

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of fabricating an anode for a lithium-ion battery, comprising the steps of:
mixing a silicon/graphite/carbon material, one or more linear polymers, one
5 or more conductive polymers, one or more self-healing polymers, and one or more
rubber polymers to produce a slurry;
coating the slurry onto a metallic member; and
drying the metallic member with coated slurry to form the anode.
- 10 2. A method according to claim 1, wherein the silicon/graphite/carbon material is a
Si@C/graphite/carbon material.
3. A method according to claim 1, wherein the metallic member is a metallic foil,
strip or grid.
- 15 4. A method according to any one of claims 1 to 3, wherein the one or more linear
polymers, the one or more conductive polymers, the one or more self-healing
polymers, and the one or more rubber polymers are firstly mixed together where:
the one or more linear polymers have a percentage weight of equal to or
20 between about 15 wt% to about 70 wt%;
the one or more conductive polymers have a percentage weight of equal to
or between about 1 wt% to about 30 wt%;
the one or more self-healing polymers have a percentage weight of equal to
or between about 5 wt% to about 20 wt%;
25 the one or more rubber polymers have a percentage weight of equal to or
between about 10 wt% to about 40 wt%;
wherein total weight percentage of the one or more linear polymers, one or
more conductive polymers, one or more self-healing polymers and one or more
rubber polymers is 100 wt%.
- 30 5. A method according to any one of claims 1 to 4, further comprising an acid.
6. A method according to claim 5, wherein the acid is an organic acid.

7. A method according to any one of claims 4 to 6, wherein the one or more linear polymers, the one or more conductive polymers, the one or more self-healing polymers, the one or more rubber polymers and acid are firstly mixed together with a mass ratio (linear polymer : conductive polymer : self-healing polymer : rubber polymer : acid) of about 30-50:10:5-10:30:40:5-15, wherein the total mass ratio of the one or more linear polymers, one or more conductive polymers, one or more self-healing polymers, one or more rubber polymers and acid is 100.
8. A method according to claim 7, wherein the one or more linear polymers, the one or more conductive polymers, the one or more self-healing polymers, the one or more rubber polymers and acid are firstly mixed together with a mass ratio (linear polymer : conductive polymer : self-healing polymer : rubber polymer : acid) of about 40:10:10:30:10 or 45:5:10:35:10.
9. A method according to any one of claims 1 to 8, wherein the one or more linear polymers are selected from a hydroxyl group, an amine group or a carboxyl group of linear polymers.
10. A method according to any one of claims 1 to 9, wherein the one or more conductive polymers are selected from an imino group or a sulfonic acid group of conductive polymers.
11. A method according to any one of claims 1 to 10, wherein the one or more self-healing polymers are selected from a urea group of self-healing polymers.
12. A method according to any one of claims 1 to 11, wherein the one or more linear polymers are selected from the group consisting of sodium carboxymethyl cellulose (CMC), polyacrylic acid (PAA), lithium polyacrylic acid (LiPAA), polyvinyl alcohol (PVA), sodium alginate (SA), 2-pentenoic acid, 2-methacrylic acid and chitosan (CS).
13. A method according to any one of claims 1 to 12, wherein the one or more conductive polymers are selected from the group consisting of polyaniline (PANI), sodium poly[9,9-bis(3-propanoate)fluorine] (PFCOONa), poly(1-pyrenemethyl

methacrylate-co-methacrylic acid) (PPyMAA), polypyrrole (PPY) and 3,4-ethylenedioxythiophene/polystyrene-4-sulfonate (PEDOT:PSS).

14. A method according to any one of claims 1 to 13, wherein the one or more self-healing polymers are selected from the group consisting of urea-pyrimidinone (UPy), urea-oligo-amidoamine (UOAA), dopamine methacrylamide (DMA) and dopamine (DA).
15. A method according to any one of claims 1 to 14, wherein the one or more rubber polymers are selected from the group consisting of styrene butadiene rubber (SBR), neoprene, nitrile rubber, butyl silicone rubber and polysulfide rubber.
16. A method according to any one of claims 1 to 15, further comprising a conductive agent selected from the group consisting of carbon black, carbon nanotubes, graphene, functionalised graphene platelets, nano-carbon fibers and a mixture thereof being mixed into the slurry.
17. A method according to claim 16, wherein the silicon/graphite/carbon material, the conductive agent, and a mixed combination of the one or more linear polymers, the one or more conductive polymers, the one or more self-healing polymers and the one or more rubber polymers, are mixed together in a mass ratio (silicon/graphite/carbon material : conductive agent : mixed combination of polymers) of equal to or between about 80-96:1-10:3-10.
18. A method according to claim 16, wherein the silicon/graphite/carbon material, and a mixed combination of the one or more linear polymers, the one or more conductive polymers, the one or more self-healing polymers and the one or more rubber polymers, are mixed together in a mass ratio (silicon/graphite/carbon material : mixed combination of polymers) of about 80-99:1-20.
19. A method according to any one of claims 1 to 18, wherein:
the one or more linear polymers is sodium carboxymethyl cellulose (CMC), polyacrylic acid (PAA) and combinations thereof;
the one or more conductive polymers is polypyrrole (PPY), PEDOT:PSS

and combinations thereof;

the one or more self-healing polymers is dopamine (DA), urea-oligo-amidoamine (UOAA) and combinations thereof; and

the one or more rubber polymers is styrene butadiene rubber (SBR).

