CLAIMS

What is claimed is:

1. A composite laminar material comprising a carbohydrate based substrate and a protein.
2. The composite laminar material of claim 1 wherein the carbohydrate based substrate comprises a film, a fiber, a sponge, a mesh, a foam, or a nanoscale structure.
3. The composite laminar material of any of claims 1-2, wherein the ratio of carbohydrate to protein is in the range of 10:1 to 1:10.
4. The composite laminar material of any of claims 1-3, wherein carbohydrate based substrate is a chitin, fructooligosaccharide, galactooligosaccharides, mannanoligosaccharides, glycogen, starch (amylase, amylopectin), glycosaminoglycans (e.g., hyaluronic acid, chondroitin 4-sulfate, chondroitin-6-sulfate, dermatan sulfate, keratin sulfate, heparin and the like), cellulose, beta-glucan (zymosan, lentinan, sizofiran), maltodextrin, inulin, or levan beta (2->6) based substrate.
5. The composite laminar material of any of claims 1-4, wherein the carbohydrate based substrate is a Chitosan based substrate.
6. The composite laminar material of any of claims 1-5, wherein the protein is selected from the group consisting of silk fibroin, perculin, abductin, elastin, resilin, fibronectin, fibrinogen, keratin, titin, collagen, actin, Arp2/3, coronin, dystrophin, FtsZ, myosin, spectrin, Tau (protein), tubulin, F-spondin, Pikachurin, fragments and analogs and derivatives thereof, and any combinations thereof.
7. The composite laminar material of claim 1, wherein the carbohydrate is Chitosan and the protein includes silk fibroin and the ratio of Chitosan to silk fibroin is in the range of 1:1.5 to 1:2.
8. The composite laminar material of any of claims 1-7, wherein the carbohydrate based substrate includes at least one surface having a predefined microtopography and the protein is applied to the surface.
9. The composite laminar material of claim 8, wherein the predefined microtopography is molded into the carbohydrate-based substrate.
10. The composite laminar material of any of claims 1-9, wherein the protein includes at least one surface having a predefined microtopography.
11. The composite laminar material of claim 10, wherein the predefined microtopography is molded into the protein.

12. The composite laminar material of any of claims 1-11 further comprising a second carbohydrate based substrate.
13. The composite laminar material of claim 12, wherein the second carbohydrate based substrate is a chitin based substrate.
14. The composite laminar material of any of claims 1-13, wherein the composite material comprises a molecule selected from the group consisting of carbon fibers, carbon nanotubes, fiberglass, small molecules, polymers, proteins, peptides, peptidomimimetics, nucleic acids, organic compounds, inorganic compounds, crystalline compounds, biological compounds, biologically active compounds, compounds having biological activity, and a biological, a pharmaceutical or a therapeutic agent, and any combinations thereof, in at least one of carbohydrate-layer or protein-layer.
15. The method of claim 14, wherein the molecule is in the carbohydrate-layer.
16. The method of claim 15, wherein the molecule is covalently linked with the carbohydrate-layer.
17. The method of claim 14, wherein the molecule is in the protein-layer.
18. The method of claim 17, wherein the molecule is covalently linked with the protein-layer.
19. The composite laminar material of any of claims 14-18, wherein the crystalline material is calcium carbonate.
20. The composite laminar material of any of claims 1-19 further comprising a water repelling coating on at least a portion of the composite material.
21. The composite laminar material of any of claims 20, wherein the composite material is composed of parylene.
22. The composite laminar material of any of claims 20-21, wherein the composite material exhibits variable mechanical properties as a function of a location of the water repelling coating on a portion of the composite material when exposed to aqueous environments.
23. A method of forming a composite laminar material comprising:
providing a carbohydrate based substrate and contacting the carbohydrate based substrate with a protein solution.
24. The method of claim 23, wherein the carbohydrate based substrate is a chitin, fructooligosaccharide, galactooligosaccharides, mannanoligosaccharides, glycogen, starch (amylase, amylopectin), glycosaminoglycans (e.g., hyaluronic acid,

chondroitin-4-sulfate, chondroitin-6-sulfate, dermatan sulfate, keratin sulfate, heparin and the like), cellulose, beta-glucan (zymosan, lentinan, sizofiran), maltodextrin, inulin, or levan beta (2->6) based substrate.

