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(54) Microfluidic chip and connector

(57) The present invention relates to a microfluidic chip 1 and a corresponding connector 5 for connecting the microfluidic chip 1 to one or more fluid supplies or fluid discharge containers. The microfluidic chip 1 comprises at least two connection channels 2 each extending from an outer surface of the chip 1 and into the chip 1, and at least one fluid channel 3 through which fluid and/or particulate suspensions can flow through the chip 1, each of the at least one fluid channel 3 extending between and in fluid connection with two connection channels 2. The dimensions and arrangement of the connection channels 2 and the elastic properties of the chip 1 are so that a watertight connection is established between the connection channels 2 and hollow needles 7 of the connector 5 when the chip 1 is pressed onto the connector 5, the watertight connection being maintained during use.

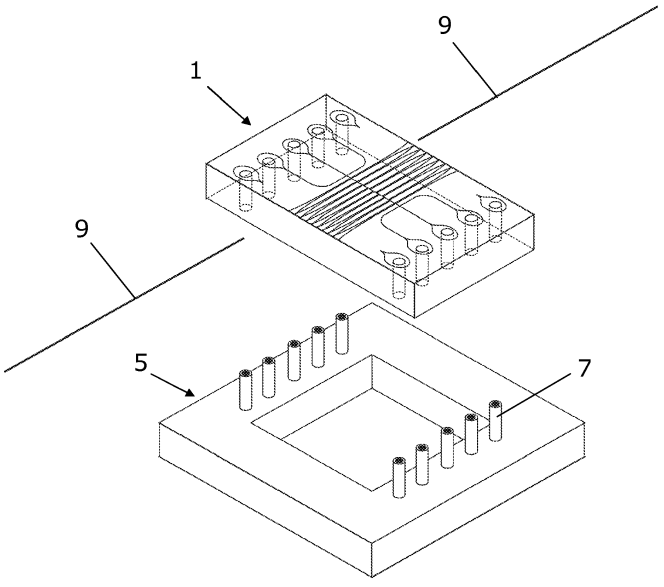


Fig. 4

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a microfluidic chip and a corresponding connector for connecting the microfluidic chip to one or more fluid supplies or fluid discharges.

BACKGROUND OF THE INVENTION

[0002] Microfluidics is a rapidly growing field relating to a number of areas both for research and for analyses in industry as well as for medical applications, e.g. for flow-cytometry, chemical analysis and environmental monitoring. The term "microfluidic" comprises lab-on-a-chip (LOC) which is a device that integrates one or several laboratory functions on a single chip typically of only millimetres to a few centimetres in size. LOCs are used for handling of extremely small fluid volumes down to less than pico litres.

[0003] Several mechanisms are known for connecting the microfluidic chips to the fluid supplies and to discharge containers. Some require specialist adaptors to be bonded directly to the chips. Others use assemblies which clamp directly onto the chip structures, but these assemblies are typically mechanically complex and can be difficult both to use and to clean after use.

[0004] Hence, an improved microfluidic chip and connector would be advantageous, and in particular such a system allowing for a more efficient connection of the chip to fluid supplies and discharge containers would be advantageous.

OBJECT OF THE INVENTION

[0005] It is an object of the present invention to provide a system for easily interfacing a microfluidic chip with fluid sources and fluid discharges.

[0006] It is another object of the present invention to provide a microfluidic chip which can be cheaply manufactured in any numbers.

[0007] It is an object of embodiments of the present invention to provide a microfluidic chip by use of which analysis comprising use of optical fibres can easily be performed.

[0008] It is a further object of the present invention to provide an alternative to the prior art.

SUMMARY OF THE INVENTION

[0009] Thus, the above described object and several other objects are intended to be obtained in a first aspect of the invention by providing a microfluidic chip comprising

- at least two connection channels each extending from an outer surface of the chip and into the chip, and
- at least one fluid channel through which fluid and/or particulate suspensions can flow through the chip, each of the at least one fluid channel extending between and in fluid connection with two connection channels,

wherein the dimensions and arrangement of the connection channels and the elastic properties of the chip are so that a watertight connection is established between the connection channels and hollow needles of a connector according to any of claims 8-9 when the chip is pressed onto the connector, the watertight connection being maintained during use.

