

Claims

1. An iron-iron oxide composition, comprising:
 - a) a cashew testa extract; and
 - b) iron-iron oxide core-shell particles, the core is an elemental iron core or an iron alloy core, and the shell is an iron oxide shell;wherein the cashew testa extract comprises a component selected from protein, amino acid, sugar, phenolic compounds or a combination thereof, the phenolic compounds selected from tannins, catechin, epicatechin, epigallocatechin, p-coumaric, gallic acid, or a combination thereof; and
wherein the iron-iron oxide particles are at least partially passivated by the protein, amino acid, sugar, phenolic compounds, or a combination thereof.
2. The iron-iron oxide composition according to claim 1, wherein the iron-iron oxide particles are further at least partially passivated by a carboxylate acid moiety or a hydroxyl moiety.
3. The iron-iron oxide composition according to claim 1 or 2, wherein the carboxylic acid is selected from fatty acid, aromatic carboxylic acid, dicarboxylic acid, tricarboxylic acid, keto acid, α -hydroxyl acid, divinylether fatty acid, phosphoric acid, polyphosphoric acid, tungstic acid, vanadic acid, molybdic acid, heteropolyacid, or a combination thereof.
4. The iron-iron oxide composition according to any one of claims 1 to 3, wherein the iron-iron oxide particles comprise elemental Fe, FeO, Fe₂O₃, Fe₃O₄, or a combination thereof.
5. The iron-iron oxide composition according to any one of claims 1 to 4, wherein the iron-iron oxide particles have an average particle size of about 1 μm to about 800 μm .
6. The iron-iron oxide composition according to any one of claims 1 to 5, wherein the shell further comprises a component from cashew testa extract.
7. The iron-iron oxide composition according to claim 1 or 6, wherein the shell has a thickness of about 5 nm to about 1 μm .
8. The iron-iron oxide composition according to any one of claims 1 or 7, having an iron content relative to the iron-iron oxide composition of about 20 w/w% to about 80 w/w% and an oxygen content relative to the iron-iron oxide composition of about 15 w/w% to about 40 w/w%.
9. The iron-iron oxide composition according to any one of claims 1 or 8, the iron-iron oxide composition has a carbon content relative to the iron-iron oxide composition of about 4 w/w% to about 50 w/w%.

- 74 -

10. The iron-iron oxide composition according to any one of claims 1 to 9, further comprising an excipient selected from stabilising agent, dispersant, colorant, or a combination thereof.
- 5 11. A method of synthesising an iron-iron oxide composition, comprising:
reacting a cashew testa extract with iron particles and an iron oxide precursor in
order to form iron-iron oxide core-shell particles;
wherein the iron-iron oxide core-shell particles has an elemental iron core or an
iron alloy core, and an iron oxide shell;
- 10 12. The method according to claim 11, wherein the iron oxide precursor is an iron (III) salt.
wherein the cashew testa extract comprises a component selected from protein,
amino acid, sugar, phenolic compounds or a combination thereof; and
wherein the iron particles and/or iron oxide particles are at least partially
passivated by a component of the cashew testa extract.
- 15 13. The method according to claim 11 or 12, wherein an anion of the iron (III) salt is
selected from nitrate, chloride, bromide, fluoride, iodide, sulphate, oxalate,
20 perchlorate, phosphate, tetrafluoroborate, or a combination thereof.
14. The method according to any one of claims 11 to 13, wherein the reaction is
performed at about 5 °C to about 80 °C.
- 25 15. The method according to any one of claims 11 to 14, wherein the reaction is
performed for a period in the range from about 1 min to about 24 h.
16. The method according to any one of claims 11 to 15, wherein the iron particles
and an iron oxide precursor are homogenously mixed before reacting with the
30 cashew testa extract.
17. The method according to any one of claims 11 to 16, wherein the cashew testa
extract comprises phenolic compounds and a weight ratio of the phenolic
compounds to iron particles and iron oxide precursor is about 1:500 to about
35 500:1.
18. A method of disinfecting a non-biological surface, comprising:
a) contacting an iron-iron oxide composition according to any one of claims 1 to 10
with the non-biological surface.
- 40 19. The method according to claim 18, further comprising a step prior to (a) of
applying the iron-iron oxide composition to an application medium.
20. A method of killing microbial in the dark by using an iron-iron oxide composition
45 according to any one of claims 1 to 10.