25. The method of any of claims 23-24, wherein the carbohydrate based substrate is a Chitosan based substrate.

26. The method of any of claims 23-25, wherein the protein is selected from the group consisting of silk fibroin, perculin, abductin, elastin, resilin, fibronectin, fibrinogen, keratin, titin, collagen, actin, Arp2/3, coronin, dystrophin, FtsZ, myosin, spectrin, Tau (protein), tubulin, F-spondin, Pikachurin, fragments and analogs and derivatives thereof, and any combinations thereof.

27. The method of any of claims 23-26, wherein the ratio of carbohydrate to protein is in the range of from 10:1 to about 1:10.

28. The method of any of claims 23-27, wherein the carbohydrate based substrate is formed by dehydrating a solution of carbohydrate based material.

29. The method of claim 28, wherein the solution of carbohydrate based material includes an acid.

30. The method of claim 29, wherein the acid is selected from the group consisting of itaconic acid, polyitaconic acid, aconitic acid, uric acid, glucuronic acid, formic acid, acetic acid, trichloroacetic acid, propionic acid, butanoic acid, 4-chlorobutanoic acid, 3-chlorobutanoic acid, 2-bromobutanoic acid, 2-chlorobutanoic acid, chlorous acid, hypochlorous acid, citric acid, gluconic acid, lactic acid, oxalic acid, tartaric acid, ascorbic acid, Meldrum's acid, hydrofluoric acid, hydrocyanic acid, hydrogens sulfide, orthophosphoric acid, sulfurous acid, carbonic acid, conjugate acid of a weak base, and any combinations thereof.

31. The method of any of claims 29-30 further comprising neutralizing the carbohydrate based material by applying a basic solution.

32. The method of claim 30, wherein the basic solution comprises a base selected from the group consisting of sodium hydroxide, ammonium hydroxide, potassium hydroxide, calcium hydroxide, magnesium hydroxide, barium hydroxide, strontium hydroxide, lithium hydroxide, rubidium hydroxide, sodium carbonate, and ammonia or the basic solution is a high pH buffer.

33. The method of claim 32, wherein the high pH buffer is a carbonate buffer.

34. The method of any of claims 23-33, wherein the carbohydrate based substrate is formed by freeze drying a solution of carbohydrate based material.

35. The method of any of claims 23-33, wherein the carbohydrate based substrate is formed by injecting air bubbles into a solution of carbohydrate based material.
36. The method of any of claims 23-33, wherein the carbohydrate based substrate is formed by spinning a carbohydrate based solution to form fibers.
37. The method of any of claims 23-33 or 35, wherein the carbohydrate based substrate is formed by electrospinning a chitin-based solution to form fibers.
38. The method of any of claims 22-32 or 35, wherein the carbohydrate based substrate is formed by rotary spinning a carbohydrate based solution to form fibers.
39. The method of any of claims 23-38 further comprising inducing a beta transition of the protein.
40. The method claim 39, wherein the beta transition is induced by treating the protein with one or more of the following agents including alcohols, organic solvents, aqueous solutions, or the application of stress, pressure or heat.
41. The method of any of claims 23-40 further comprising:
introducing carried material selected from the group consisting of carbon nanotubes, fiberglass, small molecules, polymers, proteins, peptides, peptidomimimetics, nucleic acids, organic compounds, inorganic compounds, crystalline material, biological compounds, biologically active compounds, compounds having biological activity, and a biological, a pharmaceutical or a therapeutic agent, and any combinations thereof, to the composite material.
42. The method of claim 40, wherein the carried material is covalently linked to the composite material.
43. A composition of matter formed by any of the methods of claims 23-42.
44. A prosthetic device comprising a composition of matter formed by any of the methods of claims 23-42.
45. A tissue engineering scaffold comprising a composition of matter formed by any of the methods of claims 23-42.
46. A drug delivery device comprising a composition of matter formed by any of the methods of claims 23-42.
47. An implantable material comprising a composition of matter formed by any of the methods of claims 23-42.
48. A material comprising a composition of matter formed by any of the methods of claims 23-42 comprising minerals or crystal materials.

