

Patent Claims

1. Microfluidic flow filtration system for increasing the concentration of components contained in a fluid sample having a fluid circuitry-~~(1)~~,
5 the fluid circuitry-~~(1)~~ comprising the following elements:
- a tangential flow filtration element ~~(7)~~ having a feed inlet-~~(12)~~, a retentate outlet-~~(13)~~, a permeate outlet ~~(14)~~ and a membrane ~~(15)~~ capable for separating the fluid sample into a retentate stream and a permeate stream upon passage of the fluid sample into the tangential flow filtration element ~~(7)~~ through the feed inlet-~~(12)~~,
 - an element for pumping for creating and driving a fluid flow of the fluid sample through the fluid circuitry ~~(1)~~ and the tangential flow filtration element-~~(7)~~,
 - at least two elements for obtaining information about the properties of the fluid sample within the fluid circuitry-~~(1)~~; and
 - a plurality of conduits ~~(24)~~ connecting the elements to the fluid circuitry ~~(1)~~ through which a fluid stream of the fluid sample is conducted;
- 15 wherein
- a minimal working volume of the fluid circuitry ~~(1)~~ being defined by the minimal fluid volume retained in the elements and the conduits ~~(24)~~, such that the fluid can be recirculated in the fluid circuitry ~~(1)~~ without pumping air through the fluid circuitry-~~(1)~~,
 - the minimal working volume of the fluid circuitry ~~(1)~~ is at most 5 ml,
 - the functionality of at least two elements of the group of elements of the circuitry ~~(1)~~ is integrated in one integrated microfluidic element ~~(20)~~,
 - the one integrated microfluidic element ~~(20)~~ defines a volume element having a volume which is at most one fourth of the minimal working volume of the fluid circuitry-~~(1)~~.
- 20
- 25

- the integrated microfluidic element integrates the functionality of at least two elements for obtaining information about the properties of the fluid sample,
 - and
 - one element for obtaining information about the properties is an optical measuring element for determining the concentration of the components contained in the fluid sample and
 - one element for obtaining information about the properties is a measuring element for determining the viscosity of the fluid sample.
2. Microfluidic flow filtration system according to claim 1, wherein characterized in that ~~the integrated microfluidic element (20) integrates the functionality of at least two elements for obtaining information about the properties of the fluid sample,~~
- wherein
- ~~— preferably one element for obtaining information about the properties is an optical measuring element for determining the concentration of the components contained in the fluid sample and one element for obtaining information about the properties is a measuring element for determining the viscosity of the fluid sample, and~~
 - ~~— further preferably the optical measuring element for determining the concentration is a cuvette (6) and/or the measuring element for determining the viscosity is at least one element for determining pressure preferably in combination with a capillary channel element.~~
3. Microfluidic flow filtration system according to claim 1, wherein characterized in that ~~the integrated microfluidic element (20) provides the functionality~~
- ~~of a cuvette (6) or a capillary channel element for determining the concentration, preferably in form of a transparent capillary (28), and~~

- of at least one pressure sensor ~~(26, 27)~~, preferably of at least two pressure sensors ~~(26, 27)~~, for determining the viscosity.
- 5 4. Microfluidic flow filtration system according to claim 1, wherein ~~characterized in that~~ the integrated microfluidic element ~~(20)~~ provides the functionality of at least one element for determining pressure, preferably a pressure sensor, and the tangential flow filtration element ~~(7)~~.
- 10 5. Microfluidic flow filtration system according to any of the preceding claims, wherein ~~characterized in that~~ the integrated microfluidic element ~~(20)~~ having a housing and the tangential flow filtration element ~~(7)~~ having a TFF-housing which is part of the housing of the microfluidic element ~~(20)~~,

wherein preferably the membrane of the tangential flow filtration element (7) is disposable.

6. Microfluidic flow filtration system according to any of the preceding claims, wherein~~characterized in that~~ the circuitry (1) further comprises a reservoir element (2) suitable for containing a fluid, the reservoir element (2) being integrated in the fluid circuitry (1) has at least a reservoir inlet and reservoir outlet both in connection to the circuitry (1), which is a reservoir or a tank containing the fluid sample, wherein the reservoir element (2) is also a member of the group of elements of the circuitry (1).