[0010] In this context a microfluidic chip refers to a small piece of material into which small conduits are formed such that fluids can be made to flow from one part of the chip to another. The conduits are typically of cross-sectional dimensions of less than a millimetre.

[0011] The chip is preferably manually mounted on and later removed from the corresponding connector, but a system needing use of some type of tool is also covered by the scope of the present invention.

[0012] The connection channels preferably extend perpendicular to the main plane of the microfluidic chip.

[0013] The fact that the watertight connection is to be maintained during use implies that the creep properties of the material must be so that no significant relaxation of the material takes place over typical time periods of use and at typical temperatures. At the same time the elastic properties should preferably be so that it is easy to remove the chip from the connector.

[0014] The chip is preferably made from an optically clear material to allow for e.g. analysis and/or imaging by optical microscopy. It may e.g. be made from polydimethylsiloxane (PDMS). PDMS is so flexible that it can stretch so that a watertight sealing between the chip and the hollow needles of the connector can be obtained by a manual push-fit mounting of the chip on the connector. Furthermore, it is a hydrophobic material so that it does not react with the fluid being analysed to any significant extent. The actual choice of material must also take into account the fluid to be analysed to ensure that any chemical reaction between the fluid and the materials of the chip and the connector is avoided to the largest possible extent.

[0015] The at least one fluid channel may have a cross sectional dimension of 10 to 50 microns, 50 to 300 microns, or 300 to 500 microns. All fluid channels in a chip, if there are more than one, as well as all connection channels in a chip do not necessarily have the same size or shape.

[0016] The chip may comprise a plurality of fluid channels, preferably 2-20 channels, such as 2 to 5, or 5 to 10, or 10 to 20 channels. The actual number will depend on the maximum needed for the actual application. However, it is not necessary to use all fluid channels present in a chip for a given analysis. The path of the fluid channels

may be linear, linear with bends or curved.

[0017] Some embodiments of a microfluidic chip according to the present invention further comprise at least one fibre channel extending from an outer surface of the chip and ending in close proximity of a fluid channel, the at least one fibre channel being adapted to have an optical fibre inserted therein. The fibre channels are preferably straight, and they may be flared at the surface of the chip for easy insertion of optical fibres. Optical fibres can be inserted during use e.g. to deliver laser light or to monitor light signals coming from fluid being analysed by use of the chip. The fibre channels are typically arranged in the same plane as the fluid channels, but they can also extend in an inclined direction as long as they end in close proximity of a fluid channel.

[0018] In an embodiment of the present invention, the microfluidic chip comprises

- a moulded chip body in which the at least one fluid channel, the at least two connection channels, and, if present, the at least one fibre channel are partially formed, and
- an upper layer of polymer sheet fluid-tightly bonded to an upper surface of the chip body to form an upper side of the at least one fluid channel and, if present, the at least one fibre channel.

Hereby the chip can easily and cheaply be produced by a method as described below. This is particularly relevant when only a few chips with a given design are needed, which may e.g. be the case for research or prototype purposes.

[0019] A second closely related aspect of the invention relates to a connector for connecting a microfluidic chip as described above to one or more fluid supplies or fluid discharges, the connector comprising

- a body portion extending substantially in a plane parallel to a main plane of the microfluidic chip when in use, and
- at least two hollow needles arranged in the body porting, extending substantially perpendicular to the plane of the connector and extending beyond two surfaces of the body portion,

wherein the dimensions, arrangement and material of the hollow needles are so that a watertight connection is established between the connection channels of the chip and the hollow needles of the connector when the chip is pressed onto the connector, the watertight connection being maintained during use.

[0020] By "needles" is preferably meant any structure forming a flow channel through which fluid can flow to and from the chip. Other designations could e.g. be "pin" or "pipe". The structure should be so stiff that it can be connected with the chip by a push-fit mounting.

[0021] The surfaces beyond which the needles extend are preferably the upper and lower side of the body portion so that straight needles can be used. However, in principle they could also extend e.g. from the upper side for connection with the chip and from a vertical side for connection with the fluid supplies and fluid discharge containers.