49. A thin clear film comprising a composition of matter formed by any of the methods of claims 23-42.
50. A multi-laminate material comprising a composition of matter formed by any of the methods of claims 23-42.
51. A multi-laminate material comprising a composition of matter formed by any of the methods of claims 23-42 comprising additional components to provide tailored mechanical properties.
52. A material comprising a composition of matter formed by any of the methods of claims 23-42 comprising a water-repelling coating material.
53. A material comprising a composition of matter formed by any of the methods of claims 23-42 comprising variable regions of a water-repelling coating material to provide regions with variable flexibility.
54. A method of forming a composite laminar material comprising:
dissolving a chitin based material in an acidic solution;
forming a chitin based structure of the chitin based material by evaporating the solvent;
treating the chitin based structure with a base solution to neutralize the protonated amino groups;
washing the chitin based structure;
optionally dehydrating the chitin based structure;
applying a protein solution to the chitin based structure to produce a composite material having at least one layer of protein on the chitin based structure;
drying the protein-layer on the chitin based structure; and
treating the composite material with an alcohol based solution to induce a beta transition of the protein.
55. The method of claim 54, wherein the ratio of chitin based material to protein is in the range of from 10:1 to 1:10.
56. The method of any of claims 54-55, wherein the chitin based material is chitosan.
57. The method of any of claims 54-56, wherein the protein is fibroin.
58. The method of any of claims 54-57, wherein the acidic solution includes acetic acid.
59. The method of any of claims 54-58, wherein the base solution includes NaOH.
60. The method of any of claims 54-59, wherein the alcohol based solution includes methanol.
61. A composition of matter formed by any of the methods of claims 54-60.

62. A method of adhering a medical implant device to a tissue or organ, the method comprising applying an effective amount of a transglutaminase to surface of the tissue or organ and contacting the medical implant device to the surface of the tissue.
63. The method of claim 62, wherein the medical implant device comprises a transglutaminase.
64. A method of adhering a medical implant device to a tissue or organ, the method comprising contacting the medical implant device with the organ, wherein the medical implant device comprises an effective amount of a transglutaminase.
65. The method of claim 64, further comprising applying an effective amount of a transglutaminase to surface of the tissue.
66. The method of any of claims 62-65, wherein the transglutaminase is a mammalian transglutaminase.
67. The method of any of claims 62-65, wherein the transglutaminase is a microbial transglutaminase (mTgase).
68. The method of any of claims 62-67, wherein the transglutaminase is a calcium independent transglutaminase.
69. The method of any of claims 62-68, wherein the transglutaminase is selected from the group consisting of Factor XIII A (fibrin stabilizing factor), Type 1 transglutaminase (keratinocyte transglutaminase,), Type 2 transglutaminase (tissue transglutaminase, tTgase), Type 3 transglutaminase (epidermal transglutaminase), Type 4 transglutaminase (prostate transglutaminase), Type 5 transglutaminase (Transglutaminase X), Type 6 transglutaminase (Transglutaminase Y), Type 7 transglutaminase (Transglutaminase Z), and any combinations thereof.
70. The method of any of claims 62-69, wherein the transglutaminase is formulated in a solution, an emulsion, an aerosol, a foam, an ointment, a paste, a lotion, a powder, a gel, a hydrogel, a hydrocolloid, a microparticle, a nanoparticle, or a cream.
71. The method of any of claims 62-70, wherein the medical implant device is selected from the group consisting of artificial tissues, artificial organs, prosthetic devices, drug delivery devices, wound dressings, films, foams, sponges, hemostatic materials, and any combinations thereof.
72. The method of claim 71, wherein the medical implant device is a wound dressing selected from the group consisting of bandages, gauzes, tapes, meshes, nets, adhesive plasters, films, membranes, patches, microparticles, nanoparticles, and any combinations thereof.

