

CLAIMS

1. A wirelessly triggered device for implantation in vivo comprising:
an electrically conductive suture;
5 an electronic circuit coated with a biocompatible encapsulating material
and communicatively coupled to the electrically conductive suture, the
electronic circuit arranged to convert a received wireless triggering signal
into an electrical signal for passing through the conductive suture.
- 10 2. A wirelessly triggered device according to claim 1, the electrically
conductive suture comprising a first conductive portion; a second
conductive portion; and an insulating portion between the first and
second conductive portions, the electronic circuit being communicatively
15 coupled to the first and second conductive portions and arranged to pass
the electrical signal through the first and second conductive portions.
3. A wirelessly triggered device according to claim 1 or 2, wherein the
electrically conductive suture comprises electrically conductive surgical
20 thread, wherein the electrically conductive surgical thread comprises an
inner surgical thread; an electrically conductive coating on the inner
surgical thread, and wherein the electrically conductive coating comprises
a bio-compatible conductive polymer; and a bio-compatible protective
coating on the electrically conductive coating.
- 25 4. A wirelessly triggered device according to claim 1 or 2, wherein the
electrically conductive suture comprises a stainless steel suture.
5. A wirelessly triggered device according to any of claims 1 to 4, wherein
the suture has a length of greater than 20mm.

6. A wirelessly triggered device according to any of the preceding claims,
wherein the wirelessly triggered device is a passive electronic device.
7. A wirelessly triggered device according to any one of the preceding
5 claims, wherein the biocompatible encapsulating material is selected
from PDMS, silicone, parylene-C, and polyurethane.
8. A wirelessly triggered device according to any of the preceding claims,
wherein the electrically conductive suture is arranged to receive the
10 wireless triggering signal, and the electronic circuit includes a modulating
circuit operable to modulate the received wireless triggering signal to
produce a backscatter response signal having a specific harmonic as the
electrical signal, for transmission by the electrically conductive suture.
- 15 9. A wirelessly triggered device according to claim 8, wherein the wirelessly
triggered device is a sensing device for monitoring conditions at a site,
further comprising a detector operable to detect a predetermined
condition at the site, and wherein the modulator is operable to modulate
the backscatter signal based on the detected predetermined condition.
- 20 10. A wirelessly triggered device according to claim 9, wherein the detector
includes a passive component of the modulating circuit.
11. A wirelessly triggered device according to any of claims 1 to 7, wherein
25 the electronic circuit includes a rectifier operable to rectify the wireless
triggering signal to produce an electrical current as the electrical signal,
the electrical current being passed through the conductive suture.
12. A wirelessly triggered device according to claim 11, further comprising an
30 antenna for receiving the wireless triggering signal, the rectifier being
communicatively coupled to the antenna.

13. A wirelessly triggered device according to claim 12, wherein the antenna is the electrically conductive suture or a further electrically conductive suture.
- 5 14. A wirelessly triggered device according to any of claims 11 to 13, wherein the wirelessly triggered device is configured to stimulate a nerve by passing the electrical current through the conductive suture.
- 10 15. A wirelessly triggered device according to any one of claims 11 to 13, wherein the suture is in electrical connection with an electronic device and configured to supply power to the electronic device.
- 15 16. A wirelessly triggered device for monitoring conditions at a site, comprising:
a detector operable to detect a predetermined condition at the site;
a modulating circuit configured to be communicatively coupled to an antenna, the modulating circuit operable to modulate a wireless triggering signal received at the antenna to produce a backscatter response signal having a specific harmonic, for transmission by the antenna, based on the
20 detected predetermined condition,
wherein the detector includes a passive component of the modulating circuit.
- 25 17. A wirelessly triggered device according to claim 16, where the wirelessly triggered device is a passive electronic device.
18. A wirelessly triggered device according to claim 16 or 17, further comprising an antenna.
- 30 19. A wirelessly triggered device according to claim 18, wherein the wirelessly triggered device comprises a printed circuit board and wherein

the modulating circuit and the antenna are printed onto the printed circuit board.

- 5 20. A wirelessly triggered device according to any of claims 16 to 19, wherein the modulating circuit is coated with a biocompatible encapsulating material.
- 10 21. A wirelessly triggered device according to claim 20, wherein the biocompatible encapsulating material is selected from PDMS, silicone, parylene-C, and polyurethane.
- 15 22. A wirelessly triggered device according to claim 20 or 21, further comprising a connector for connecting the wirelessly triggered device to a wound closure device.
- 20 23. A wirelessly triggered device according to claim 22, wherein the wound closure device is one of a suture, a staple, a surgical zip and an endoscopic clip.
- 25 24. A wirelessly triggered device according to claim 22 or 23, when the connector comprises a mechanical connector or a chemical adhesive.
- 25 25. A wirelessly triggered device according to claim 20 or 21, wherein the antenna is an electrically conductive component of a medical device.
- 30 26. A wirelessly triggered device according to claim 25, wherein the medical device is one or more of a bandage; a valve; a prosthesis; and an implant.
- 30 27. A wirelessly triggered device according to one of claims 10 and 20 to 26, wherein the predetermined condition comprises one or more adverse physiopathological states.

