Claims:

~~1. A tissue repair membrane comprising a hydrogel polymer coating wherein the hydrogel polymer coating provides one or more of self-adhesion and lubrication to the tissue repair membrane.~~

~~2. The tissue repair membrane according to claim 1 wherein the hydrogel polymer is a poly-anionic polymer.~~

~~3. The tissue repair membrane according to claim 2 wherein the poly-anionic polymer is selected from the group consisting of hyaluronic acid, chondroitin, alginate, oxidized cellulose, heparin, dermatan, sulfated or otherwise modified versions of the prior polymers and combinations thereof.~~

~~4. The tissue repair membrane according to claim 2 wherein the hydrogel polymer is additionally combined with a poly-cationic polymer.~~

~~5. The tissue repair membrane according to claim 4 wherein the poly-cationic polymer is selected from the group consisting of chitosan, poly-lysine, poly-ornithine, polyhexamethylene biguanide, polyethyleneimine, diethylaminoethyl-dextran, poly(amidoamine), quaternary ammonium, otherwise modified versions of the thereof, and combinations thereof.~~

~~6. The tissue repair membrane according to claim 4, wherein the hydrogel polymer includesa poly-anionic polymer including hyaluronic acid and is additionally combined with a poly-cationic polymer including chitosan.~~

~~7. The tissue repair membrane according to claim 1 wherein the membrane is selected from human tissue and animal tissue, and combinations thereof.~~

~~8. The tissue repair membrane according to claim 1 wherein the membrane is selected from human cadaver tissue, human placental tissue, porcine tissue, ruminant tissue, films and woven or non-fabrics of natural and synthetic polymers, and combinations thereof.~~

~~9. A method of preparing a tissue repair membrane-hydrogel polymer complex comprising:~~

~~treating a membrane with a reagent to increase active chemical regions on a surface of the membrane;~~

~~treating a hydrogel polymer with a reagent to increase active chemical regions on the hydrogel polymer;~~

~~combining the treated membrane with the treated hydrogel polymer to provide a membrane-hydrogel complex.~~

~~10. The method according to claim 9 wherein the hydrogel polymer is a poly-anionic polymer.~~

~~11. The method according to claim 10 wherein the poly-anionic polymer is selected from the group consisting of hyaluronic acid, chondroitin, alginate, oxidized cellulose, heparin, dermatan, sulfated, otherwise modified versions thereof, and combinations thereof.~~

~~12. The method according to claim 10 wherein the hydrogel polymer is further combined with a poly-cationic polymer.~~

~~13. The method according to claim 12 wherein the poly-cationic polymer is selected from the group consisting of chitosan, poly-lysine, poly-ornithine, polyhexamethylene biguanide, polyethyleneimine, diethylaminoethyl-dextran, poly(amidoamine), quartenary ammonium, otherwise modified versions thereof, and combinations thereof.~~

~~14. The method according to claim 12 wherein the hydrogel polymer includes a poly-anionic polymer including hyaluronic acid and is further combined with a poly-cationic polymer including chitosan.~~

~~15. The method according to claim 9 wherein a reducing agent is added to the membrane-polymer complex to stabilize the active chemical regions of one or more of the treated membrane and the treated hydrogel polymer.~~

~~16. An apparatus~~

~~comprising:a substrate;~~

~~and~~

~~a hydrogel polymer coating on at least a portion of a surface of the substrate, wherein the hydrogel polymer coating provides adhesion and lubrication to the coated substrate.~~

~~17. The apparatus according to claim 16 wherein the hydrogel polymer is a poly-anionic polymer.~~

18. The apparatus according to claim 17 wherein the poly-anionic polymer is selected fromthe group consisting of hyaluronic acid, chondroitin, alginate, oxidized cellulose, heparin, dermatan, sulfated, otherwise modified versions thereof, and combinations thereof.

19. The apparatus according to claim 17 wherein the hydrogel polymer is additionally combined with a poly-cationic polymer.

20. The apparatus according to claim 19 wherein the poly-cationic polymer is selected fromthe group consisting of chitosan, poly-lysine, poly-ornithine, polyhexamethylene biguanide, polyethyleneimine, diethylaminoethyl-dextran, poly(amidoamine), quartenary-ammonium, otherwise modified versions thereof, and combinations thereof.

21. The apparatus according to claim 19, wherein the hydrogel polymer includes a poly-anionic polymer including hyaluronic acid and is additionally combined with a poly-cationic polymer including chitosan.

22. The apparatus according to claim 16 wherein the substrate is selected from tissue derived membrane, films and woven or non-woven fabrics of natural and synthetic polymers.