73. The method of claim 71, wherein the medical implant device is a foam.

74. The method of any of claims 62-73, wherein the medical implant device is comprises a protein and wherein the protein is cross-linkable by a transglutaminase.

75. The method of claim 74, wherein the medical implant device is coated with the protein.

76. The method of any of claims 74-75, wherein the protein is a silk fibroin.

77. The method of any of claims 62-76, wherein the transglutaminase is coated on the surface of the medical implant device.

78. The method of any of claims 62-77, wherein the transglutaminase is non-covalently linked with the medical implant device.

79. The method of any of claims 62-78, wherein the effective amount of transglutaminase is from about 1μg to about 100mg per cm^2 of contact surface area between the tissue or the organ and the medical implant device.

80. The method of any of claims 62-79, further comprising administering a wound healing agent.

81. The method of any claim claims 80, wherein the wound healing agent is selected from the group consisting of dexpanthenol; growth factors; enzymes, hormones; povidon-iodide; fatty acids; anti-inflammatory agents; antibiotics; antimicrobials; antiseptics; cytokines; thrombin; angalgesics; opioids; aminoxyls; furoxans; nitrosothiols; nitrates and anthocyanins; nucleosides, such as adenosine; and nucleotides, such as adenosine diphosphate (ADP) and adenosine triphosphate (ATP); neutotransmitter/neuromodulators, such as acetylcholine and 5-hydroxytryptamine (serotonin/5-HT); histamine and catecholamines, such as adrenalin and noradrenalin; lipid molecules, such as sphingosine-1-phosphate and lysophosphatidic acid; amino acids, such as arginine and lysine; peptides such as the bradykinins, substance P and calcium gene-related peptide (CGRP); nitric oxide; and any combinations thereof.

82. The method of any of claim 62-81, wherein the medical implant device is fabricated from a biocompatible, biodegradable material.

83. The method of any of claims 62-82, wherein the medical implant device is fabricated from a composite material of any of claims 1-21.

84. The method of any of claims 62-83, wherein said applying comprises increasing expression or activity of a host transglutaminase.

85. A method of promoting wound healing in a subject in need thereof, comprising applying an effective amount of a transglutaminase to a wound surface and contacting

a wound dressing to the wound, wherein the wound dressing comprises a composite material of any of claims 1-21.

86. The method of claim 85, further comprising applying a foam to the wound, wherein the foam comprises a composite material of any of claims 1-21.

87. The method of any of claims 85-86, wherein the wound is selected from the group consisting of cuts and lacerations, surgical incisions, punctures, grazes, scratches, compression wounds, abrasions, friction wounds, chronic wounds, ulcers, thermal effect wounds, chemical wounds, wounds resulting from pathogenic infections, skin graft/transplant donor and recipient sites, immune response conditions, oral wounds, stomach or intestinal wounds, damaged cartilage or bone, amputation sites and corneal lesions.

88. The method of any of claims 85-87, wherein the transglutaminase is a mammalian transglutaminase.

89. The method of any of claims 85-87, wherein the transglutaminase is a microbial transglutaminase (mTgase).

90. The method of any of claims 85-89, wherein the transglutaminase is a calcium independent transglutaminase.

91. The method of any of claims 85-90, wherein the transglutaminase is selected from the group consisting of Factor XIII A (fibrin stabilizing factor), Type 1 transglutaminase (keratinocyte transglutaminase), Type 2 transglutaminase (tissue transglutaminase), Type 3 transglutaminase (epidermal transglutaminase), Type 4 transglutaminase (prostate transglutaminase), Type 5 transglutaminase (Transglutaminase X), Type 6 transglutaminase (Transglutaminase Y), Type 7 transglutaminase (Transglutaminase Z), and any combinations thereof.