28. A wirelessly triggered device according to claim 27 wherein the one or more adverse physiopathological states includes one or more of bleeding, bacterial infection, gastric juice leakage and anastomotic leakage.
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29. A wirelessly triggered device according to any one of claims 10 and 20 to 28, wherein the modulating circuit is an RLC circuit and a resonance frequency of the RLC circuit varies based on the detected predetermined condition.
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30. A wirelessly triggered device according to any of claims 10 and 20 to 29, wherein the passive component is a capacitor or inductor.
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31. A wirelessly triggered device according to any one of claims 10 and 20 to 30, further comprising a support member for supporting a layer of responsive material which is susceptible to undergo a change in the predetermined condition, the support member configured to support the responsive material over the passive component.
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32. A wirelessly triggered device according to claim 31, wherein the support member comprises a plurality of relief structures projecting from the modulating circuit and defining a cavity for receiving the responsive material.
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33. A wirelessly triggered device according to any one of claims 10 and 20 to 32, further comprising a responsive material which is susceptible to undergo a change in the predetermined condition, the responsive material being coated over the passive component.
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34. A wirelessly triggered device of any one of claims 31 to 33, wherein the responsive material is a hydrogel.

35. A wirelessly triggered device of claim 34, wherein the predetermined condition includes bacterial infection and the responsive material is a DNA hydrogel susceptible to degradation in the presence of nuclease secreted by bacteria.
- 5 36. A wirelessly triggered device of claim 34, wherein the predetermined condition includes gastric juice leakage and the responsive material is a peptide hydrogel susceptible to degradation in the presence of pepsin.
- 10 37. A wirelessly triggered device of any of claims 9, 10 or 20 to 36, wherein the site is the site of a wound.
- 15 38. A reader for use with a wirelessly triggered device of any of claims 9, 10 or 16 to 37 the reader comprising:
a transmitter configured to transmit a plurality of interrogation signals configured to stimulate a backscatter response signal from the wirelessly triggered device;
a receiver configured to receive the backscatter response signal from the wirelessly triggered device; and
20 a processor configured to determine a condition at a site based on the backscatter response signal.
- 25 39. The reader of claim 38, wherein the condition at the site includes one or more of healing, bleeding, infection, bacterial growth, dehiscence, suture breakage, heart rate and respiration rate.
- 30 40. A system comprising the wirelessly triggered device of any one of claims 9, 10 or 16 to 37 and the reader of claim 38 or 39.
41. Electrically conductive surgical thread for use as a suture to appose tissue portions, the surgical thread comprising:
an inner surgical thread;

an electrically conductive coating on the inner surgical thread, the electrically conductive coating comprising a bio-compatible conductive polymer; and

5 a bio-compatible protective coating on the electrically conductive coating.

42. The surgical thread of claim 41, wherein the bio-compatible conductive polymer comprises one or more of PEDOT:PSS, poly(pyrrole); polythiophene; poly(3-alkylthiophene); polyphenylene-vinylene; 10 polyaniline; and poly(p-phenylene sulfide).

43. The surgical thread of claim 42, wherein the bio-compatible conductive polymer comprises PEDOT:PSS.

15 44. The surgical thread of claim 43, wherein the bio-compatible conductive polymer comprises three or more layers of PEDOT:PSS.

45. The surgical thread of any one of claims 41 to 44, wherein the bio-compatible protective coating comprises Parylene-c. 20

46. The surgical thread of any one of claims 41 to 45, wherein the inner surgical thread comprises silk.

25 47. The surgical thread of any one of claims 41 to 46 having a diameter of U.S.P. size 0.

48. A method of producing the electrically conductive surgical thread of any of claims 41 to 47, the method comprising:
providing a surgical thread;
30 coating the thread with an electrically conductive coating comprising a bio-compatible conductive polymer; and
encapsulating the coated thread in a biocompatible material.

49. The method of claim 48, further comprising:
applying an oxygen plasma treatment to the provided thread.
50. The method of claim 48 or 49, further comprising:
5 vacuum drying the electrically conductive coating.
51. The method of any of claims 48 to 50, further comprising:
removing wax from the provided thread via a chemical treatment.
- 10 52. A method of monitoring conditions at a site in vivo,
the method comprising:
implanting a wirelessly triggered device according to any of claims 9, 10
or 20 to 37 into the site;
transmitting a plurality of interrogation signals configured to stimulate a
15 backscatter response signal from the wirelessly triggered device;
receiving the backscatter response signal from the wirelessly triggered
device; and
determining a condition at the site based on the backscatter response
signal.
- 20 53. A method according claim 52, wherein the condition comprises one or
more physiopathological conditions.
54. A method according to claim 52, wherein the condition includes one or
25 more of healing, bleeding, infection, dehiscence, suture breakage, heart
rate and respiration rate.
55. A method according to claims 52 to 54, comprising implanting a wirelessly
triggered device according to claim 9 or 10, wherein implanting the
30 wirelessly triggered device comprises suturing at least a portion of a
wound with the electrically conductive surgical suture.

56. A method according to claims 52 to 54, comprising implanting a wirelessly triggered device according to claim 20, wherein implanting the wirelessly triggered device comprises connecting the wirelessly triggered device to a medical device at the site.

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57. A transmission assembly comprising:

a transmission device comprising:

an antenna connector for connecting to an antenna, and

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a signal generator for generating a signal for transmission using the antenna when the transmission device is attached thereto, wherein the signal generator has an unaffected condition and an affected condition, and predetermined conditions around the transmission device cause the signal generator to transition to the affected condition, the signal when generated by the signal generator in the unaffected condition being different to the signal if generated by the signal generator when in the affected condition; and

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an antenna connected to the signal generator by the antenna connector,

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wherein the antenna comprises a conductive suture.