[0022] The hollow needles may e.g. be arranged in a row at each side of the connector as shown in the figures.

[0023] The body portion can e.g. be made from aluminium, and the hollow needles can e.g. be made from stainless steel. The materials are to be chosen such that for a given design, changes in dimensions due to temperature variations during use are so small that they do not result in damage to the chip, leak of fluid or so tight a fit that it is too difficult to remove the chip from the connector.

[0024] When the system is in use, the hollow needles are connected to the fluid supplies e.g. via syringe pumps or any other suitable means which will be well known to a person skilled in the art. Connections to fluid discharges may e.g. be obtained by mounting flexible tubes directly on the hollow needles.

[0025] A connector according to the present invention may further comprise at least one through-going window. Such a window will allow for analysis comprising illuminating from below, such as for microscopic imaging of the fluids in the chip.

[0026] A third aspect of the invention relates to a system comprising a microfluidic chip and a connector as described above.

[0027] A fourth aspect of the invention relates to a method of manufacturing a microfluidic chip comprising a chip body and an upper layer as described above. The method comprises the steps of:

- pouring a liquid polymer material over a mould containing a predetermined structure of the channels in the chip body in relief,
- curing or solidifying the polymer material,
- preparing the upper layer to a predetermined size and shape, and
- fastening the upper layer to the upper surface of the chip body so that a watertight bonding is established.

[0028] Such a method may further comprise the steps of activating the upper surface of the chip body and a lower surface of the upper layer by oxygen plasma treatment, and pressing the upper surface of the chip body and the lower surface of the upper layer together so that the watertight bonding is established. This method is particularly applicable if PDMS is used.

[0029] The connection channels may e.g. be formed by arranging needles or pins in the mould at positions corresponding to the positions of the hollow needles of a connector.

[0030] Such a method is particularly applicable for rapid prototyping and if only a relatively small number of chips is needed. The simple and cheap method of manufacturing makes it feasible to use at least the chip as a

disposable product which may be particularly applicable to analyses where the risk of contamination between subsequent samples are to be avoided.

[0031] A fifth aspect of the invention relates to use of a system as described above for medical diagnostics applications, remote environmental monitoring or food quality control.

[0032] The first, second, third, fourth and fifth aspect of the present invention may each be combined with any of the other aspects. These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE FIGURES

[0033] The system comprising a microfluidic chip and a corresponding connector according to the invention will now be described in more detail with regard to the accompanying figures. The figures show one way of implementing the present invention and is not to be construed as being limiting to other possible embodiments falling within the scope of the attached claim set.

Figure 1 shows schematically a three-dimensional view of a possible design of a microfluidic chip according to the invention.

Figure 2.a and 2.b show schematically a side view and a top view, respectively, of a connector according to the present invention.

Figure 3.a and 3.b show schematically a side view and a top view, respectively, of the connector in figure 2 with a chip mounted thereon.

Figure 4 shows a three-dimensional view of a chip and a connector before assembly.

Figure 5 shows a three-dimensional view of the chip and the connector in figure 5 after assembly.

Figure 6 shows schematically a cross sectional partial view of a chip manufactured by a method according to an aspect of the invention.

DETAILED DESCRIPTION OF AN EMBODIMENT

[0034] Figure 1 shows schematically a possible design of a microfluidic chip 1 according to the present invention. The chip 1 is shown as being made from a transparent material so that the inner channels 2,3,4 are visible. Such a material may e.g. be polydimethylsiloxane (PDMS). In the embodiment shown in figure 1, the microfluidic chip 1 comprises ten connection channels 2 each extending from a bottom outer surface of the chip 1 and into the chip 1. The connection channels 2 are arranged in two rows near the two ends of the chip 1. However, other designs are also possible such as arranged in pairs, at the corners, or in two rows at each end. Each fluid channel 3 through which fluid and/or particulate suspensions can flow through the chip 1 for analysis extends between and in fluid connection with two connection channels 2, one at each end. Where the connection channels 2 reach the patterned upper side of the chip 1, there is a large void 12 moulded into the PDMS. The fluid channels 3 then extend close to the surface of the chip 1 from these voids 12. The purpose of the voids 12 is to provide a degree of tolerance to the exact position of the fluid channels 3 with respect to the connection channels 2. The number and layout of the channels in figure 1 is given for illustrative purposes only; any practically usable design and number of channels is considered to be covered by the present invention. Furthermore, some of the channels are shown at the upper surface of the chip for illustrative purposes only; in practise they will be at a certain depth. A typical cross sectional dimension of a fluid channel 3 is 50 to 300 microns, and a typical dimension of a connection channel is 1 mm or less.