23. A method of preparing a substrate-hydrogel polymer composite comprising:

treating at least one of a substrate and a hydrogel polymer with a reagent to increase active chemical regions on the treated at least one of the substrate and the hydrogel polymer;

combining the substrate and the hydrogel polymer to react and bind the materialstogether.

24. The method according to claim 23 wherein the hydrogel polymer is a poly-anionic polymer.

25. The method according to claim 24 wherein the poly-anionic polymer is selected from the group consisting of hyaluronic acid, chondroitin, alginate, oxidized cellulose, heparin, dermatan, keratin, a sulfated version thereof, and combinations thereof.

26. The method according to claim 24 wherein the hydrogel polymer is further combined with a poly-cationic polymer in at least one area.

27. The method according to claim 26 wherein the poly-cationic polymer is selected from the group consisting of chitosan, poly-lysine, poly-ornithine, polyhexamethylene biguanide, polyethyleneimine, diethylaminoethyl-dextran, poly(amidoamine), quaternary anime versions thereof, and combinations thereof.

28. The method according to claim 26 wherein the hydrogel polymer includes a poly-anionic polymer including hyaluronic acid and is further combined with a poly-cationic polymer including chitosan in at least one area.

29. The method according to claim 23 wherein aldehyde chemistry creates imine crosslinks and a reducing agent is added to reduce the imine to an amine and stabilize binding of the treatedsubstrate and the treated hydrogel polymer.

30. A tissue repair membrane

comprising:a substrate; and

a hydrogel polymer at least partially coated on at least one surface of the substrate, the hydrogel polymer decreasing a coefficient of static friction when the hydrogel polymer is in a hydrated condition.

31. The tissue repair membrane according to claim 30, wherein the substrate comprises oneor more of: tissue derived membrane, films and woven or non-woven fabrics of natural and synthetic polymers.

32. The tissue repair membrane according to claim 30, wherein the substrate includes a small intestine submucosa sheet.

33. The tissue repair membrane according to claim 30, wherein the hydrogel polymer comprises hyaluronic acid.

34. The tissue repair membrane according to claim 30, wherein the hydrogel polymer comprises alginate.

35. The tissue repair membrane according to claim 30, wherein the hydrogel polymer comprises a combination of hyaluronic acid and alginate.

36. The tissue repair membrane according to claim 34, further comprising a divalent ion providing at least partial ionic cross-linking of the alginate.

37. The tissue repair membrane according to claim 35, further comprising a divalent ion providing at least partial ionic cross-linking of the alginate.

38. The tissue repair membrane according to claim 35, further comprising an at least partial coating of hyaluronic acid adjacent to a least a portion of the hydrogel polymer.

39. The tissue repair membrane according to claim 30, wherein the hydrogel polymer at least partially physically interpenetrates the substrate.

40. A method of preparing a tissue repair membrane comprising;

providing a substrate;

soaking the substrate in a solution including a hydrogel polymer; and

drying the substrate soaked in the solution of hydrogel polymer to provide an at leastpartial coating of dried hydrogel polymer on the substrate.

41. The method of preparing the tissue repair membrane according to claim 40, wherein the substrate comprises one or more of: tissue derived membrane, films and woven or non-woven fabrics of natural and synthetic polymers.

42. The method of preparing the tissue repair membrane according to claim 40, wherein the substrate includes a small intestine submucosa sheet.

43. The method of preparing the tissue repair membrane according to claim 40, wherein the hydrogel polymer comprises hyaluronic acid.

44. The method of preparing the tissue repair membrane according to claim 40, wherein the hydrogel polymer comprises alginate.

45. The method of preparing the tissue repair membrane according to claim 40, wherein the hydrogel polymer comprises a combination of hyaluronic acid and alginate.

46. The method of preparing the tissue repair membrane according to claim 44, further comprising adding a divalent ion providing at least partial ionic cross-linking of the alginate.

47. The method of preparing the tissue repair membrane according to claim 45, further comprising adding a divalent ion providing at least partial ionic cross-linking of the alginate.

48. The method of preparing the tissue repair membrane according to claim 45, further comprising soaking the coated substrate in a solution comprising hyaluronic acid to provide an at least partial coating of hyaluronic acid adjacent to the hydrogel polymer.

~~49. The method of preparing the tissue repair membrane according to claim 40, wherein the hydrogel polymer at least partially physically interpenetrates the substrate.~~

1. A tissue repair membrane comprising:

a tissue repair membrane substrate; and

a hydrogel polymer applied to at least a portion of a surface of the tissue repair membrane substrate, wherein the applied hydrogel polymer provides one or more of self-adhesion and lubrication to the tissue repair membrane.

