CLAIMS

~~1. A method for preparing a durable sheet material comprising fungal biomass, comprising:~~

~~(a) causing a solution to infiltrate an inactivated fungal biomass, the solution comprising a solvent and a component selected from the group consisting of a polymer, a crosslinker, and combinations and mixtures thereof; and~~

~~(b) curing the biomass to remove solvent from the biomass and form the durable sheet material.~~

~~2. The method of claim 1, wherein the fungal biomass comprises fungal mycelia.~~

~~3. The method of claim 1, wherein the inactivated fungal biomass is size-reduced prior to step (a) and wherein step (a) comprises blending the size-reduced inactivated fungal biomass with the solution to form a blended composition.~~

~~4. The method of claim 3, further comprising casting the blended composition to form a cast sheet from which solvent is removed in step (b).~~

~~5. The method of claim 3, wherein the size-reduced inactivated fungal biomass has an average particle size of no more than about 125 microns.~~

~~6. The method of claim 1, wherein the inactivated fungal biomass comprises a cohesive fungal biomass and wherein step (a) comprises agitating the inactivated fungal biomass and the solution together for a time period.~~

~~7. The method of claim 6, wherein the cohesive fungal biomass is produced by a surface fermentation process or a submerged solid surface fermentation process.~~

~~8. The method of claim 6, wherein the time period is selected from the group consisting of at least about 4 hours, at least about 5 hours, at least about 10 hours, at least about 15 hours, at least about 20 hours, or at least about 25 hours.~~

~~9. The method of claim 6, wherein the time period is between about 10 hours and about 20 hours.~~

~~10. The method of claim 6, wherein the agitating is carried out at a pressure other than atmospheric pressure.~~

~~11. The method of claim 10, wherein the pressure is sub-atmospheric pressure.~~

~~12. The method of claim 10, wherein the pressure is super-atmospheric pressure.~~

13. The method of claim 6, further comprising subjecting the inactivated fungal biomass to treatment with at least one chemical selected from the group consisting of calcium hydroxide and tannins.

14. The method of claim 1, wherein the inactivated fungal biomass comprises a fungal paste produced by submerged fermentation.

15. The method of claim 1, wherein the solution comprises a polymer selected from the group consisting of polyvinyl alcohol, chitosan, polyethylene glycol, alginates, starches, polycaprolactones, polyacrylic acids, hyaluronic acid, and combinations thereof.

16. The method of claim 1, wherein the solution comprises a polymer and the polymer is present in the durable sheet material in an amount selected from the group consisting of no more than about 25 wt% of the durable sheet material, no more than about 20 wt% of the durable sheet material, no more than about 15 wt% of the durable sheet material, no more than about 10 wt% of the durable sheet material, and no more than about 5 wt% of the durable sheet material.

17. The method of claim 1, wherein the solution comprises a crosslinker selected from the group consisting of citric acid, tannic acid, suberic acid, adipic acid, succinic acid, extracted vegetable tannins, glyoxal, and combinations thereof.

18. The method of claim 1, wherein the solution further comprises a plasticizer.

19. The method of claim 18, wherein the plasticizer is selected from the group consisting of glycerol and esters thereof, polyethylene glycol, citric acid, oleic acid, oleic acid polyols and esters thereof, epoxidized triglyceride vegetable oils, castor oil, pentaerythritol, fatty acid esters, carboxylic ester-based plasticizers, trimellitates, adipates, sebacates, maleates, biological plasticizers, and combinations thereof.

20. The method of claim 1, wherein the fungal biomass comprises at least one filamentous fungus belonging to an order selected from the group consisting of *Ustilaginales*, *Russulales*, *Agaricales*, *Pezizales*, and *Hypocreales*.

21. The method of claim 1, wherein the fungal biomass comprises at least one filamentous fungus belonging to a family selected from the group consisting of *Ustilaginaceae*, *Hericiaceae*, *Polyporaceae*, *Grifolaceae*, *Lyophyllaceae*, *Strophariaceae*, *Lycoperdaceae*, *Agaricaceae*, *Pleurotaceae*, *Physalacriaceae*, *Omphalotaceae*, *Tuberaceae*, *Morchellaceae*, *Sparassidaceae*, *Nectriaceae*, and *Cordycipitaceae*.