- 75 -

21. A method of disinfecting a surface using iron-iron oxide composition according to any one of claims 1 to 10, wherein the iron-iron oxide composition provides at least a 2 log reduction in microbial activity after 5 min.
- 5 22. A composite material, comprising a porous fabric impregnated with an iron-iron oxide composition according to any one of claims 1 to 10 and coated with a water repellent coating on at least one side of the porous fabric, wherein the iron-iron oxide composition is present at about 0.1% w/w to about 5% w/w relative to the composite material; and
- 10 wherein the water repellent coating has a thickness of about 10 μm to about 500 μm .
23. The composite material according to claim 22, wherein the porous fabric is a fabric comprising cotton and spandex;
- 15 wherein the cotton is about 90% w/w relative to the fabric; and wherein the spandex is about 10% w/w relative to the fabric.
24. The composite material according to claim 22 or 23, wherein the iron-iron oxide composition comprises iron, iron (II) oxide and iron (III) oxide.
- 20 25. The composite material according to any one of claims 22 to 24, wherein the iron-iron oxide composition comprises elemental Fe, Fe_3O_4 , and amino acid, carbohydrate or a mixture thereof.
- 25 26. The composite material according to claim 24 or 25, wherein the amino acid, carbohydrate or a mixture thereof is selected from glycine, alanine, valine, leucine, isoleucine, methionine, proline, phenylalanine, tryptophane, serine, threonine, cysteine, tyrosine, asparagine, aspartic acid, glutamine, glutamic acid, lysine, arginine, histidine, taurine, betaine, N-methylalanine, zein, glucose, galactose,
- 30 fructose, xylose, sucrose, lactose, maltose, trehalose, sorbitol, mannitol, maltodextrin, raffinose, stachyose, fructo-oligosaccharide, amylose, amylopectin, modified starch, glycogen, cellulose, hemicellulose, ethylcellulose, methylcellulose, pectin, hydrocolloid and a combination thereof.
- 35 27. The composite material according to any one of claims 22 to 26, wherein the iron-iron oxide composition has a particle size of about 1 μm to about 800 μm .
28. The composite material according to claim 22 or 27, wherein the shell has a thickness of about 50 nm to about 400 nm.
- 40 29. The composite material according to any one of claims 22 to 28, wherein the water repellent coating is selected from perfluorobutanesulfonic acid, perfluorooctanoic acid, perfluorohexanoic acid, Scotchgard, perfluorooctanesulfonic acid, paraffin (and other hydrocarbon based solutions), silica nanoparticles and silanes (e.g. alkyl trialkoxy silanes).
- 45

- 76 -

30. A method of manufacturing a composite material, comprising:
 - a) impregnating a porous fabric with an iron-iron oxide composition; and
 - b) coating the porous fabric with a water repellent coating on at least one side of the porous fabric in order to form the composite material,
 5 wherein the iron-iron oxide composition is present relative to the composite material at about 0.1% w/w to about 5% w/w; wherein the water repellent coating has a thickness of about 10 μm to about 500 μm .
- 10 31. A face mask comprising:
 - a) a face covering structure configured to cover at least a mouth and nasal passages of a user; and
 - b) an attachment structure comprising:
 - 15 i) a drawstring attached to opposed sides of the face covering structure, for securing the face covering structure to a face of the user; and
 - ii) a fastener releasably attached to the drawstring to maintain the drawstring in a tightened or loosened position;
 20 wherein the drawstring is arranged to form ear straps for looping behind respective ears of the user and a neck strap for looping behind a neck of the user; wherein the fastener is attached to the neck strap; and wherein the face covering structure comprises a composite material according to any one of claims 22 to 29.
- 25 32. The face mask according to claim 31, wherein the fastener is a cord lock.
33. The face mask according to claim 31 or claim 32, wherein each ear strap comprises a section of the drawstring that is attached at a first point on one of the opposed sides, and is threaded through an attachment loop at a second point that is spaced
 30 from the first point.
34. The face mask according to claim 33, wherein the neck strap comprises a section of the drawstring that spans between respective attachment loops.
- 35 35. The face mask according to claim 32, wherein the drawstring is threaded through eyelets of the cord lock.
36. The face mask according to any one of claims 31 to 35, wherein the face covering structure comprises a nasal cushion located at an inner surface thereof.
- 40 37. The face mask according to any one of claims 31 to 36, wherein the face covering structure comprises a filter layer.
38. The face mask according to claim 37, wherein the filter layer is sandwiched
 45 between an outer fabric layer and an inner fabric layer.

- 77 -

39. The face mask according to claim 38, wherein the outer fabric layer is a composite material according to any one of claims 22 to 30.
- 5 40. The face mask according to any one of claims 37 to 39, wherein the filter layer is replaceable.
41. The face mask according to any one of claims 37 to 40, wherein the face covering structure comprises a sleeve for accommodating the filter layer.
- 10 42. The face mask according to any one of claims 31 to 41, wherein the face covering structure is configured to at least partially cover a submental triangle of the user.
- 15 43. The face mask according to claim 42, wherein the face covering structure further comprises a lower fabric attached to a longitudinal side of the outer fabric layer and an inner fabric layer, and distal from the nasal cushion, such that when in use, the lower fabric is connected to the face covering structure at an angle of more than 20°.
- 20 44. The face mask according to any one of claims 31 to 43, wherein the face covering structure is configured to at least partially cover a zygomatic region of the user.
- 25 45. The face mask according to claim 44, wherein the face covering structure further comprises two extensions each extending out from the first point on the opposed sides of the face covering structure, for attaching to the drawstring.