[0035] The microfluidic chip 1 shown has a row of fibre channels 4 extending from an outer surface of the chip 1 and each ending in close proximity of a fibre channel. Each of these fibre channels 4 are adapted to have an optical fibre (9, see figure 5) inserted therein. The fibre channels 4 are typically flared at the ends to ease the insertion of the optical fibres 9. The fibre channels 4 are typically straight but they do not necessarily extend perpendicular to the chip 1 as shown in the figure. The actual position and number of the fibre channels 4 can be chosen for a given application of the chip 1. Furthermore, for a given chip it may not be necessary or desired to use all fibre channels 4 for a given application.

[0036] According to an important idea behind the present invention, the microfluidic chip 1 can be connected to one or more fluid supplies (not shown) or fluid discharges (not shown) by use of a corresponding connector 5 as will be described in more detail in the following. An embodiment of such a connector 5 is shown schematically in figure 2. Figure 2.a and 2.b show a side view and a top view, respectively, of the connector 5. The connector 5 comprises a body portion 6 extending substantially in a plane parallel to a main plane of the microfluidic chip 1 when in use. It furthermore comprises a number of hollow needles 7 extending substantially perpendicular to the plane of the body portion 6 and extending beyond the upper and lower surfaces of the connector 5. The body portion 6 can e.g. be made from aluminium, and the hollow needles 7 can e.g. be made from stainless steel. At least the hollow needles 7 must be made from a material which does not react with the fluid to be analysed to any significant extent. The body portion 6 can e.g. be made by casting and/or machining, and the hollow needles 7 can e.g. be stiff tubes inserted through holes made in the body portion 6. However, any suitable manufacturing method known to a person skilled in the art can be used.

[0037] The connector 5 shown has a central and

through-going window 8 which allows for analysis comprising illuminating from below, such as for microscopic imaging of the fluids in the chip 1.

[0038] The materials are to be chosen such that for a given design, changes in dimensions due to temperature variations during use are so small that they do not result in damage to the chip 1 or leak of fluid or to so tight a fit that it is too difficult to remove the chip 1 from the connector 5. The dimensions, arrangement and material of the hollow needles 7 as well as the dimensions and arrangement of the connection channels 2 and the elastic properties of the chip 1 must be so that a watertight connection is established between the connection channels 2 of the chip 1 and the hollow needles 7 of the connector 5 when the chip 1 is pressed onto the connector 5, preferably manually. The watertight connection should also be maintained during use.

[0039] Figure 3.a and 3.b show schematically a side view and a top view, respectively, of the connector 5 in figure 2 with the chip 1 in figure 1 mounted thereon. When the system is in use, some of the hollow needles 7 are connected to the fluid supplies e.g. via syringe pumps (not shown) or any other suitable means which will be well known to a person skilled in the art. Connection of some of the hollow needles 7 to fluid discharges may e.g. be obtained by mounting flexible tubes (not shown) directly on the hollow needles 7.

[0040] Figure 4 and 5 show three-dimensional views of a chip 1 and a connector 5 after assembly, respectively. The figures furthermore show an optical fibre 9 before and after insertion in one of the fibre channels 4. Optical fibres are used during analyses e.g. to deliver laser light or to monitor light signals coming from fluid being analysed by use of the chip.

