Claims

1. A device for collecting and storing blood from a subject, the device comprising:

a housing comprising a recess having an opening;

a vacuum chamber in the housing, the vacuum chamber having an initial state of a vacuum and configured such that activation of the vacuum causes fluidic communication to be established between the vacuum chamber and the recess to draw skin of the subject into the recess, and the recess serves as a suction cavity for drawing the skin, the recess comprising a size or shape configured to enable an increased volume of the blood to be collected under increased capillary pressure differential, the increased volume of the blood being dependent on a volume and/or surface area of the skin that is drawn into the recess;

one or more piercing elements that are extendable through the opening to penetrate the skin of the subject to enable collection of the blood while the skin is drawn into the recess; and

a cartridge that is releasably coupled to the housing, wherein the cartridge is configured to hold one or more matrices for collecting and storing the blood.

2. The device of claim 1, wherein the initial state of the vacuum in the vacuum chamber comprises a pressure ranging from -4psig (73745.97 Pa) to -15psig (-2096.36 Pa).

3. The device of claim 1, wherein the device is configured to draw and collect the blood from the subject at an average flowrate of at least 30µL/min after penetration by the one or more piercing elements.

4. The device of claim 1, wherein the device is configured to draw and collect the blood at an average flowrate of at least 150µL/min, and to maintain the average flowrate until at least 150µL of the blood has been collected.

5. The device of claim 1, wherein upon activation of the vacuum from the vacuum chamber, (1) a pressure of the vacuum and (2) the recess comprising the size or shape are configured to permit the skin to substantially conform to the recess, such that a surface of the recess is substantially in contact with the skin drawn into the recess.

6. The device of claim 1, wherein a surface area of the recess is at least ten times greater than an area of the opening.

7. The device of claim 6, wherein the surface area of the recess ranges from 75mm^2 to 2900mm^2, and the area of the opening ranges from 1.5mm^2 to 30mm^2.

8. The device of claim 1, wherein an area of the skin directly under the opening is at least 1.5 times smaller than a total area of the skin drawn into the recess.

9. The device of claim 8, wherein the area of the skin directly under the opening is at least 5 times smaller than the total area of the skin drawn into the recess.

10. The device of claim 1, wherein the recess comprises a concave cavity comprising a volume ranging from 1.0 cm^3 to 5.0 cm^3.

11. The device of claim 1, wherein the recess is in the shape of a spherical cap comprising a base diameter ranging from 10mm to 60mm and a height ranging from 3mm to 30 mm.

12. The device of claim 11, wherein the opening is at an apex of the spherical cap.

13. The device of claim 1, wherein the recess comprises one or more fillets configured to improve vacuum suction to the skin and reduce vacuum leak.

14. The device of claim 13, wherein the one or more fillets extends continuously along a periphery of the recess.

15. The device of claim 13, wherein the one or more fillets is in contact with the skin when the skin is drawn into the recess.

16. The device of claim 1, wherein the skin is drawn into the recess by the vacuum and completely fills the recess in less than 1 second.

17. The device of claim 1, wherein the device is supported and held in place on the skin of the subject with aid of an adhesive and the vacuum.

18. The device of claim 1, wherein the device is configured to collect the blood at a rate that is dependent on the size or shape of the recess and/or vacuum pressure.

19. The device of claim 1, wherein the device is capable of collecting at least 175uL of blood from the subject in less than 3 minutes.

20. The device of claim 1, wherein the device is configured for use on an upper portion of the subject's arm in a position or orientation that enhances the collection of the blood with aid of gravity.

21. The device of claim 1, wherein the vacuum is activated by breaking a barrier provided on a wall of the vacuum chamber, and wherein the fluidic communication between the vacuum chamber and the recess is established when the barrier is broken.

22. The device of claim 1, wherein the vacuum chamber comprises a septum through which air is drawn out of the vacuum chamber to provide the initial state of vacuum.

23. The device of claim 1, wherein the housing comprises a cartridge chamber configured to receive the cartridge, wherein the cartridge is releasably coupled to the cartridge chamber.

24. The device of claim 23, wherein the cartridge is releasably coupled to the cartridge chamber via a quick release mechanism.

25. The device of claim 1, wherein a volume of the skin enclosed by the recess under vacuum ranges from 0.4 cm^3 to 4.0 cm^3, and a surface area of the skin in contact with the recess ranges from 3.2 cm^2 to 7.2 cm^2.