92. The method of any of claims 85-91, wherein the transglutaminase is formulated in a solution, an emulsion, an aerosol, a foam, an ointment, a paste, a lotion, a powder, a gel, a hydrogel, a hydrocolloid, a microparticle, a nanoparticle, or a cream.

93. The method of any of claims 85-92, wherein the wound dressing is selected from the group consisting of bandages, gauzes, tapes, meshes, nets, adhesive plasters, films, membranes, patches, and any combinations thereof.

94. The method of any of claims 85-93, wherein the transglutaminase is associated with the wound dressing.

95. The method of claim 94, wherein the transglutaminase is coated on the surface of the wound dressing.

96. The method of any of claims 94-95, wherein the transglutaminase is non-covalently linked with the wound dressing.

97. The method of any of claims 85-96, wherein the effective amount of transglutaminase is from about 1μg to about 100mg per cm^2 of wound area.

98. The method of any of claims 85-97, further comprising administering a wound healing agent to the subject.

99. The method of claim 98, wherein the wound healing agent is selected from the group consisting of dexpanthenol; growth factors; enzymes, hormones; povidon-iodide; fatty acids; anti-inflammatory agents; antibiotics; antimicrobials; antiseptics; cytokines; thrombin; analgesics; opioids; aminoxyls; furoxans; nitrosothiols; nitrates and anthocyanins; nucleosides; nucleotides,; neurotransmitter/neuromodulators, such as acetylcholine and 5-hydroxytryptamine (serotonin/5-HT); histamine and catecholamines, such as adrenalin and noradrenalin; lipid molecules, such as sphingosine-1-phosphate and lysophosphatidic acid; amino acids, such as arginine and lysine; peptides such as the bradykinins, substance P and calcium gene-related peptide (CGRP); nitric oxide; and any combinations thereof.

100. The method of any of claims 85-99, wherein said applying comprises increasing expression or activity of a host transglutaminase.

101. The method of any of claims 85-99, wherein said applying is before, after or during contacting of the medical implant device or the wound dressing.

CLAIMS

1. A composite laminar material comprising a carbohydrate layer and a protein layer, in which the carbohydrate is neutralized with a base before forming the protein layer.

2. A composite laminar material according to Claim 1 in which the carbohydrate layer is a film, a fiber, a sponge, a mesh, a foam, or a nanoscale structure.

3. A composite laminar material according to Claim 1 or 2, in which the ratio of carbohydrate to protein is in the range of 10:1 to 1:10.

4. A composite laminar material according to any of Claims 1, 2 or 3, in which carbohydrate based layer is a chitin, fructooligosaccharide, galactooligosaccharides, mannanoligosaccharides, glycogen, starch (amylase, amylopectin), glycosaminoglycans (e.g., hyaluronic acid, chondroitin-4-sulfate, chondroitin-6-sulfate, dermatan sulfate, keratin sulfate, heparin and the like), cellulose, beta-glucan (zymosan, lentinan, sizofiran), maltodextrin, inulin, or levan beta (2->6) based substrate.

5. A composite laminar material according to any preceding claim, in which the carbohydrate layer is a Chitosan based substrate.

6. A composite laminar material according to any preceding claim, in which the protein is selected from the group consisting of silk fibroin, perculin, abductin, elastin, resilin, fibronectin, fibrinogen, keratin, titin, collagen, actin, Arp2/3, coronin, dystrophin, FtsZ, myosin, spectrin, Tau (protein), tubulin, F-spondin, Pikachurin, fragments and analogs and derivatives thereof, and any combinations thereof.

7. A composite laminar material according to Claim 1, in which the carbohydrate is Chitosan and the protein includes silk fibroin and the ratio of Chitosan to silk fibroin is in the range of 1:1.5 to 1:2.

8. A composite laminar material according to any preceding claim, in which the carbohydrate layer includes at least one surface having a predefined microtopography and the protein is applied to the surface.

9. A composite laminar material according to Claim 8, in which the predefined microtopography is molded into the carbohydrate-based substrate.

10. A composite laminar material according to any preceding claim, in which the protein includes at least one surface having a predefined microtopography.