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20. A multi-functional polymer binder comprising:

one or more linear polymers;

one or more conductive polymers;

one or more self-healing polymers, and

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one or more rubber polymers.

21. A multi-functional polymer binder according to claim 20, wherein:

the one or more linear polymers have a percentage weight of equal to or between about 15 wt% to about 70 wt%;

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the one or more conductive polymers have a percentage weight of equal to or between about 1 wt% to about 30 wt%;

the one or more self-healing polymers have a percentage weight of equal to or between about 5 wt% to about 20 wt%; and

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the one or more rubber polymers have a percentage weight of equal to or between about 10 wt% to about 40 wt%, wherein the total weight percentage of the binder is 100 wt%.

22. A multi-functional polymer binder according to claim 20, wherein the one or more linear polymers, the one or more conductive polymers, the one or more self-healing polymers, and the one or more rubber polymers are mixed together with a mass ratio (linear polymer : conductive polymer : self-healing polymer : rubber polymer) of about 15-70:1-30:5-20:10-40, wherein the total mass ratio of the one or more linear polymers, one or more conductive polymers, one or more self-healing polymers and one or more rubber polymers is 100.

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23. A multi-functional polymer binder according to claim 20, wherein the one or more linear polymers, the one or more conductive polymers, the one or more self-healing polymers, and the one or more rubber polymers are mixed together with a mass ratio (linear polymer : conductive polymer : self-healing polymer : rubber polymer)

of about 20-50:1-20:5-20, wherein the total mass ratio of the one or more linear polymers, one or more conductive polymers, one or more self-healing polymers and one or more rubber polymers is 100.

- 5 24. A multi-functional polymer binder according to any one of claims 20 to 23,
 wherein the one or more linear polymers are selected from a hydroxyl group, an
 amine group or a carboxyl group of linear polymers.
25. A multi-functional polymer binder according to any one of claims 20 to 24,
10 wherein the one or more conductive polymers are selected from an imino group or
 a sulfonic acid group of conductive polymers.
26. A multi-functional polymer binder according to any one of claims 20 to 25,
 wherein the one or more self-healing polymers are selected from a urea group of
15 self-healing polymers.
27. A multi-functional polymer binder according to any one of claims 20 to 26,
 wherein the one or more liner polymers are selected from the group consisting of
 sodium carboxymethyl cellulose (CMC), polyacrylic acid (PAA), lithium
20 polyacrylic acid (LiPAA), polyvinyl alcohol (PVA), sodium alginate (SA), 2-
 pentenoic acid, 2-methacrylic acid and chitosan (CS) and combinations thereof.
28. A multi-functional polymer binder according to any one of claims 20 to 27,
 wherein the one or more conductive polymers are selected from the group
25 consisting of polyaniline (PANI), sodium poly[9,9-bis(3-propanoate)fluorine]
 (PFCOONa), poly(1-pyrenemethyl methacrylate-co-methacrylic acid) (PPyMAA),
 polypyrrole (PPY) and 3,4-ethylenedioxythiophene/polystyrene-4-sulfonate
 (PEDOT:PSS) and combinations thereof.
- 30 29. A multi-functional polymer binder according to any one of claims 20 to 28,
 wherein the one or more self-healing polymers are selected from the group
 consisting of urea-pyrimidinone (UPy), urea-oligo-amidoamine (UOAA),
 dopamine methacrylamide (DMA) and dopamine (DA) and combinations thereof.

30. A multi-functional polymer binder according to any one of claims 20 to 29,
wherein the one or more rubber polymers are selected from the group consisting of
styrene butadiene rubber (SBR), neoprene, nitrile rubber, butyl silicone rubber and
polysulfide rubber and combinations thereof.
- 5 31. A multi-functional polymer binder according to any one of claims 20 to 30, further
comprising an acid.
32. A multi-functional polymer binder according to claim 31, wherein the acid is an
10 organic acid.
33. A method of producing a multi-functional polymer binder, comprising mixing
together one or more linear polymers, one or more conductive polymers, one or
more self-healing polymers, and one or more rubber polymers.
- 15 34. A kit comprising:
an emulsion (part 1) comprising mixture of a silicon/graphite/carbon
material, one or more linear polymers, one or more conductive polymers, one or
more self-healing polymers, and optionally a conductive agent; and
20 an emulsion (part 2) comprising one or more rubber polymers.
35. A kit according to claim 34, wherein the emulsion (part 1) further comprises an
acid.
- 25 36. A kit according to claim 35, wherein the acid is an organic acid.