7. Microfluidic flow filtration system according to the preceding claims, wherein~~characterized in that~~ the volume of the reservoir (2) is at most 10 ml, preferably at most 1 ml, particularly preferably at most 0.7 ml and also particularly preferably at most 0.5 ml.

8. Microfluidic flow filtration system according to any one of the preceding claims, wherein~~characterized in that~~ the circuitry (1) further comprises

- at least a valve element (9); and/or
- a hollow fiber element; and/or
- a regulator element (8) for regulating the flow of the fluid through the fluid circuitry, which is preferably is a pump, and/or
- a pressure regulation element for regulating the pressure of the fluid in the fluid circuitry, which is preferably a valve, and/or
- an element for determining pressure data which is one or more pressure sensors (4, 5, 39); and/or
- an optical detection element (6),

wherein these elements are also members of the group of elements of the circuitry (1).

9. Microfluidic flow filtration system according to any one of the preceding claims, ~~wherein~~ characterized in that the minimal working volume of the fluid circuitry (1) is at most 1 ml, preferably at most 500 μ l, further preferably at most 200 μ l and particularly preferably at most 100 μ l.
- 5 10. Microfluidic flow filtration system according to any one of the preceding claims, ~~wherein~~ characterized in that the conduits (24) have an internal diameter of at most 1.5 mm, preferably of at most 1 mm, particularly preferably of at most 0.7 mm or also particularly preferably of at most 0.1 mm wherein a conduit (24) is preferably a channel, or a passage in
10 an element of the circuitry, or a pipe, or a tubing.
11. Integrated microfluidic element (20) for a microfluidic flow filtration system for increasing the concentration of components contained in a fluid sample with a fluid circuitry (1) having a minimal working volume of at most 5 ml, preferably for a system (100) according to any one of the
15 preceding claims,
~~wherein~~ characterized in that the integrated microfluidic element (20) defines a volume element having a volume which is at most one fourth of the minimal working volume of the fluid circuitry of the micro flow filtration system, and
20 provides the functionality of at least two elements of the group of elements of the fluid circuitry (1),
-wherein
the group of elements comprises a tangential flow filtration element (7), an element for pumping suitable for creating and driving a fluid flow and
25 at least two elements for obtaining information about the properties of the fluid sample within the circuitry,
wherein the integrated microfluidic element provides the functionality of at least two elements for obtaining information about the properties of the fluid sample,
30 wherein

the element for obtaining information about the properties of the fluid sample within the circuitry that is an optical measuring element for obtaining information about the concentration of the components contained in the fluid sample or an element for determining the physical properties of the fluid sample.

12. Integrated microfluidic element according to the preceding claim where-
in~~characterized in that~~ the at least two elements for obtaining information about the properties of the fluid sample within the circuitry ~~is~~are

- an optical measuring element for obtaining information about the concentration of the components contained in the fluid sample and/or
- an element for determining the physical properties of the fluid sample, preferably for determining the viscosity of the fluid sample.

5 13. Integrated microfluidic element according to claims 11 or 12, wherein
~~characterized in that~~ the optical measurement element is a transparent
cuvette ~~(6)~~ and the two elements for obtaining information about the
properties of the fluid sample ~~which~~ are preferably pressure sensors ~~(4,~~
5, 26, 27).

10 14. Integrated microfluidic element according to claims 11 to 13 wherein
~~characterized in that~~ it comprises the functionality of the tangential flow
filtration element ~~(7)~~ and of two elements for obtaining information about
the properties of the fluid sample, which are preferably pressure sensors
~~(4, 5, 26, 27)~~, and preferably but not mandatory in addition the function-
15 ality of the pressure regulator element ~~(8)~~.

15 15. Integrated microfluidic element according to claims 11 to 14 wherein
~~characterized in that~~ it comprises the functionality of a capillary ~~(28)~~ or
capillary channel and of two elements for obtaining information about the
properties of the fluid sample, which are preferably pressure sensors ~~(4,~~
20 5, 26, 27).