22. The method of claim 1, wherein the fungal biomass comprises at least one filamentous fungus belonging to a genus selected from the group consisting of *Agaricus*,

Calocybe, *Calvatia*, *Cordyceps*, *Disciotis*, *Fomes*, *Fusarium*, *Ganoderma*, *Grifola*, *Hericulum*, *Hypholoma*, *Hypsizygus*, *Morchella*, *Pholiota*, *Pleurotus*, *Polyporous*, *Sparassis*, *Stropharia*, *Tuber*, and *Ustilago*.

23. The method of claim 1, wherein the fungal biomass comprises at least one filamentous fungus selected from the group consisting of *Ustilago esculenta*, *Hericulum erinaceus*, *Polyporous squamosus*, *Grifola fondosa*, *Hypsizygus marmoreus*, *Hypsizygus ulmarius*, *Calocybe gambosa*, *Pholiota nameko*, *Calvatia gigantea*, *Agaricus bisporus*, *Stropharia rugosoannulata*, *Hypholoma lateritium*, *Pleurotus eryngii*, *Pleurotus ostreatus*, *Pleurotus ostreatus* var. *columbinus*, *Tuber borchii*, *Morchella esculenta*, *Morchella conica*, *Morchella importuna*, *Sparassis crispa*, *Fusarium venenatum*, MK7 ATCC Accession Deposit No. PTA-10698, *Disciotis venosa*, and *Cordyceps militaris*.

24. The method of claim 1, wherein the solution further comprises at least one of a pigment, a solubilizer, and a pH adjusting agent.

25. The method of claim 24, wherein the solution comprises a solubilizer selected from the group consisting of hydrochloric acid, acetic acid, formic acid, lactic acid, and combinations and mixtures thereof.

26. The method of claim 24, wherein the solution comprises a pH adjusting agent selected from the group consisting of hydrochloric acid, acetic acid, formic acid, lactic acid, and combinations and mixtures thereof.

27. The method of claim 1, wherein the durable sheet material comprises proteins crosslinked with isopeptide bonds.

28. The method of claim 1, further comprising at least one of (i) adding a thermal dopant to the inactivated fungal biomass and (ii) adding a thermal dopant to the durable sheet material after step (b).

29. The method of claim 28, wherein an amount of the thermal dopant is selected from the group consisting of at least about 2.5 wt% of the durable sheet material, at least about 5 wt% of the durable sheet material, at least about 7.5 wt% of the durable sheet material, at least about 10 wt% of the durable sheet material, at least about 12.5 wt% of the durable sheet material, at least about 15 wt% of the durable sheet material, and at least about 17.5 wt% of the durable sheet material.

30. The method of claim 28, wherein an amount of the thermal dopant is selected from the group consisting of no more than about 20 wt% of the durable sheet material, no more than about 17.5 wt% of the durable sheet material, no more than about 15 wt% of the

~~durable sheet material, no more than about 12.5 wt% of the durable sheet material, no more than about 10 wt% of the durable sheet material, no more than about 7.5 wt% of the durable sheet material, and no more than about 5 wt% of the durable sheet material.~~

~~31. The method of claim 28, wherein the thermal dopant is selected from the group consisting of a ceramic material, a metallic material, a polymeric material, and combinations thereof.~~

~~32. The method of claim 28, wherein the thermal dopant is selected from the group consisting of activated charcoal, aluminum oxide, bentonite, diatomaceous earth, ethylene vinyl acetate, lignin, nanosilica, polycaprolactone, polylactic acid, silicone, and yttrium oxide.~~

~~33. The method of claim 1, wherein the inactivated fungal biomass is a size-reduced inactivated fungal biomass.~~

~~34. The method of claim 1, wherein the inactivated fungal biomass comprises a biomat, or portion thereof, produced by a surface fermentation process.~~

~~35. The method of claim 1, wherein the inactivated fungal biomass was grown on a growth medium with a carbon-to-nitrogen molar ratio between about 5 and about 20, or between about 7 and about 15.~~

1~~36~~. A textile composition, comprising:

an inactivated fungal biomass; and

~~at least one component selected from the group consisting of a plasticizer,~~ a polymer, ~~a crosslinker, and a dye,~~

wherein the polymer is infiltrated into the inactivated fungal biomass to a fungal biomass:polymer loading ratio of between about 25:75 and about 75:25, and

wherein the textile composition has a tensile strength of at least about 2 MPa~~at least one component is distributed in the fungal mycelial biomass~~.

