[0012] In some embodiments, the print head is configured to produce a constant mass flow rate through the dispensing channel. In some embodiments, a system further comprises a crosslinking component. In some embodiments, the crosslinking component comprises a UV lamp. In some embodiments, the crosslinking component is positioned adjacent to the dispensing orifice.

[0013] Aspects of the invention include a method for generating a solidified fiber structure, the method comprising: providing a system for producing a fiber structure, the system comprising: a print head comprising: a dispensing channel comprising a distal end and a proximal end; a dispensing orifice located at the distal end of the dispensing channel; one or more material channels converging with the dispensing channel at the proximal end of the dispensing channel; a buffer solution channel converging with the one or more material channels at the proximal end of the dispensing channel; and a sheath solution channel converging with the dispensing channel at a sheath fluid convergence position that is located between the proximal end and the distal end of the dispensing channel; wherein the one or more material channels, the buffer solution channel and the sheath solution channel are in fluid communication with the dispensing channel; and wherein the print head is configured to displace one or more input materials with a buffer solution at the proximal end of the dispensing channel; a receiving surface for a receiving a first layer of material dispensed from the print head; a positioning component for positioning the dispensing orifice of the print head in 3D space, wherein the positioning component is operably coupled to the print head; a programmable control processor for controlling the positioning component and for controlling a flow rate of one or more fluids through the print head; a first fluid reservoir comprising a first input material; a second fluid reservoir comprising the buffer solution; and a third fluid reservoir comprising a sheath solution, wherein the sheath solution comprises a crosslinking solution; wherein the fluid reservoirs are in fluid communication with the print head; contacting the first input material with the sheath solution in the dispensing channel to generate the solidified fiber structure; and dispensing the solidified fiber structure from the dispensing orifice of the print head.

[0014] Aspects of the invention include a method for generating a solidified fiber structure, the method comprising: providing a system for producing a fiber structure, the system comprising: a print head comprising: a dispensing channel comprising a distal end and a proximal end; a dispensing orifice located at the distal end of the dispensing channel; one or more material channels converging with the dispensing channel at the proximal end of

the dispensing channel; a buffer solution channel converging with the one or more material channels at the proximal end of the dispensing channel; a sheath solution channel converging with the dispensing channel at a sheath fluid convergence position that is located between the proximal end and the distal end of the dispensing channel; and a crosslinking component; wherein the one or more material channels, the buffer solution channel and the sheath solution channel are in fluid communication with the dispensing channel; and wherein the print head is configured to displace one or more input materials with a buffer solution at the proximal end of the dispensing channel; a receiving surface for a receiving a first layer of material dispensed from the print head; a positioning component for positioning the dispensing orifice of the print head in 3D space, wherein the positioning component is operably coupled to the print head; a programmable control processor for controlling the positioning component and for controlling a flow rate of one or more fluids through the print head; a first fluid reservoir comprising a first input material; a second fluid reservoir comprising the buffer solution; and a third fluid reservoir comprising a sheath solution, wherein the sheath solution comprises a crosslinking solution; wherein the fluid reservoirs are in fluid communication with the print head; passing the first input material through the dispensing channel; crosslinking the first input material with the crosslinking component to generate the solidified fiber structure; and dispensing the solidified fiber structure from the dispensing orifice of the print head.

[0015] In some embodiments, the first input material is crosslinked in the dispensing channel. In some embodiments, the crosslinking component is located adjacent to the dispensing orifice, and the first input material is crosslinked as it is dispensed from the dispensing orifice.

[0016] In some embodiments, a method further comprises: encoding the programmable control processor with a planar structure to be printed; and depositing a first layer of the solidified fiber structure on the receiving surface to print the planar structure.

[0017] In some embodiments, a method further comprises: encoding the programmable control processor with a 3D structure to be printed; and depositing a subsequent layer of the solidified fiber structure on top of the planar structure to print a 3D structure.

[0018] In some embodiments, a method further comprises displacing an input material with the buffer solution in the dispensing channel to cease deposition of a solidified fiber structure comprising the input material. In some embodiments, displacing the input material

Claims:

1. A print head for producing a fiber structure, the print head comprising:

a dispensing channel comprising a distal end and a proximal end;

a dispensing orifice located at the distal end of the dispensing channel;

one or more material channels converging with the dispensing channel at the proximal end of the dispensing channel;

a buffer solution channel converging with the one or more material channels at the proximal end of the dispensing channel; and

a sheath solution channel converging with the dispensing channel at a sheath fluid convergence position that is located between the proximal end and the distal end of the dispensing channel;

wherein the one or more material channels, the buffer solution channel and the sheath solution channel are in fluid communication with the dispensing channel; and

wherein the print head is configured to displace one or more input materials with a buffer solution at the proximal end of the dispensing channel.