11. A composite laminar material according to Claim 10, in which the predefined microtopography is molded into the protein.

12. A composite laminar material according to any preceding claim further comprising a second carbohydrate layer.

13. A composite laminar material according to Claim 12, in which the second carbohydrate layer is a chitin based substrate.

14. A composite laminar material according to any preceding claim, in which the composite material comprises a molecule selected from the group consisting of carbon fibers, carbon nanotubes, fiberglass, small molecules, polymers, proteins, peptides, peptidomimimetics, nucleic acids, organic compounds, inorganic compounds, crystalline compounds, biological compounds, biologically active compounds, compounds having biological activity, and a biological, a pharmaceutical or a therapeutic agent, and any combinations thereof, in at least one of carbohydrate-layer or protein-layer.

15. A composite laminar material according to Claim 14, in which the molecule is in the carbohydrate-layer.

16. A composite laminar material according to Claim 15, in which the molecule is covalently linked with the carbohydrate-layer.

17. A composite laminar material according to Claim 14, in which the molecule is in the protein-layer.

18. A composite laminar material according to Claim 17, in which the molecule is covalently linked with the protein-layer.

19. A composite laminar material according to any of Claims 14 to 18, in which the crystalline material is calcium carbonate.

20. A composite laminar material according to any preceding claim further comprising a water repelling coating on at least a portion of the composite material.

21. A composite laminar material according to Claim 20, in which the composite material is composed of parylene.

22. A composite laminar material according to Claim 20 or 21, in which the composite material exhibits variable mechanical properties as a function of a location of the water repelling coating on a portion of the composite material when exposed to aqueous environments.

23. A method of forming a composite laminar material comprising:

providing a carbohydrate layer;

neutralizing the carbohydrate layer with a base solution;

optionally dehydrating the protein layer;

contacting the carbohydrate layer with a protein solution to produce a composite material; and

optionally treating the composite material with an alcohol based solution.

24. A method according to Claim 23, in which the carbohydrate based substrate is a chitin, fructooligosaccharide, galactooligosaccharides, mannanoligosaccharides, glycogen, starch (amylase, amylopectin), glycosaminoglycans (e.g., hyaluronic acid, chondroitin-4-sulfate, chondroitin-6-sulfate, dermatan sulfate, keratin sulfate, heparin and the like), cellulose, beta-glucan (zymosan, lentinan, sizofiran), maltodextrin, inulin, or levan beta (2->6) based substrate.

25. A method according to Claim 23 or 24, in which the carbohydrate based substrate is a Chitosan based substrate.

26. A method according to Claim 23, 24 or 25, in which the protein is selected from the group consisting of silk fibroin, perculin, abductin, elastin, resilin, fibronectin, fibrinogen, keratin, titin, collagen, actin, Arp2/3, coronin, dystrophin, FtsZ, myosin, spectrin, Tau (protein), tubulin, F-spondin, Pikachurin, fragments and analogs and derivatives thereof, and any combinations thereof.

27. A method according to any of Claims 23 to 26, in which the ratio of carbohydrate to protein is in the range of from 10:1 to about 1:10.

28. A method according to any of Claims 23 to 27, in which the carbohydrate based substrate is formed by dehydrating a solution of carbohydrate based material.

29. A method according to Claim 28, in which the solution of carbohydrate based material includes an acid.

30. A method according to Claim 29, in which the acid is selected from the group consisting of itaconic acid, polyitaconic acid, acontic acid, uric acid, glucuronic acid, formic acid, acetic acid, trichloroacetic acid, propionic acid, butanoic acid, 4-chlorobutanoic acid, 3-chlorobutanoic acid, 2-bromobutanoic acid, 2-chlorobutanoic acid, chlorous acid, hypochlorous acid, citric acid, gluconic acid, lactic acid, oxalic acid, tartaric acid, ascorbic acid, Meldrum's acid, hydrofluoric acid, hydrocyanic acid, hydrogens sulfide, orthophosphoric acid, sulfurous acid, carbonic acid, conjugate acid of a weak base, and any combinations thereof.