2. The textile composition of claim 1, further comprising at least one component selected from the group consisting of a plasticizer, a crosslinker, and a dye, wherein the polymer and the at least one component are distributed in the inactivated fungal biomass.

3~~37~~. The textile composition of claim ~~36~~1 or 2, having a thickness of at least about 1 mm.

4~~38~~. The textile composition of any one of claims 1-3~~claim 36~~, having a tear force of at least about 30 N.

5~~39~~. The textile composition of any one of claims 1-4~~claim 36~~, having a tear strength of at least about 10 N/mm.

6~~40~~. The textile composition of any one of claims 1-5~~claim 36~~, having a flexural rigidity of no more than about 5 gram-centimeters.

7~~41~~. The textile composition of any one of claims 1-6~~claim 36~~, ~~having a~~wherein the tensile strength of the textile composition is between about 2 MPa and about 8 MPa~~at least about 10 MPa~~.

8~~42~~. The textile composition of any one of claims 1-7~~claim 36~~, having a water spotting grey scale rating of at least about 3.

9~~43~~. The textile composition of any one of claims 1-8~~claim 36~~, having a light color fastness blue wool rating of at least about 4.

10~~44~~. The textile composition of any one of claims 1-9~~claim 36~~, having a rub color fastness grey scale rating, when dry, of at least about 3.

11~~45~~. The textile composition of any one of claims 1-10~~claim 36~~, having a rub color fastness grey scale rating, when wet, of at least about 2.

12. The textile composition of any one of claims 1-11, having a strain at break of between about 75% and about 275%.

13. The textile composition of any one of claims 1-12, having a degree of swelling of between about 200% and about 450%.

14. The textile composition any one of claims 1-13, having a mass loss upon soaking of between about 20% and about 60%.

~~46. The textile composition of claim 36, further comprising at least one backing layer of a non-fungal textile material.~~

15. A textile composition, comprising:

an inactivated fungal biomass;

a polymer; and

at least one backing layer of a non-fungal textile material,

wherein the polymer is infiltrated into the inactivated fungal biomass to a fungal biomass:polymer loading ratio of between about 25:75 and about 75:25.

16~~47~~. The textile composition of claim 15~~46~~, wherein the non-fungal textile material is selected from the group consisting of an acrylic textile, an alpaca textile, an angora textile, a cashmere textile, a coir textile, a cotton textile, an eisengarn textile, a hemp textile, a jute textile, a Kevlar textile, a linen textile, a microfiber textile, a mohair textile, a

nylon textile, an olefin textile, a pashmina textile, a polyester textile, a piña textile, a ramie textile, a rayon textile, a sea silk textile, a silk textile, a sisal textile, a spandex textile, a spider silk textile, a wool textile, and combinations and mixtures thereof.

17. The textile composition of claim 15 or 16, further comprising at least one component selected from the group consisting of a plasticizer, a crosslinker, and a dye, wherein the polymer and the at least one component are distributed in the inactivated fungal biomass.

18. The textile composition of any one of claims 15-17, having a tear force of at least about 30 N.

19. The textile composition of any one of claims 15-18, having a tear strength of at least about 10 N/mm.

20. The textile composition of any one of claims 15-19, having a flexural rigidity of no more than about 5 gram-centimeters.

21. The textile composition of any one of claims 15-20, wherein the tensile strength of the textile composition is between about 2 MPa and about 8 MPa.

22. The textile composition of any one of claims 15-21, having a water spotting grey scale rating of at least about 3.

23. The textile composition of any one of claims 15-22, having a rub color fastness grey scale rating, when dry, of at least about 3.

24. The textile composition of any one of claims 15-23, having a strain at break of between about 75% and about 275%.

25. The textile composition of any one of claims 15-24, having a degree of swelling of between about 200% and about 450%.

26. The textile composition of any one of claims 15-25, having a mass loss upon soaking of between about 20% and about 60%.

27. A textile composition, comprising:

an inactivated fungal biomass;

a polymer; and

a thermal dopant,

wherein the polymer is infiltrated into the inactivated fungal biomass to a fungal biomass:polymer loading ratio of between about 25:75 and about 75:25.

