at low flow rates such as those generated within a syringe. Therefore, improved systems, devices, and methods are desirable.

SUMMARY

[006] The instant disclosure provides a novel class of hemostats, and methods of manufacturing thereof, for use in methods for establishing local hemostasis. Disclosed examples provide an essentially thrombin-free fibrin composition, and methods of manufacture and use thereof, said methods comprising heterogeneous catalysis.

[007] Use of heterogeneous instead of homogeneous catalysis enables the use of a single syringe or container, and eliminates the complications associated with managing parameters such as viscosity and back pressure. Through the use of disclosed examples, mixing of fibrinogen and thrombin is no longer required, thus simplifying the administration of a fibrin glue such as TISSEEL® to a single syringe. Further, viscosity is no longer problematic, as fibrinogen can be directly diluted to obtain 50 mg/ml formulations. Because the solution viscosity is low, fibrin produced with heterogeneous catalysis can be easily sprayed and delivered, for example through a catheter. For example, the viscosity of the produced fibrin composition can be, for example, 90cps, 80cps, 70cps, 60cps, 50cps, 40cps, 30cps, 20cps, 10cps, 5cps, 1cps, or the like.

[007a] In one aspect, the present disclosure provides a method of preparing a liquid fibrin composition, said method comprising passing a fibrinogen solution over a dry solid phase substrate comprising thrombin, wherein the liquid fibrin composition has a viscosity of 50 cps or less, and wherein said liquid fibrin composition comprises less than 2 IU thrombin per mL.

[007b] In another aspect, the present disclosure provides a liquid hemostatic material comprising fibrin, wherein said composition comprises less than 2 IU thrombin per mL and has a viscosity of 50, 40, 30, 20, 10, 5 or 1 cps.

[007c] In another aspect, the present disclosure provides a kit for use in establishing local hemostasis, comprising;

a fibrinogen composition;

a dry solid substrate comprising thrombin adsorbed to the surface of the substrate;

and at least one administration device, buffer solution, syringe, tube, catheter, forceps, scissors, sterilizing pad or lotion.

[008] In examples, adsorption of thrombin can be performed on the inner wall of ancillaries, for example devices and equipment such as tubes, pipes, vessels, and the like, that can be connected to a syringe, for example the luer of a syringe, containing the fibrinogen solution.

[009] In examples, the need for calcium chloride in forming a fibrin clot is eliminated.

[010] Examples disclosed herein comprise methods of adsorbing thrombin on to a surface.

[011] Examples disclosed herein comprise methods of producing an essentially thrombin-free fibrin using heterogeneous catalysis.

[012] Examples disclosed herein comprise compositions comprising an essentially thrombin-free fibrin.

CLAIMS

1. A method of preparing a liquid fibrin composition, said method comprising passing a fibrinogen solution over a dry solid phase substrate comprising thrombin, wherein the liquid fibrin composition has a viscosity of 50 cps or less, and wherein said liquid fibrin composition comprises less than 2 IU thrombin per mL.

2. The method of claim 1, wherein said liquid fibrin composition comprises less than 1 IU thrombin per mL.

3. The method of claim 1, wherein said liquid fibrin composition comprises less than 0.5 IU thrombin per mL.

4. The method of claim 1, wherein said liquid fibrin composition comprises less than 0.25 IU thrombin per mL.

5. The method of claim 1, wherein said liquid fibrin composition comprises less than 0.125 IU thrombin per mL.

6. A liquid hemostatic material comprising fibrin, wherein said composition comprises less than 2 IU thrombin per mL and has a viscosity of 50, 40, 30, 20, 10, 5 or 1 cps.

7. The liquid hemostatic material of claim 6, wherein said composition comprises less than 1 IU thrombin per mL.

8. The liquid hemostatic material of claim 7, wherein said composition comprises less than 0.5 IU thrombin per mL.

9. The liquid hemostatic material of claim 8, wherein said composition comprises less than 0.25 IU thrombin per mL.

10. The liquid hemostatic material of claim 9, wherein said composition comprises less than 0.125 IU thrombin per mL.

11. The liquid hemostatic material of claim 10, wherein said composition comprises less than 0.0625 IU thrombin per mL.

12. A kit for use in establishing local hemostasis, comprising;

a fibrinogen composition;

a dry solid substrate comprising thrombin adsorbed to the surface of the substrate;

and at least one administration device, buffer solution, syringe, tube, catheter, forceps, scissors, sterilizing pad or lotion.