Claims

1- A biological and chemical sample processing device that
- **a.** comprises a high pressure-resistant, shallow and wide area microfluidic chamber having at least one wall formed by a detachable slide containing samples such as immobilized entities, biological samples or molecules,
- **b.** comprises an arrangement of microfluidic access holes for injecting to and collecting fluid form said chamber,
- **c.** is interfaced with inlet ports and microfluidic channels which are formed external to the chamber,
- **d.** is configured so that the slide may be brought into contact with the device to form the said chamber,
- **e.** is adapted to deliver and to transport fluidic substances and reagents inside said chamber in a fast manner, preferably within less than 15 seconds, and in a regular or uniform way owing to said arrangement of microfluidic access holes.

2- A device according to claim 1 comprising pressure-driven flow generating means for creating a fluid flow inside the chamber, i.e. which induces a pressure difference between inlets and outlets.

3- A device according to claim 1 comprising electrokinetic flow generating means for creating a fluid flow inside the chamber, by application of an electrical potential difference between any two or more points of said microfluidic chamber, said microfluidic channels and said microfluidic access holes.

4- A device according to claim 1 comprising thermally induced flow generating means for creating a fluid flow inside the chamber, i.e. by inducing fluidic flow by generation of a temperature difference between any two or more points of said microfluidic chamber, said microfluidic channels and said microfluidic access holes.

5- A device according to anyone of the previous claims which comprises a heating element and a temperature sensor to adjust and control the temperature of the fluid confined in said chamber, said microfluidic channels and said microfluidic access holes.

6- A device according to anyone of the previous claims, which incorporates light detectors and sources or an array of light detectors and sources fabricated with silicon microelectronics technology for digital imaging of entities immobilized on glass slide for bright field or fluorescent detection.

7- A device according to anyone of the previous claims which comprises microlens arrays, polarization and/or fluorescence light filters located in front of light detectors and sources or array of these light detectors and sources.

8- A method of biological and chemical sample processing performed using the device as defined regard in any of the above claims, comprising steps of:
- **a.** Obtaining said slides with entities on one or more sides manually or automatically

b. Establishing said formed chamber by incorporating said slides to said microfluidic device manually or automatically

c. Subjecting the entities on the said slides sequentially to appropriate fluidic or reactive substances during predefined periods and at predefined temperatures d. Subjecting the entities on the said slides sequentially to appropriate fluidic or reactive substances during predefined periods and at predefined temperatures for indication of detection.

9- A method according to claim 8 comprising one of the following :

a. Providing a total histochemical detection less than 10 minutes
b. Providing a histochemical detection less than 5 minutes
c. Providing a histochemical detection less than 2.5 minutes
d. Providing a cytochemical detection less than 10 minutes
e. Providing a cytochemical detection less than 5 minutes
f. Providing a cytochemical detection less than 2.5 minutes
g. Providing a staining process less than 2 minutes
h. Providing a paraffin dissolution or etching process less than 2 minutes
i. an antigen retrieval process less than 5 minutes
j. an epitope retrieval process less than 5 minutes
k. a heat induced antigen retrieval process less than 5 minutes
l. a heat induced epitope retrieval process less than 5 minutes

10- A method according to claim 8 or 9 characterized by a relatively short processing and fluidic exchange time, in such a way as to reduces non-specific indication, false positives and ambiguous results.

11- Use of a device as defined in anyone of claims 1 to 7 for subjecting entities on the surface of the slide to an appropriate fluidic or reactive substance or any sequence of appropriate fluidic reactive substances during predefined periods, said use comprising at least one of the following operations :

i. histochemical process
ii. cytochemical process
iii. an immunohistochemical process
iv. an immunocytochemical process
v. an immunohistofluorescence process
vi. an immunocytofluorescence process
vii. an in situ hybridization process
viii. a fluorescence in situ hybridization process
ix. an antigen retrieval process
x. an epitope retrieval process
xi. a heat-induced antigen retrieval process
xii. a heat-induced epitope retrieval process
xiii. a paraffin dissolution or etching process
xiv. a staining process

Claims:

1. A biological and chemical sample processing device comprising:
   a microfluidic device,
   an arrangement of microfluidic access holes in said microfluidic device for injecting to and collecting fluid from a microfluidic chamber, said arrangement of microfluidic access holes configured for advective transport of fluidic substances and reagents inside said microfluidic chamber in a uniform manner,
   inlet ports and microfluidic channels formed external to the chamber, the microfluidic channels connected to the microfluidic access holes, and a sealing ring positioned on a side of the microfluidic device, the biological and chemical sample processing device configured so that a detachable slide containing samples such as immobilized entities, biological samples or molecules may be brought into contact with the sealing ring of the microfluidic device to form said microfluidic chamber.

2. The biological and chemical sample processing device according to claim 1 comprising pressure-driven flow generating means which induces a pressure difference between inlets and outlets for creating a fluid flow inside the microfluidic chamber.

3. The biological and chemical sample processing device according to claim 1 comprising electrokinetic flow generating means for creating a fluid flow inside the microfluidic chamber, by application of an electrical potential difference between any two or more points of said microfluidic chamber, said microfluidic channels and said microfluidic access holes.

4. The biological and chemical sample processing device according to claim 1 comprising thermally induced flow generating means for creating a fluid flow inside the microfluidic chamber, i.e. by inducing fluidic flow by generation of a temperature difference between any two or more points of said microfluidic chamber, said microfluidic channels and said microfluidic access holes.

5. The biological and chemical sample processing device according to any one of the previous claims which comprises a heating element and a temperature sensor to adjust and control the temperature of the fluid confined in said microfluidic chamber, said microfluidic channels and said microfluidic access holes.

6. The biological and chemical sample processing device according to any one of the previous claims, which incorporates light detectors and sources or an array of light detectors and sources fabricated with silicon microelectronics technology for digital imaging of entities immobilized on glass slide for bright field or fluorescent detection.

7. The biological and chemical sample processing device according to any one of the previous claims which comprises microlens arrays, polarization and/or fluorescence light filters located in front of light detectors and sources or array of these light detectors and sources.

8. The biological and chemical sample processing device according to any one of the preceding claims wherein the chamber height is less than 100 pm.

9. The biological and chemical sample processing device according to any one of the preceding claims wherein said microfluidic access holes for in-flow and out-flow are located along edges of the microfluidic chamber.

10. The biological and chemical sample processing device according to the preceding claim wherein said microfluidic access holes comprise holes for in-flow arranged along an edge of the microfluidic chamber and holes for out-flow arranged along an opposite edge of the microfluidic chamber.

11. The biological and chemical sample processing device according to any one of the preceding claims wherein said microfluidic access holes extend between a top side and a bottom side of the microfluidic device, the bottom side facing the microfluidic chamber, said microfluidic channels forming a distributed network channel on the top side.

12. A method of biological and chemical sample processing performed using the biological and chemical sample processing device as defined in any one of the preceding claims, comprising steps of:

obtaining said slides with entities on one or more sides manually or automatically;
establishing said formed chamber by incorporating said slides to said microfluidic device manually or automatically;
subjecting the entities on the said slides sequentially to appropriate fluidic or reactive substances during predefined periods and at predefined temperatures;
and
subjecting the entities on said slides sequentially to appropriate fluidic or reactive substances during predefined periods and at predefined temperatures for indication of detection.

13. Use of a device as defined in any one of claims 1 to 11 for subjecting entities on the surface of the slide to an appropriate fluidic or reactive substance or any sequence of appropriate fluidic reactive substances during predefined periods, said use comprising at least one of the following operations :

i. histochemical process;
ii. cytochemical process;
iii. an immunohistochemical process;
iv. an immunocytochemical process;
v. an immunohistofluorescence process;
vi. an immunocytofluorescence process;
vii. an in situ hybridization process;
viii. a fluorescence in situ hybridization process;
ix. an antigen retrieval process;
x. an epitope retrieval process;
xi. a heat-induced antigen retrieval process;
xii. a heat-induced epitope retrieval process;
xiii. a paraffin dissolution or etching process; and
xiv. a staining process.