~~48. The textile composition of claim 36, further comprising a thermal dopant.~~

2849. The textile composition of claim 2748, wherein the thermal dopant is selected from the group consisting of a ceramic material, a metallic material, a polymeric material, and combinations and mixtures thereof.

2950. The textile composition of claim 2748 or 28, wherein the thermal dopant is selected from the group consisting of activated charcoal, aluminum oxide, bentonite, diatomaceous earth, ethylene vinyl acetate, lignin, nanosilica, polycaprolactone, polylactic acid, silicone, and yttrium oxide.

3051. The textile composition of any one of claims 27-29~~claim 48~~, wherein a thermal characteristic of the textile composition is altered relative to the same thermal characteristic of the textile composition in the absence of the thermal dopant, wherein the thermal characteristic is selected from the group consisting of thermal effusivity, thermal conductivity, heat capacity, and combinations thereof.

~~52. An article of manufacture, comprising the textile composition of claim 36, wherein the article of manufacture is selected from the group consisting of an article of clothing, an accessory item, and a furniture item.~~

~~53. A method for making a durable sheet material, comprising:~~

~~(a) contacting an inactivated fungal biomass with an aqueous solution comprising calcium hydroxide to form a limed inactivated fungal biomass;~~

~~(b) contacting the limed inactivated fungal biomass with an aqueous solution comprising ammonium sulfate to form a delimed inactivated fungal biomass;~~

~~(c) contacting the delimed inactivated fungal biomass with an aqueous solution comprising a polymer to form a pickled inactivated fungal biomass;~~

~~(d) contacting the pickled inactivated fungal biomass with an aqueous solution comprising a crosslinker to form a tanned inactivated fungal biomass;~~

~~(e) contacting the tanned inactivated fungal biomass with an aqueous solution comprising a plasticizer to form a plasticized inactivated fungal biomass;~~

~~(f) drying the plasticized inactivated fungal biomass to form a dried inactivated fungal biomass; and~~

~~(g) heat-pressing the dried inactivated fungal biomass to form the durable sheet material.~~

~~54. The method of claim 53, further comprising, between any pair of steps selected from the group consisting of steps (a) and (b), steps (b) and (c), steps (c) and (d),~~

and steps (d) and (e), rinsing the inactivated fungal biomass with water to remove residual aqueous solution.

55. The method of claim 53, wherein at least one of steps (a) through (e) comprises agitating the inactivated fungal biomass with the aqueous solution.

56. The method of claim 53, wherein the aqueous solution of at least one of steps (a) through (c) further comprises a surfactant or solubilizer.

57. The method of claim 56, wherein the surfactant or solubilizer is selected from the group consisting of polysorbates, hydrochloric acid, acetic acid, formic acid, lactic acid, and combinations and mixtures thereof.

58. The method of claim 53, wherein the polymer is selected from the group consisting of polyvinyl alcohol, chitosan, polyethylene glycol, alginates, starches, polycaprolactones, polyacrylic acids, hyaluronic acid, and combinations and mixtures thereof.

59. The method of claim 53, wherein the aqueous solution of step (c) further comprises a plasticizer selected from the group consisting of glycerol and esters thereof, polyethylene glycol, citric acid, oleic acid, oleic acid polyols and esters thereof, epoxidized triglyceride vegetable oils, castor oil, pentaerythritol, fatty acid esters, carboxylic ester-based plasticizers, trimellitates, adipates, sebacates, maleates, biological plasticizers, and combinations and mixtures thereof.

60. The method of claim 53, wherein the aqueous solution of step (c) further comprises an alkali metal halide.

61. The method of claim 60, wherein the alkali metal halide is sodium chloride.

62. The method of claim 53, wherein the crosslinker is selected from the group consisting of citric acid, tannic acid, suberic acid, adipic acid, succinic acid, extracted vegetable tannins, glyoxal, and combinations and mixtures thereof.

63. The method of claim 53, wherein the plasticizer is selected from the group consisting of glycerol and esters thereof, polyethylene glycol, citric acid, oleic acid, oleic acid polyols and esters thereof, epoxidized triglyceride vegetable oils, castor oil, pentaerythritol, fatty acid esters, carboxylic ester-based plasticizers, trimellitates, adipates, sebacates, maleates, biological plasticizers, and combinations and mixtures thereof.