2. The print head according to claim 1, comprising a first and a second material channel.

3. The print head according to claim 1, wherein the sheath solution channel diverges into two or more sheath solution sub-channels at a divergence position.

4. The print head according to claim 3, wherein the two or more sheath solution sub-channels converge with the dispensing channel at the sheath fluid convergence position.

5. The print head according to claim 1, wherein each of the one or more material channels comprises a material input orifice and a control valve.

6. The print head according to claim 1, wherein the buffer solution channel comprises a buffer solution input orifice and a control valve.

7. The print head according to claim 1, wherein the sheath solution channel comprises a sheath solution input orifice and a control valve.

8. A system for producing a fiber structure, the system comprising:

a print head comprising:

a dispensing channel comprising a distal end and a proximal end;

a dispensing orifice located at the distal end of the dispensing channel;

one or more material channels converging with the dispensing channel at the proximal end of the dispensing channel;

a buffer solution channel converging with the one or more material channels at the proximal end of the dispensing channel; and

a sheath solution channel converging with the dispensing channel at a sheath fluid convergence position that is located between the proximal end and the distal end of the dispensing channel;

wherein the one or more material channels, the buffer solution channel and the sheath solution channel are in fluid communication with the dispensing channel; and

wherein the print head is configured to displace one or more input materials with a buffer solution at the proximal end of the dispensing channel;

a receiving surface for receiving a first layer of material dispensed from the print head; and

a positioning component for positioning the dispensing orifice of the print head in 3D space, wherein the positioning component is operably coupled to the print head.

9. The system according to claim 8, further comprising a programmable control processor for controlling the positioning component and for controlling a flow rate of one or more fluids through the print head.

10. The system according to claim 8, further comprising a fluid removal component that is configured to remove an excess fluid that is dispensed from the print head.

11. The system according to claim 10, wherein the fluid removal component comprises a porous membrane that is configured to allow passage of the excess fluid.

12. The system according to claim 10, wherein the fluid removal component comprises an absorbent material.

13. The system according to claim 10, wherein the fluid removal component comprises a vacuum that is configured to aspirate the excess fluid.

14. The system according to claim 13, wherein the vacuum is applied below the receiving surface.

15. The system according to claim 13, wherein the vacuum is applied above the receiving surface.

16. The system according to claim 13, wherein the vacuum is applied through one or more vacuum channels on the print head.

17. The system according to claim 16, wherein the one or more vacuum channels are positioned near the dispensing orifice on the print head.

18. The system according to claim 9, further comprising a pressure control component that is configured to regulate the flow rate of the one or more fluids through the print head.

19. The system according to claim 8, further comprising one or more fluid reservoirs that are in fluid communication with the print head.

20. The system according to claim 19, wherein a fluid reservoir comprises a sheath solution.

21. The system according to claim 20, wherein the sheath solution comprises a crosslinking solution that is configured to solidify an input material.

22. The system according to claim 21, wherein the crosslinking solution comprises a divalent cation.

23. The system according to claim 22, wherein the divalent cation is Ca^{++}.

24. The system according to claim 19, wherein a fluid reservoir comprises the buffer solution.

25. The system according to claim 24, wherein the buffer solution is miscible with an input material.

26. The system according to claim 19, wherein a fluid reservoir comprises an input material.

27. The system according to claim 26, wherein the input material comprises a hydrogel.

28. The system according to claim 27, wherein the hydrogel comprises an alginate.

29. The system according to claim 28, wherein the alginate is a depolymerized alginate.

30. The system according to claim 26, wherein the input material comprises one or more living cells.

31. The system according to claim 26, wherein the input material comprises an extra cellular matrix material.

32. The system according to claim 26, wherein the input material comprises an active agent.

33. The system according to claim 8, wherein the print head is configured to produce a constant mass flow rate through the dispensing channel.

34. The system according to claim 8, further comprising a crosslinking component.

35. The system according to claim 34, wherein the crosslinking component comprises a UV lamp.

36. The system according to claim 34, wherein the crosslinking component is positioned adjacent to the dispensing orifice.