31. A method according to any of Claims 23 to 30 , in which the basic solution comprises a base selected from the group consisting of sodium hydroxide, ammonium hydroxide, potassium hydroxide, calcium hydroxide, magnesium hydroxide, barium hydroxide, strontium hydroxide, lithium hydroxide, rubidium hydroxide, sodium carbonate, and ammonia or the basic solution is a high pH buffer.

32. A method according to Claim 31, in which the high pH buffer is a carbonate buffer.

33. A method according to any of Claims 23 to 32, in which the carbohydrate based substrate is formed by freeze drying a solution of carbohydrate based material.

34. A method according to any of Claims 23 to 32, in which the carbohydrate based substrate is formed by injecting air bubbles into a solution of carbohydrate based material.

35. A method according to any of Claims 23 to 32, in which the carbohydrate based substrate is formed by spinning a carbohydrate based solution to form fibers.

36. A method according to any of Claims 23 to 32 or 34, in which the carbohydrate based substrate is formed by electrospinning a chitin-based solution to form fibers.

37. A method according to any of Claims 23 to 32 or 34, in which the carbohydrate based substrate is formed by rotary spinning a carbohydrate based solution to form fibers.

38. A method according to any of Claims 23 to 37 further comprising inducing a beta transition of the protein.

39. A method according to Claim 38, in which the beta transition is induced by treating the protein with one or more of the following agents including alcohols, organic solvents, aqueous solutions, or the application of stress, pressure or heat.

40. A method according to any of Claims 23 to 39 further comprising:

introducing carried material selected from the group consisting of carbon nanotubes, fiberglass, small molecules, polymers, proteins, peptides, peptidomimimetics, nucleic acids, organic compounds, inorganic compounds, crystalline material, biological compounds, biologically active compounds, compounds having biological activity, and a biological, a pharmaceutical or a therapeutic agent, and any combinations thereof, to the composite material.

41. A method according to Claim 40, in which the carried material is covalently linked to the composite material.

42. A composition of matter formed by a method according to any of Claims 23 to 41.

43. A prosthetic device comprising a composition of matter formed by a method according to any of Claims 23 to 41.

44. A tissue engineering scaffold comprising a composition of matter formed by a method according to any of Claims 23 to 41.

45. A drug delivery device comprising a composition of matter formed by a method according to any of Claims 23 to 41.

46. An implantable material comprising a composition of matter formed by a method according to any of Claims 23 to 41.

47. A material comprising a composition of matter formed by a method according to any of Claims 23 to 41 comprising minerals or crystal materials.

48. A thin clear film comprising a composition of matter formed by a method according to any of Claims 23 to 41.

49. A multi-laminate material comprising a composition of matter formed by a method according to any of Claims 23 to 41.

50. A multi-laminate material comprising a composition of matter formed by a method according to any of Claims 23 to 41 comprising additional components to provide tailored mechanical properties.

51. A material comprising a composition of matter formed by a method according to any of Claims 23 to 41 comprising a water-repelling coating material.

52. A material comprising a composition of matter formed by a method according to any of Claims 23 to 41 comprising variable regions of a water-repelling coating material to provide regions with variable flexibility.

53. A method of forming a composite laminar material comprising:

dissolving a chitin based material in an acidic solution;

forming a chitin based structure of the chitin based material by evaporating the solvent;

treating the chitin based structure with a base solution to neutralize the protonated amino groups;

washing the chitin based structure;

optionally dehydrating the chitin based structure;

applying a protein solution to the chitin based structure to produce a composite material having at least one layer of protein on the chitin based structure;

drying the protein-layer on the chitin based structure; and

treating the composite material with an alcohol based solution to induce a beta transition of the protein.

54. A method according to Claim 53, in which the ratio of chitin based material to protein is in the range of from 10:1 to 1:10.