64. A method for making a durable sheet material, comprising:

(a) inactivating a fungal biomass by boiling the biomass in water;

(b) contacting the inactivated fungal biomass with an aqueous solution comprising calcium hydroxide to form a limed inactivated fungal biomass;

(c) contacting the limed inactivated fungal biomass with an aqueous solution comprising ammonium sulfate to form a delimed inactivated fungal biomass;

(d) contacting the delimed inactivated fungal biomass with an aqueous solution comprising an alkali metal halide to form a pickled inactivated fungal biomass;

(e) contacting the pickled inactivated fungal biomass with a first crosslinker to form a tanned inactivated fungal biomass;

(f) contacting the tanned inactivated fungal biomass with an aqueous solution comprising at least one of a second crosslinker and a polymer to form a re-tanned inactivated fungal biomass;

(g) contacting the re-tanned inactivated fungal biomass with a fatliquoring oil to form a fatliquored inactivated fungal biomass;

(h) adhering a non-fungal textile backing to the inactivated fungal biomass to form a backed inactivated fungal biomass;

(i) heat-pressing the backed inactivated fungal biomass to form a heat-pressed inactivated fungal biomass;

(j) drying the heat-pressed inactivated fungal biomass to form a dried inactivated fungal biomass; and

(k) applying at least one of a finishing wax, a finishing oil, and nitrocellulose to the dried inactivated fungal biomass to form the durable sheet material.

65. The method of claim 64, further comprising, between any pair of steps selected from the group consisting of steps (b) and (c), steps (c) and (d), and steps (e) and (f), rinsing the inactivated fungal biomass with water to remove residual aqueous solution.

66. The method of claim 64, wherein at least one of steps (a) through (g) comprises agitating the inactivated fungal biomass with the aqueous solution.

67. The method of claim 64, wherein the aqueous solution of at least one of steps (b) and (c) further comprises a surfactant or solubilizer.

68. The method of claim 67, wherein the surfactant or solubilizer is selected from the group consisting of polysorbates, hydrochloric acid, acetic acid, formic acid, lactic acid, and combinations and mixtures thereof.

69. The method of claim 64, wherein the polymer is selected from the group consisting of polyvinyl alcohol, chitosan, polyethylene glycol, alginates, starches,

~~polycaprolactones, polyacrylic acids, hyaluronic acid, and combinations and mixtures thereof.~~

~~70. The method of claim 64, wherein the alkali metal halide is sodium chloride.~~

~~71. The method of claim 64, wherein the aqueous solution of at least one of steps (d) through (f) comprises a pH adjusting agent.~~

~~72. The method of claim 71, wherein the pH adjusting agent comprises hydrochloric acid, acetic acid, formic acid, lactic acid, or a combination or mixture thereof, or a metal hydroxide.~~

~~73. The method of claim 64, wherein the first crosslinker comprises an aluminum salt, a chromium salt, a titanium salt, an aldehyde, or a combination or mixture thereof.~~

~~74. The method of claim 73, wherein the first crosslinker is an aluminum silicate.~~

~~75. The method of claim 64, wherein the second crosslinker is selected from the group consisting of citric acid, tannic acid, suberic acid, adipic acid, succinic acid, extracted vegetable tannins, glyoxal, and combinations and mixtures thereof.~~

~~76. The method of claim 64, wherein the polymer is selected from the group consisting of polyvinyl alcohol, chitosan, polyethylene glycol, alginates, starches, polycaprolactones, polyacrylic acids, hyaluronic acid, and combinations and mixtures thereof.~~

~~77. The method of claim 64, wherein the aqueous solution of step (f) further comprises an anionic dye.~~

~~78. The method of claim 64, wherein the fatliquoring oil is selected from the group consisting of sulfated castor oil, beeswax, coconut oil, vegetable oil, olive oil, linseed oil, oleic acid, and combinations and mixtures thereof.~~

~~79. The method of claim 64, wherein the fatliquoring oil comprises an emulsion, wherein the method further comprises, between steps (g) and (h), contacting the fatliquoring oil with an acid to dissociate the emulsion.~~

~~80. The method of claim 64, wherein the finishing wax is selected from the group consisting of carnauba wax, candelilla wax, and combinations and mixtures thereof.~~