2. The tissue repair membrane according to claim 1, wherein the hydrogel polymer is a poly-anionic polymer.

3. The tissue repair membrane according to claim 2, wherein the poly-anionic polymer is selected from the group consisting of hyaluronic acid, chondroitin, alginate, oxidized cellulose, heparin, dermatan, sulfated or otherwise modified versions of the prior polymers and combinations thereof.

4. The tissue repair membrane according to claim 2, wherein the hydrogel polymer is additionally combined with a poly-cationic polymer.

5. The tissue repair membrane according to claim 4, wherein the poly-cationic polymer is selected from the group consisting of chitosan, poly-lysine, poly-ornithine, polyhexamethylene biguanide, polyethyleneimine, diethylaminoethyl-dextran, poly(amidoamine), quaternary ammonium, otherwise modified versions of the thereof, and combinations thereof.

6. The tissue repair membrane according to claim 4, wherein the hydrogel polymer includes a poly-anionic polymer including hyaluronic acid and is additionally combined with a poly-cationic polymer including chitosan in at least one area..

7. The tissue repair membrane according to claim 1, wherein the tissue repair membrane substrate is selected from one of human tissue and animal tissue, and combinations thereof.

8. The tissue repair membrane according to claim 1, wherein the tissue repair membrane substrate is selected from one of human cadaver tissue, human placental tissue, porcine tissue, ruminant tissue, films and woven or non-woven fabrics of natural and synthetic polymers, and combinations thereof.

9. A method of preparing a tissue repair membrane substrate, the method comprising:

treating a tissue repair membrane substrate with a reagent to increase active chemical regions on a surface of the membrane;

treating a hydrogel polymer with a reagent to increase active chemical regions on the hydrogel polymer;

applying the hydrogel polymer to at least the portion of the surface of the tissue repair membrane substrate to form a tissue repair membrane.

10. The method according to claim 9, wherein the hydrogel polymer is a poly-anionic polymer.

11. The method according to claim 10, wherein the poly-anionic polymer is selected from the group consisting of hyaluronic acid, chondroitin, alginate, oxidized cellulose, heparin, dermatan, sulfated, otherwise modified versions thereof, and combinations thereof.

12. The method according to claim 10, wherein the hydrogel polymer is further combined with a poly-cationic polymer.

13. The method according to claim 12, wherein the poly-cationic polymer is selected from the group consisting of chitosan, poly-lysine, poly-ornithine, polyhexamethylene biguanide, polyethyleneimine, diethylaminoethyl-dextran, poly(amidoamine), quartenary ammonium, otherwise modified versions thereof, and combinations thereof.

14. The method according to claim 12, wherein the hydrogel polymer includes a poly-anionic polymer including hyaluronic acid and is further combined with a poly-cationic polymer including chitosan.

15. The method according to claim 9, further comprising adding a reducing agent to the tissue repair membrane substrate to stabilize the active chemical regions of one or both of the treated tissue repair membrane substrate and the treated hydrogel polymer.

16. A tissue repair membrane comprising:

a tissue repair membrane substrate; and

a hydrogel polymer at least partially applied on at least one surface of the tissue repair membrane substrate, the hydrogel polymer decreasing a coefficient of static friction when the hydrogel polymer is in a hydrated condition.

17. The tissue repair membrane according to claim 16, wherein the tissue repair membrane substrate is prepared from one or more of: tissue derived membrane, films and woven or non-woven fabrics of natural and synthetic polymers, and combinations thereof.

18. The tissue repair membrane according to claim 16, wherein the tissue repair membrane substrate is prepared from a small intestine submucosa sheet.

19. The tissue repair membrane according to claim 16, wherein the hydrogel polymer comprises hyaluronic acid.

20. The tissue repair membrane according to claim 16, wherein the hydrogel polymer comprises alginate.

21. The tissue repair membrane according to claim 16, wherein the hydrogel polymer comprises a combination of hyaluronic acid and alginate.

22. The tissue repair membrane according to claim 20, wherein the tissue repair membrane substrate further comprises a divalent ion providing at least partial ionic cross-linking of the alginate.

23. The tissue repair membrane according to claim 21, further comprising a divalent ion providing at least partial ionic cross-linking of the alginate.

24. The tissue repair membrane according to claim 21, further comprising an at least partial coating of hyaluronic acid adjacent to a least a portion of the hydrogel polymer.

25. The tissue repair membrane according to claim 16, wherein the hydrogel polymer at least partially physically interpenetrates the tissue repair membrane substrate.

26. A method of preparing a tissue repair membrane, the method comprising;
applying a solution including a hydrogel polymer to a tissue repair membrane substrate; and
drying the tissue repair membrane substrate, to which the solution of hydrogel polymer has been applied, to provide an at least partial coating of dried hydrogel polymer on the tissue repair membrane substrate, thereby forming the tissue repair membrane.