37. A method for generating a solidified fiber structure, the method comprising:

providing a system for producing a fiber structure, the system comprising:

a print head comprising:

a dispensing channel comprising a distal end and a proximal end;

a dispensing orifice located at the distal end of the dispensing channel;

one or more material channels converging with the dispensing channel at the proximal end of the dispensing channel;

a buffer solution channel converging with the one or more material channels at the proximal end of the dispensing channel; and

a sheath solution channel converging with the dispensing channel at a sheath fluid convergence position that is located between the proximal end and the distal end of the dispensing channel;

wherein the one or more material channels, the buffer solution channel and the sheath solution channel are in fluid communication with the dispensing channel; and

wherein the print head is configured to displace one or more input materials with a buffer solution at the proximal end of the dispensing channel;

a receiving surface for a receiving a first layer of material dispensed from the print head;

a positioning component for positioning the dispensing orifice of the print head in 3D space, wherein the positioning component is operably coupled to the print head;

a programmable control processor for controlling the positioning component and for controlling a flow rate of one or more fluids through the print head;

a first fluid reservoir comprising a first input material;

a second fluid reservoir comprising the buffer solution; and

a third fluid reservoir comprising a sheath solution, wherein the sheath solution comprises a crosslinking solution;

wherein the fluid reservoirs are in fluid communication with the print head;

contacting the first input material with the sheath solution in the dispensing channel to generate the solidified fiber structure; and

dispensing the solidified fiber structure from the dispensing orifice of the print head.

38. A method for generating a solidified fiber structure, the method comprising:

providing a system for producing a fiber structure, the system comprising:

a print head comprising:

a dispensing channel comprising a distal end and a proximal end;

a dispensing orifice located at the distal end of the dispensing channel;

one or more material channels converging with the dispensing channel at the proximal end of the dispensing channel;

a buffer solution channel converging with the one or more material channels at the proximal end of the dispensing channel;

a sheath solution channel converging with the dispensing channel at a sheath fluid convergence position that is located between the proximal end and the distal end of the dispensing channel; and

a crosslinking component;

wherein the one or more material channels, the buffer solution channel and the sheath solution channel are in fluid communication with the dispensing channel; and

wherein the print head is configured to displace one or more input materials with a buffer solution at the proximal end of the dispensing channel;

a receiving surface for a receiving a first layer of material dispensed from the print head;

a positioning component for positioning the dispensing orifice of the print head in 3D space, wherein the positioning component is operably coupled to the print head;

a programmable control processor for controlling the positioning component and for controlling a flow rate of one or more fluids through the print head;

a first fluid reservoir comprising a first input material;

a second fluid reservoir comprising the buffer solution; and

a third fluid reservoir comprising a sheath solution, wherein the sheath solution comprises a crosslinking solution;

wherein the fluid reservoirs are in fluid communication with the print head;

passing the first input material through the dispensing channel;

crosslinking the first input material with the crosslinking component to generate the solidified fiber structure; and

dispensing the solidified fiber structure from the dispensing orifice of the print head.

39. The method according to claim 38, wherein the first input material is crosslinked in the dispensing channel.

40. The method according to claim 38, wherein the crosslinking component is located adjacent to the dispensing orifice, and wherein the first input material is crosslinked as it is dispensed from the dispensing orifice.

41. The method according to any one of claims 37-40, further comprising:

encoding the programmable control processor with a planar structure to be printed; and

depositing a first layer of the solidified fiber structure on the receiving surface to print the planar structure.

42. The method according to claim 41, further comprising:

encoding the programmable control processor with a 3D structure to be printed; and

depositing a subsequent layer of the solidified fiber structure on top of the planar structure to print a 3D structure.

43. The method according to any one of claims 37-42, further comprising displacing an input material with the buffer solution in the dispensing channel to cease deposition of a solidified fiber structure comprising the input material.

44. The method according to claim 43, wherein displacing the input material with the buffer solution in the dispensing channel comprises maintaining a constant mass flow rate in the dispensing channel.

45. The method according to any one of claims 37-42, further comprising displacing the buffer solution with an input material in the dispensing channel to commence deposition of a solidified fiber structure comprising the input material.

46. The method according to claim 45, wherein displacing the buffer solution with the input material in the dispensing channel comprises maintaining a constant mass flow rate in the dispensing channel.

47. The method according to any one of claims 37-40, wherein the system further comprises a fourth fluid reservoir comprising a second input material, and wherein the method comprises generating a solidified fiber structure that comprises the second input material.

48. The method according to claim 47, further comprising displacing the first input material with the second input material in the dispensing channel to generate a solidified fiber structure that comprises a transition from the first input material to the second input material.

49. The method according to claim 48, wherein displacing the first input material with the second input material in the dispensing channel comprises maintaining a constant mass flow rate in the dispensing channel.

50. The method according to claim 47, further comprising simultaneously dispensing the first and the second input materials to generate a solidified fiber structure that comprises a mixture of the first and second input materials.