element is embedded within two isolating substrates.~~

~~19~~17. The implantable neurological probe of any one of claims ~~18~~12 to 16, wherein the ~~microelectrode embedded substrate is~~insulative layers are formable into a cylindrical assembly.

~~20~~18. The implantable neurological probe of claim ~~19~~17, where the protruding shafts can be formed to bend radially from the longitudinal axis of the cylindrical assembly.

~~21~~19. The implantable neurological probe of claim ~~19~~17, where one of the protruding shafts extends and is centered along the longitudinal axis of the cylindrical assembly.

~~22~~20. The implantable neurological probe of claim ~~19~~18, where the protruding shafts are stiffened by a supporting member.

~~23~~21. The implantable neurological probe of claim ~~21~~19, where the longitudinal protruding shaft is stiffened by a supporting member.

24. A method for finding a neurological target comprising:

implanting a neurological probe within a vicinity of a neurological target site, the neurological probe comprising:

an elongated shaft having a distal end and an internal lumen;

a support cylinder slidingly disposed in only a distal portion of the internal lumen;

a plurality of shafts coupled to the support cylinder and arranged to be selectively extended from the distal end of the elongated shaft;

a plurality of microelectrode elements disposed on each of the plurality of shafts, the microelectrode elements comprising a planar substrate having an insulative layer and a plurality of conductive traces disposed on the insulative layer,

a stylet removably disposed in the internal lumen and configured to contact the support cylinder to selectively extend the plurality of shafts during implantation; and

a pull wire coupled to the support cylinder to selectively retract the support cylinder and plurality of shafts within the internal lumen;

retracting the plurality of shafts within the internal lumen before surgical implantation;

extending the plurality of shafts in the vicinity of the neurological target site following implantation;

recording electrophysiological signals from the neurological target site using at least one of the microelectrode elements on at least one of the protruding shafts; and

stimulating the neurological target using at least one of the microelectrode elements on at least one of the plurality of shafts.

25. The method of claim 24, further comprising:

after the acts of recording and stimulating, retracting the plurality of shafts within the internal lumen and removing the neurological probe from a subject.

26. The method of claim 24, wherein the protruding shafts are retracted using the pull wire.

27. The method of claim 24, wherein the plurality of shafts are extended using the stylet.

28. The method of claim 24, wherein the neurological probe comprises a push-pull rod which comprises the pull wire and the stylet

29. The method of claim 24, wherein the act of recording neurophysiological signals comprises recording neural activity detected by at least one of the plurality of microelectrode elements and repositioning the distal end of the elongated shaft as required, until the recorded activity is indicative of the distal end of the elongated probe shaft being located sufficiently at the neurological target site.

30. The method of claim 24, comprising:

stimulating neural activity by applying electrical signals to at least one of the plurality of microelectrode elements on at least one of the plurality of shafts,

performing a clinical evaluation of the efficacy on the stimulation site in the implanted patient, and

repositioning the distal end of the elongated shaft as required, until the patient's response is indicative of the distal end of the elongated shaft being located sufficiently at the neurological target site.

31. The method of claim 24, comprising:

inhibiting neural activity by applying electrical signals to at least one of the plurality of microelectrode elements on at least one of the plurality of shafts,

performing a clinical evaluation of the efficacy on the inhibition site in the implanted patient, and

repositioning the distal end of elongated shaft as required, until the patient's response is indicative of the distal end of the elongated shaft being located sufficiently at the neurological target site.

32. A method for finding a neurological target comprising:

implanting a neurological probe within a vicinity of a neurological target site, the neurological probe comprising:

an elongated shaft having a distal end and an internal lumen;

a support cylinder slidingly disposed in only a distal portion of the internal lumen;

a plurality of shafts coupled to the support cylinder and arranged to be selectively extended from the distal end of the elongated shaft;

a plurality of microelectrode elements disposed on each of the plurality of shafts, the microelectrode elements comprising a planar substrate having an insulative layer and a plurality of conductive traces disposed on the insulative layer,

a stylet removably disposed in the internal lumen and configured to contact the support cylinder to selectively extend the plurality of shafts during implantation; and

a pull wire coupled to the support cylinder to selectively retract the support cylinder and plurality of shafts within the internal lumen;

retracting the plurality of shafts within the internal lumen before surgical implantation;

expanding the plurality of shafts in the vicinity of the neurological target site following implantation;

applying an oscillating electric current between at least two of the microelectrode elements on at least one of the plurality of shafts;

detecting an electric voltage between at least two of the microelectrode elements on at least one of the plurality of shafts.