55. A method according to Claim 53 or 54, in which the chitin based material is chitosan.

56. A method according to Claim 53, 54 or 55, in which the protein is fibroin.

57. A method according to any of Claims 53 to 56, in which the acidic solution includes acetic acid.

58. A method according to any of Claims 54 to 57, in which the base solution includes NaOH.

59. A method according to any of Claims 54 to 58, in which the alcohol based solution includes methanol.

60. A composition of matter formed by a method according to any of Claims 53 to 59.

61. Use of a transglutaminase for preparing a medicament for promoting wound healing by contacting a wound dressing to the wound, in which the wound dressing comprises a composite material of any of Claims 1 to 21.

62. A use according to Claim 61, further comprising applying a foam to the wound, in which the foam comprises a composite material according to any of Claims 1 to 21.

63. A use according to Claim 61 or 62, in which the wound is selected from the group consisting of cuts and lacerations, surgical incisions, punctures, grazes, scratches, compression wounds, abrasions, friction wounds, chronic wounds, ulcers, thermal effect wounds, chemical wounds, wounds resulting from pathogenic infections, skin graft/transplant donor and recipient sites, immune response conditions, oral wounds, stomach or intestinal wounds, damaged cartilage or bone, amputation sites and corneal lesions.

64. A use according to Claim 61, 62 or 63, in which the transglutaminase is a mammalian transglutaminase.

65. A use according to Claim 61, 62 or 63, in which the transglutaminase is a microbial transglutaminase (mTgase).

66. A use according to any of Claims 61 to 65, in which the transglutaminase is a calcium independent transglutaminase.

67. A use according to any of Claims 61 to 66, in which the transglutaminase is selected from the group consisting of Factor XIII A (fibrin stabilizing factor), Type 1 transglutaminase (keratinocyte transglutaminase,), Type 2 transglutaminase (tissue transglutaminase), Type 3 transglutaminase (epidermal transglutaminase), Type 4 transglutaminase (prostate

transglutaminase), Type 5 transglutaminase (Transglutaminase X), Type 6 transglutaminase (Transglutaminase Y), Type 7 transglutaminase (Transglutaminase Z), and any combinations thereof.

68. A use according to any of Claims 61 to 67, in which the transglutaminase is formulated in a solution, an emulsion, an aerosol, a foam, an ointment, a paste, a lotion, a powder, a gel, a hydrogel, a hydrocolloid, a microparticle, a nanoparticle, or a cream.

69. A use according to any of Claims 61 to 68, in which the wound dressing is selected from the group consisting of bandages, gauzes, tapes, meshes, nets, adhesive plasters, films, membranes, patches, and any combinations thereof.

70. A use according to any of Claims 61 to 69, in which the transglutaminase is associated with the wound dressing.

71. A use according to Claim 70, in which the transglutaminase is coated on the surface of the wound dressing.

72. A use according to Claim 70 or 71, in which the transglutaminase is non-covalently linked with the wound dressing.

73. A use according to any of Claims 61 to 72, in which the effective amount of transglutaminase is from about 1μg to about 100mg per cm^2 of wound area.

74. A use according to any of Claims 61 to 73, further comprising administering a wound healing agent to the subject.

75. A use according to Claim 74, in which the wound healing agent is selected from the group consisting of dexpanthenol; growth factors; enzymes, hormones; povidon-iodide; fatty acids; anti-inflammatory agents; antibiotics; antimicrobials; antiseptics; cytokines; thrombin; analgesics; opioids; aminoxyls; furoxans; nitrosothiols; nitrates and anthocyanins; nucleosides; nucleotides,; neurotransmitter/neuromodulators, such as acetylcholine and 5-hydroxytryptamine (serotonin/5-HT); histamine and catecholamines, such as adrenalin and noradrenalin; lipid molecules, such as sphingosine-1-phosphate and lysophosphatidic acid; amino acids, such as arginine and lysine; peptides such as the bradykinins, substance P and calcium gene-related peptide (CGRP); nitric oxide; and any combinations thereof.

76. A use according to any of Claims 61 to 75, in which the applying comprises increasing expression or activity of a host transglutaminase.

77. A use according to any of Claims 61 to 75, in which the applying is before, after or during contacting of the medical implant device or the wound dressing.