LONG-TERM STORAGE AND PROPORTIONAL DISPENSING DEVICE

TECHNICAL FIELD

[0001] The subject matter disclosed herein is generally directed to microfluidic device components. More specifically, to microfluidic device components that can function as valves, pumps, and/or storage compartments for onboard storage and metered release of reagents on a microfluidic device.

BACKGROUND

[0002] "A successful microfluidic diagnostic technology will be self-calibrating, carrying all necessary reagents to run positive and negative controls along with it."[1] In microfluidics, reagents are so far dispensed by tedious manual pipetting or automated but expensive and immobile systems. Therefore, on-board pre-storage of reagents is indispensable to the automation of clinical tasks and accelerates the commercialization of Lab On Chip (LOC) systems. A variety of microfluidics operations e.g., switching [2-4], mixing [5, 6], metering [5, 7], etc., with the least amount of human intervention can be performed by implementing a reproducible, robust and reliable on-board pre-storage system. However, perhaps due to the challenge included, the majority of researchers have disregarded the on-board storage of reagents on LOC systems. The nature of reagents used in these systems include a wide range of dried to substances of high wettability (a comprehensive list of reagents is found in [8]).

[0003] In general, pre-stored reagents require compartments (i.e., directly embedded) or containers (i.e., separately placed) into LOC systems that are able to enclose the reagents and release them on call. There are also other complex, rather expensive and therefore less favorable mechanisms such as using pipetting robots, and mounting rotatable containers on centrifugal microfluidics [9, 10].

[0004] While offering simplicity and ease of fabrication, the use of compartment embedded in the systems require a hermetic sealing. In this regard, the phase change valves are reliable but not resealable valves which, require external power sources to actuate e.g., fast-actuated paraffin and ferrowax valves where the solid phase is melted by laser irradiation [11-13]. They have been used to pre-store and release highly reactive bromine water as well as to sequential release of reagents by employing different waxes of differing melting temperatures [12, 13]. However, requiring external power sources and inability to reseal the

CLAIMS

1. A device component, comprising:

a core material that is press fit within one or more layers of an elastic and/or flexible sheath material such that the elastic and/or flexible sheath material fully or partially covers the core material, wherein the device has a size suitable for use as a component of a clinical, medical, medicinal, and/or microfluidic device.

2. The device component of claim 1, wherein the core material comprises one or more elastic and/or flexible materials, one or more non-elastic materials, or a combination thereof, wherein a surface of the core material is grooved, physically and/or chemically modified, comprises one or more indentations, wherein the core material is insulated, or a combination thereof.

3. The device component of claim 1, wherein the core material is shaped as a cylinder, cube, cuboid, polyhedral, disc, capsule or sphere, or the core material is opaque, translucent, transparent, or comprises different portions that are individually opaque, translucent, or transparent.

4. The device component of claim 1, wherein the core material comprises one or more internal compartments, wherein the one or more internal compartments is optionally accessible by one or more openings through one or more sides of the core material and/or optionally each internal compartment has a volume of approximately 5 microliter to approximately 10 milliliter.

5. The device component of claim 4, wherein the one or more internal compartments further comprises a mechanical actuator that is optionally a piston attached to a solid shaft or a spring.

6. The device component of claim 4, wherein each compartment is the same size or a different size, wherein a surface of one or more core materials are grooved or comprise one or more indentations, physically and/or chemically modified, wherein the core material is insulated, or a combination thereof.

7. The device component of claim 1, wherein the elastic and/or flexible sheath material comprises latex, synthetic rubber, silicone rubber, thermoplastic elastomers, natural rubber, a bio-compatible rubber like material, polymeric material, or has a thickness of approximately 0.1 mm to approximately 10 mm.

8. The device component of claim 1, further comprising a filter material between the core material and the elastic and/or flexible sheath material, a filter material between each internal compartment or a combination thereof.

9. A device comprising one or more of the components of claim 1 and optionally connected to an actuator to apply pressure to the core material.

10. The device of claim 9, wherein the device is a centrifugal device and/or the device component is actuated by application of a centrifugal force to the device component.

11. The device component of claim 9, wherein the elastic and/or flexible sheath comprises a spongy or permeable elastic material configured to cause the device to function as a spray valve and/or comprises a core material that is hollow or semi-hollow.

12. A device comprising one or more of the components of claim 11.

13. The device of claim 12, wherein each component is connected to an actuator, or wherein the device is a centrifugal device and/or the device component is actuated by application of a centrifugal force to the device component.

14. The device component of claim 1, wherein the elastic and/or flexible sheath material comprises an elastic material having the Young's modulus of range of between 10 MPa and 1 GPa, or the core material comprises one or more components that are fully or partially filled of liquid.

15. A device comprising one or more device components of claim 14.

16. The device of claim 15, wherein each device component is connected to an actuator or the device is a centrifugal device and the device component is actuated by application of a centrifugal force to the device component.

17. A device storage container, comprising

one or more device components of claim 4, and wherein optionally the one or more internal compartments each has a volume of approximately 5 microliter to approximately 10 mL.

18. A device comprising one or more of the storage containers as defined in claim 17.

19. The device of claim 18, wherein the one or more storage containers are connected to an actuator, wherein application of force to the core material deforms the elastic and/or flexible sheath material allowing release of materials stored in the one or more compartments via the one or more holes in the core material or a centrifugal microfluidic device, wherein application of a centrifugal force to the core material inflates the elastic and/or flexible sheath material allowing release of materials stored in the one or more compartments via the one or more holes in the core material.

20. A method for storing and releasing reagents on devices, comprising:

providing a device comprising one or more of the storage containers as defined in claim 17, the storage containers comprising reagents to be stored and released during operation of the device;

releasing at least a portion of one or more reagents stored in the one or more containers by applying a pressure to the core material to unseal the one or more openings in the core

material by actuating a separation of the elastic and/or flexible sheath material from the core material; and

resealing the one or more containers by releasing the pressure applied to the core material thereby allowing the elastic and/or flexible sheath material to seal the one or more openings in the core material.

21. A device filter comprising:

the device component of claim 1 and a porous elastic and/or flexible sheath material with a pore size of between 0.01 μm to 100 μm, the elastic and/or flexible sheath material comprising one or more of latex, synthetic rubber, and/or thermoplastic elastomers.

22. A device comprising one or more filters according to claim 21.

23. A device filter comprising:

the device component of claim 1, the core material comprising two or more internal compartments, each compartment separated by a porous filter material, and one or more apertures providing access to a terminal compartment at either end of the core material to facilitate entry into and out of the two or more internal compartments and wherein the porous filter material is optionally located between each internal compartment has a different pore size and/or comprises a different porous filter material.

24. A device comprising one or more filters according to claim 23 and wherein the device is optionally a centrifugal device.

25. A method for separating plasma from blood comprising:

introducing whole blood into the device component of claim 1 or claim 4;

sealing the device component for a time sufficient to allow plasma to separate from the red and white blood cells, or sealing the device component and applying a centrifugal force to separate the plasma from the red or white blood cells; and

optionally pumping or pushing the separated plasma and/or white cells, and/or buffy coat out one or more apertures of the device component.