33. The method of claim 32, further comprising:

after the act of detecting, retracting the plurality of shafts within the internal lumen and removing the neurological probe from a subject.

34. The method of claim 32, comprising imaging the electrical characteristics of the volume of neurological tissue between the plurality of shafts based on the applied oscillating electric current and the detected electric voltage.

35. The method of claim 32, wherein the neurological probe comprises a push-pull rod which comprises the pull wire and the stylet.

36. A method for finding a neurological target comprising:

implanting a neurological probe within a vicinity of a neurological target site, the neurological probe comprising:

an elongated shaft having a distal end and an internal lumen;

a plurality of shafts arranged to be selectively extended from the distal end of the elongated shaft; and

a plurality of microelectrode elements disposed on each of the plurality of shafts, the microelectrode elements comprising a planar substrate having an insulative layer and a plurality of conductive traces disposed on the insulative layer,

wherein the plurality of shafts define a substantially cylindrical volume when fully extended.

retracting the plurality of shafts within the internal lumen before surgical implantation;

extending the plurality of shafts in the vicinity of the neurological target site following implantation;

recording electrophysiological signals from the neurological target site using at least one of the microelectrode elements on at least one of the protruding shafts; and

stimulating the neurological target using at least one of the microelectrode elements on at least one of the plurality of shafts.

37. The method of claim 36, wherein the protruding shafts are retracted using a pull wire.

38. The method of claim 37, wherein the plurality of shafts are extended using a stylet.

39. The method of claim 38, wherein the neurological probe comprises a push-pull rod which comprises the pull wire and the stylet.

40. The method of claim 36, wherein the act of recording neurophysiological signals comprises recording neural activity detected by at least one of the plurality of microelectrode elements and repositioning the distal end of the elongated shaft as required, until the recorded activity is indicative of the distal end of the elongated probe shaft being located sufficiently at the neurological target site.

41. ~~The method of claim 36, further comprising:~~

after the acts of recording and stimulating, retracting the plurality of shafts within the internal lumen and removing the neurological probe from a subject.

42. The method of claim 36, comprising:

stimulating neural activity by applying electrical signals to at least one of the plurality of microelectrode elements on at least one of the plurality of shafts,

performing a clinical evaluation of the efficacy on the stimulation site in the implanted patient, and

repositioning the distal end of the elongated shaft as required, until the patient's response is indicative of the distal end of the elongated shaft being located sufficiently at the neurological target site.

43. The method of claim 36, comprising:

inhibiting neural activity by applying electrical signals to at least one of the plurality of microelectrode elements on at least one of the plurality of shafts,

performing a clinical evaluation of the efficacy on the inhibition site in the implanted patient, and

repositioning the distal end of elongated shaft as required, until the patient's response is indicative of the distal end of the elongated shaft being located sufficiently at the neurological target site.

44. A method for finding a neurological target comprising:

implanting a neurological probe within a vicinity of a neurological target site, the neurological probe comprising:

an elongated shaft having a distal end and an internal lumen;

a plurality of shafts arranged to be selectively extended from the distal end of the elongated shaft; and

a plurality of microelectrode elements disposed on each of the plurality of shafts, the microelectrode elements comprising a planar substrate having an insulative layer and a plurality of conductive traces disposed on the insulative layer,

wherein the plurality of shafts define a substantially cylindrical volume when fully extended;

retracting the plurality of shafts within the internal lumen before surgical implantation;

expanding the plurality of shafts in the vicinity of the neurological target site following implantation;

applying an oscillating electric current between at least two of the microelectrode elements on at least one of the plurality of shafts;

detecting an electric voltage between at least two of the microelectrode elements on at least one of the plurality of shafts.

~~45. The method of claim 44, comprising imaging the electrical characteristics of the volume of~~ neurological tissue between the plurality of shafts based on the applied oscillating electric current and the detected electric voltage.

46. The method of claim 34, further comprising:

after the act of detecting, retracting the plurality of shafts within the internal lumen and removing the neurological probe from a subject.