[0041] In an embodiment of the invention, the microfluidic chip 1 comprises a moulded chip body 10 in which the at least one fluid channel 3 and the at least two connection channels 2 are formed, and an upper layer 11 of polymer sheet fluid-tightly bonded to an upper surface of the chip body 10 to form an upper side of the at least one fluid channel 3. This is shown schematically in figure 6 which is not shown to scale. Figure 6 shows a connection channel 2 ending in a void 12; no fluid channels or fibre channels are shown in this figure. Such a chip 1 may e.g. be manufactured by a method comprising the following steps:

- pouring a liquid polymer material over a mould (not shown) containing a predetermined structure of the channels 2,3,4 and void 12 in the chip body 10 in relief,
- curing or solidifying the polymer material,
- preparing the upper layer 11 to a predetermined size and shape,
- activating the upper surface of the chip body 10 and a lower surface of the upper layer 11 by oxygen plasma treatment, and
- pressing the upper surface of the chip body 10 and the lower surface of the upper layer 11 together so that a watertight bonding is established.

[0042] The analyses being performed by use of a microfluidic chip 1 according to the present invention typically use water or saline as carrying medium. This means that the relevant temperature interval ranges from just below 0°C to 100° C. The whole range has been tested during the development work related to the present invention and seemed to work fine with PDMS as chip material and a connector 5 having a body section 6 of aluminium and hollow needles 7 of stainless steel. For these materials, microfluidic chips and connectors have been tested with a flow rate up to 250 ml/min without any leak of the liquid taking place. When deciding a pressure for a given application, it should not only be assured that the connection between the chip 1 and the connector 5 remains watertight during use. It should also be ensured that the bonding between the chip body 10 and the upper layer 11 remains intact.

[0043] Although the present invention has been described in connection with the specified embodiments, it should not be construed as being in any way limited to the presented examples. The scope of the present invention is set out by the accompanying claim set. In the context of the claims, the terms "comprising" or "comprises" do not exclude other possible elements or steps. Also, the mentioning of references such as "a" or "an" etc. should not be construed as excluding a plurality. The use of reference signs in the claims with respect to elements indicated in the figures shall also not be construed as limiting the scope of the invention. Furthermore, individual features mentioned in different claims, may possibly be advantageously combined, and the mentioning of these features in different claims does not exclude that a combination of features is not possible and advantageous.

Claims

1. Microfluidic chip comprising

- at least two connection channels each extending from an outer surface of the chip and into the chip, and
- at least one fluid channel through which fluid and/or particulate suspensions can flow through the chip, each of the at least one fluid channel extending between and in fluid connection with two connection channels,

wherein the dimensions and arrangement of the connection channels and the elastic properties of the chip are so that a watertight connection is established between the connection channels and hollow needles of a connector according to any of claims 8-9 when the chip is pressed onto the connector, the

watertight connection being maintained during use.

2. A microfluidic chip according to claim 1, wherein the chip is made from an optically clear material.

3. A microfluidic chip according to claim 1 or 2, wherein the chip is made from PDMS.

4. A microfluidic chip according to any of the preceding claims, wherein the at least one fluid channel has a cross sectional dimension of 10 to 500 microns, such as 10 to 50 microns, 50 to 300 microns, or 300 to 500 microns.

5. A microfluidic chip according to any of the preceding claims, the chip comprising a plurality of fluid channels, preferably 2-20 channels, such as 2 to 5, or 5 to 10, or 10 to 20 channels.

6. A microfluidic chip according to any of the preceding claims, further comprising at least one fibre channel extending from an outer surface of the chip and ending in close proximity of a fluid channel, the at least one fibre channel being adapted to have an optical fibre inserted therein.

7. A microfluidic chip according to any of the preceding claims, comprising

- a moulded chip body in which the at least one fluid channel, the at least two connection channels, and, if present, the at least one fibre channel are partially formed, and
- an upper layer of polymer sheet fluid-tightly bonded to an upper surface of the chip body to form an upper side of the at least one fluid channel and, if present, the at least one fibre channel.

8. A connector for connecting a microfluidic chip according to any of the preceding claims to one or more fluid supplies or fluid discharges, the connector comprising

- a body portion extending substantially in a plane parallel to a main plane of the microfluidic chip when in use, and
- at least two hollow needles arranged in the body portion, extending substantially perpendicular to the plane of the connector and extending beyond two surfaces of the body portion,

wherein the dimensions, arrangement and material of the hollow needles are so that a watertight connection is established between the connection channels of the chip and the hollow needles of the connector when the chip is pressed onto the connector, the watertight connection being maintained during use.