27. The method of preparing the tissue repair membrane according to claim 26, wherein the tissue

repair membrane substrate is prepared from one or more of: tissue derived membrane, films and woven or non-woven fabrics of natural and synthetic polymers, and combinations thereof.

28. The method of preparing the tissue repair membrane according to claim 26, wherein the tissue repair membrane substrate is prepared from a small intestine submucosa sheet.

29. The method of preparing the tissue repair membrane according to claim 26, wherein the hydrogel polymer comprises hyaluronic acid.

30. The method of preparing the tissue repair membrane according to claim 26, wherein the hydrogel polymer comprises alginate.

31. The method of preparing the tissue repair membrane according to claim 26, wherein the hydrogel polymer comprises a combination of hyaluronic acid and alginate.

32. The method of preparing the tissue repair membrane according to claim 30, further comprising adding a divalent ion providing at least partial ionic cross-linking of the alginate.

33. The method of preparing the tissue repair membrane according to claim 31, further comprising adding a divalent ion providing at least partial ionic cross-linking of the alginate.

34. The method of preparing the tissue repair membrane according to claim 29, wherein the method further comprising soaking the tissue repair membrane substrate, to which the hydrogel polymer has been applied, in a solution comprising hyaluronic acid to provide an at least partial coating of hyaluronic acid adjacent to the hydrogel polymer.

35. The method of preparing the tissue repair membrane according to claim 26, wherein the hydrogel polymer at least partially physically interpenetrates the tissue repair membrane substrate.

36. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 35, wherein the hydrogel polymer comprises about 0.5% to 5% by weight alginate and about 0.5% to 5% by weight hyaluronic acid.

37. The tissue repair membrane or method of preparing the tissue repair membrane according to claim 36, wherein the hydrogel polymer comprises 2% by weight alginate and 2% by weight hyaluronic acid.

38. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 37, wherein the tissue repair membrane substrate comprises 1 layer to 8 layers.

39. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 38, wherein the tissue repair membrane substrate comprises 2 layers to 6 layers.

40. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 39, wherein the tissue repair membrane substrate comprises 2 layers to 4 layers.

41. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 40, wherein the tissue repair membrane substrate comprises 4 layers.

42. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 41, wherein a degree of substitution of the hydrogel polymer is about 1% to about 100%.

43. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 42, wherein the degree of substitution of the hydrogel polymer is approximately 5%.

44. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 41, wherein a level of linkage between the hydrogel polymer and the tissue repair membrane substrate is approximately every monomer, or 100% modification to every one thousand monomers (0.1% modification) within the hydrogel polymer.

45. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 44, wherein the level of linkage between the hydrogel polymer and the tissue repair membrane substrate is approximately one in twenty monomers (5% modification) to one in five monomers (20% modification).

46. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 23, wherein bonding of the hydrogel polymer to the tissue repair membrane substrate includes a technique selected from the group of: 1-Ethyl-3-(3-dimethylaminopropyl)-carbodiimide/N-hydroxysuccinimide (EDC/NHS) ester, sulfhydryl/disulfide bonding, thio-ene reaction, malemide, epoxide, imidoester, any “click” chemistry, or combinations thereof.

47. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 24, wherein the hydrogel polymer comprises a poly-anionic polymer having a molecular weight in a range from 10,000 Da to 4,000,000 Da, and the poly-cationic polymer has a molecular weight in a range of 10,000 Da to 4,000,000 Da.

48. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 25, wherein the poly-anionic polymer has a molecular weight in a range from 1,000,000 Da to 2,000,000 Da, and the poly-cationic polymer has a molecular weight in a range of 80,000 Da to 120,000 Da.

49. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 10, 15 to 48, wherein the hydrogel polymer has poly-anionic regions and poly-cationic regions which, when brought together, provide for adhesion of the tissue repair membrane to itself, with limited if any adhesion to surrounding or adjacent matter.

50. The tissue repair membrane or the method of preparing the tissue repair membrane according to claim 49, wherein the poly-anionic region provides lubrication.

51. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 10, 15 to 50, wherein an average coefficient of friction of the tissue repair membrane is less than 0.2.

52. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 10, 15 to 51, wherein a duration of the application of the hydrogel polymer to the tissue repair membrane substrate is approximately 2 minutes.

53. The tissue repair membrane or the method of preparing the tissue repair membrane according to any one of claims 1 to 10, 15 to 52, wherein applying of the hydrogel polymer is achieved by one or more of soaking; coating; substantially coating; grafting; submerging; hydrating; and saturating the tissue repair membrane substrate with the hydrogel polymer.