CLAIMS

1. A relay for a near-field communication system comprising:

a flexible substrate; and

an electric circuit on the flexible substrate,

wherein the electric circuit comprises

a hub inductor pattern configured to receive and transmit at least data via electro-magnetic induction;

one or more terminal inductor patterns laterally spaced apart from the hub inductor pattern relative to a surface of the flexible substrate and configured to receive and transmit at least data via electro-magnetic induction; and

a connecting trace between the hub inductor and the one or more terminal inductors for transmitting data from the hub inductor to the one or more terminal inductors and vice versa.

2. The relay of claim 1, wherein the flexible substrate comprises textile.

3. The relay of claim 2, wherein the textile comprises clothing.

4. The relay of any one of claim 1 to 3, wherein the connecting trace is configured to connect two or more of the terminal inductor patterns in series to the hub inductor.

5. The relay of any one of claim 1 to 4, wherein the connecting trace is configured to connect two or more of the terminal inductor patterns in parallel to the hub inductor.

6. The relay of any one of claims 1 to 5, wherein the hub inductor pattern, the one or more terminal inductor patterns and the connecting trace are formed from a conductive thread.

7. The relay of claim 6, wherein the conductive thread is embroidered on the flexible substrate.

8. The relay of claim 7, comprising a textile thread securing the conductive thread on the flexible substrate.

9. The relay of any one of claims 6 to 8, wherein the conductive thread comprises one or more of a group consisting of a bare wire and~~,~~ an encapsulated wire~~, and a tubing filled with a conductive material~~.

~~10. The relay of claim 9, wherein the tubing comprises Perfluoroalkoxy and the conductive material comprises Galinstan.~~

10~~11~~. A near-field communication system comprising one or more relays of any one of the preceding claims.

11~~12~~. The system of claim 10~~11~~, further comprising one or more sensors/devices configured to receive and transmit via electro-magnetic induction and disposable within a near-filed communication range of respective ones of the one or more terminal induction patterns.

12~~13~~. The system of claim 11~~12~~, wherein the one or more sensors/devices are configured for near-filed communication including data communication and power extraction.

13~~14~~. The system of claims 10~~12~~ or 11~~13~~, wherein the sensors/devices are disposed at clothing and/or skin, or implanted.

14~~15~~. The system of any one of claim 10~~11~~ to 13~~14~~, further comprising at least one reader device configured to receive and transmit via electro-magnetic induction and disposable within a near-filed communication range of one of the hub induction patterns.

15~~16~~. The system of claim 14~~15~~, wherein the one or more reader devices are configured for near-filed communication including data communication and power transmission.

~~17. A conductive tubing comprising:~~

~~a tubing element capable of being embroidered on a textile; and~~

~~Galinstan filled into the tubing element.~~

~~18. A wearable wireless powering system comprising:~~

~~a flexible substrate having an inductor pattern formed thereon; and~~

~~a powering source comprising a battery and a circuit on a flexible print circuit board, the powering source configured to be attachable to the flexible substrate;~~

~~wherein the powering source is further configured for near-field power transmission via the inductor pattern when attached to the flexible substrate.~~

~~19. The system of claim 18, wherein the powering source is attached to the flexible substrate.~~

~~20. The system of claims 18 or 19, wherein the flexible substrate comprises textile.~~

~~21. The system of claim 20, wherein the textile comprises clothing.~~

16~~22~~. A method of fabricating a relay for a near-field communication system, comprising the steps of:

providing a flexible substrate; and

providing an electric circuit on the flexible substrate,

wherein the electric circuit comprises

a hub inductor pattern configured to receive and transmit at least data via electro-magnetic induction;

one or more terminal inductor patterns laterally spaced apart from the hub inductor pattern relative to a surface of the flexible substrate and configured to receive and transmit at least data via electro-magnetic induction; and

a connecting trace between the hub inductor and the one or more terminal inductors for transmitting data from the hub inductor to the one or more terminal inductors and vice versa.

17~~23~~. The method of claim 16~~22~~, wherein the flexible substrate comprises textile.

18~~24~~. The method of claim 17~~23~~, wherein the textile comprises clothing.

19~~25~~. The method of any one of claim 16~~22~~ to 18~~24~~, comprising connecting two or more of the terminal inductor patterns in series to the hub inductor.

20~~26~~. The method of any one of claim 16~~22~~ to 19~~25~~, comprising connecting two or more of the terminal inductor patterns in parallel to the hub inductor.

21~~27~~. The method of any one of claims 16~~22~~ to 20~~26~~, wherein the hub inductor pattern, the one or more terminal inductor patterns and the connecting trace are formed from a conductive thread.

22~~28~~. The method of claim 21~~27~~, comprising embroidering the conductive thread on the flexible substrate.

23~~29~~. The method of claim 22~~28~~, comprising using a textile thread for securing the conductive thread on the flexible substrate.

24~~30~~. The method of any one of claims 21~~27~~ to 23~~29~~, wherein the conductive thread comprises one or more of a group consisting of a bare wire~~,~~ and an encapsulated wire~~, and a tubing filled with a conductive material~~.

~~31. The method of claim 30, wherein the tubing comprises Perfluoroalkoxy and the conductive material comprises Galinstan.~~

25~~32~~. The method of any one of claims 16~~22~~ to 24~~31~~, further comprising providing one or more sensors/devices configured to receive and transmit via electro-magnetic induction and disposable within a near-filed communication range of respective ones of the one or more terminal induction patterns.

26~~33~~. The method of claim 25~~32~~, wherein the one or more sensors/devices are configured for near-filed communication including data communication and power extraction.

27~~34~~. The method of claims 25~~32~~ or 26~~33~~, comprising disposing the sensors/devices at clothing and/or skin, or implanting the sensors/devices.

2835. The method of any one of claims 1622 to 2734, further comprising providing at least one reader device configured to receive and transmit via electro-magnetic induction and disposable within a near-filed communication range of one of the hub induction patterns.

2936. The method of claim 2835, wherein the one or more reader devices are configured for near-filed communication including data communication and power transmission.

~~37. A method of fabricating a conductive tubing, comprising the steps of:~~

~~providing a tubing element capable of being embroidered on a textile; and~~

~~filling Galinstan into the tubing element.~~

~~38. A method of fabricating a wearable wireless powering system, comprising the steps of:~~

~~providing a flexible substrate having an inductor pattern formed thereon; and~~

~~providing a powering source comprising a battery and a circuit on a flexible print circuit board, the powering source configured to be attachable to the flexible substrate;~~

~~wherein the powering source is further configured for near-field power transmission via the inductor pattern when attached to the flexible substrate.~~

~~39. The method of claim 38, comprising attaching the powering source to the flexible substrate.~~

~~40. The method of claims 38 or 39, wherein the flexible substrate comprises textile.~~

~~41. The method of claim 40, wherein the textile comprises clothing.~~