9. A connector according to claim 8, further comprising at least one through-going window.

10. System comprising a microfluidic chip according to any of claims 1-7 and a connector according to any of claims 8-9.

11. Method of manufacturing a microfluidic chip according to claim 7, the method comprising the steps of:

- pouring a liquid polymer material over a mould containing a predetermined structure of the channels in the chip body in relief,
- curing or solidifying the polymer material,
- preparing the upper layer to a predetermined size and shape, and
- fastening the upper layer to the upper surface of the chip body so that a watertight bonding is established.

12. Method according to claim 11, further comprising the steps of:

- activating the upper surface of the chip body and a lower surface of the upper layer by oxygen plasma treatment, and
- pressing the upper surface of the chip body and the lower surface of the upper layer together so that the watertight bonding is established.

13. Use of a system according to claim 10 for medical diagnostics applications.

14. Use of a system according to claim 10 for remote environmental monitoring.

15. Use of a system according to claim 10 for food quality control.

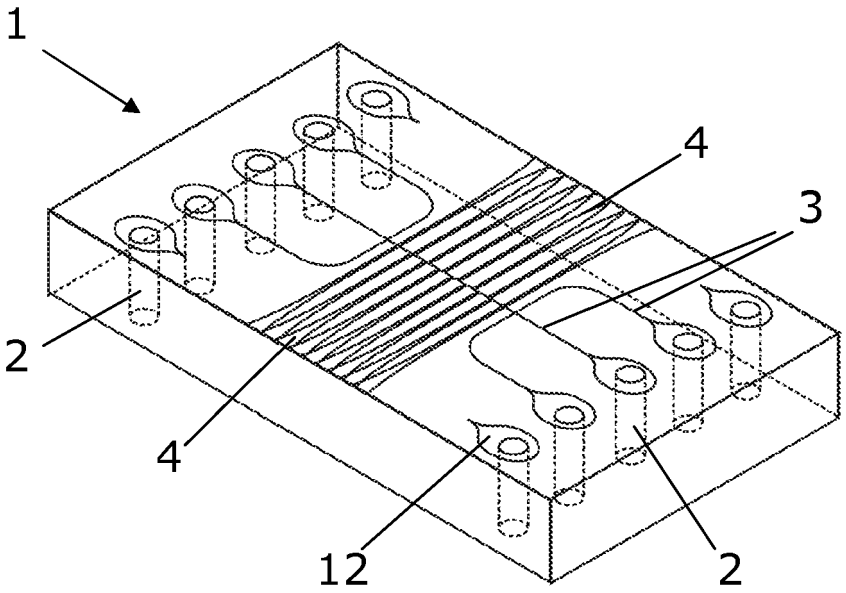


Fig. 1

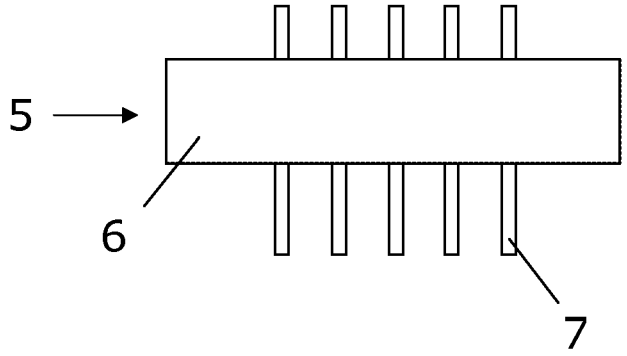


Fig. 2.a

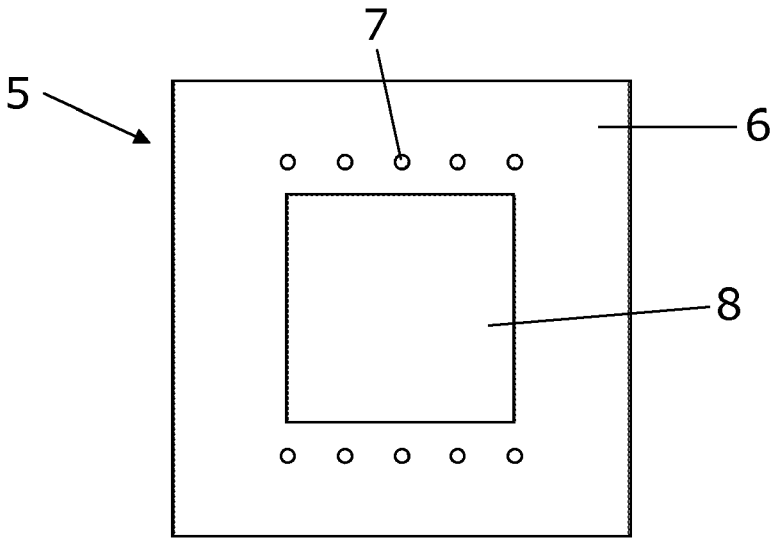


Fig. 2.b

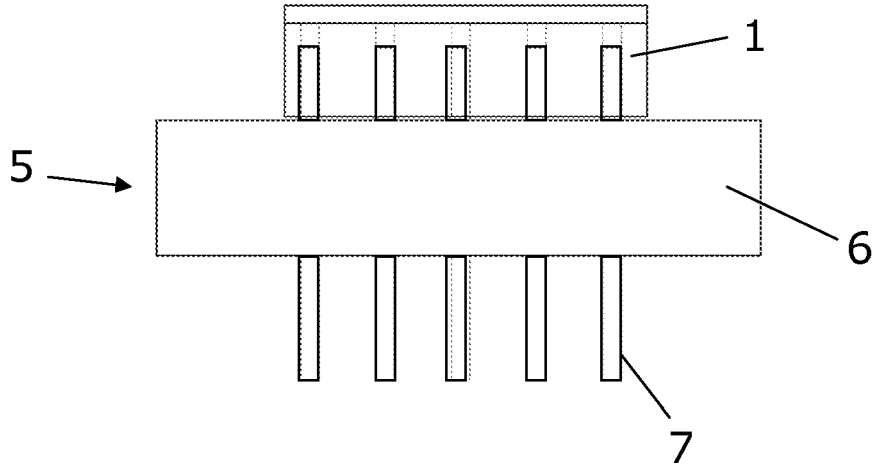


Fig. 3.a

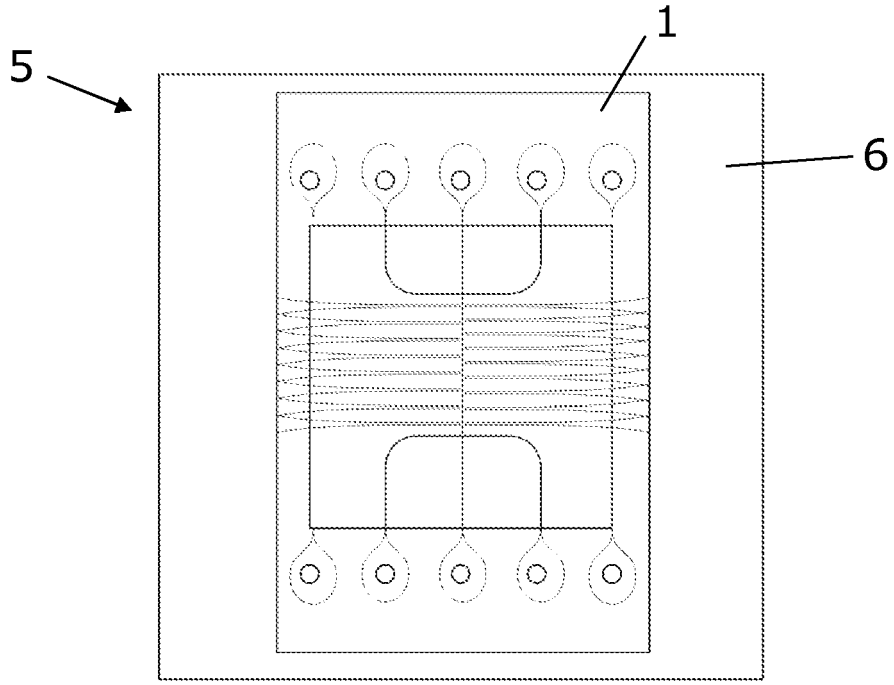


Fig. 3.b

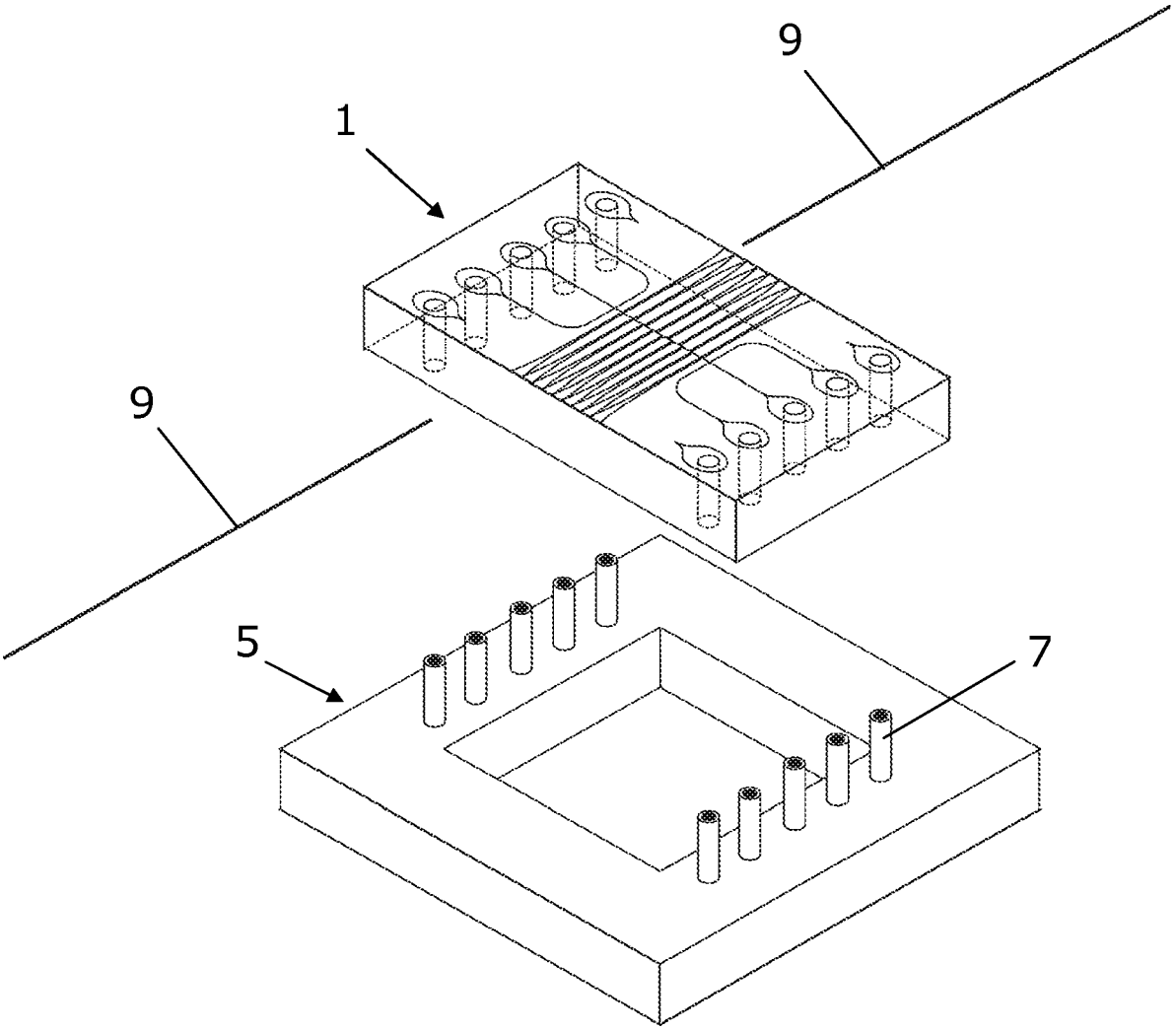


Fig. 4

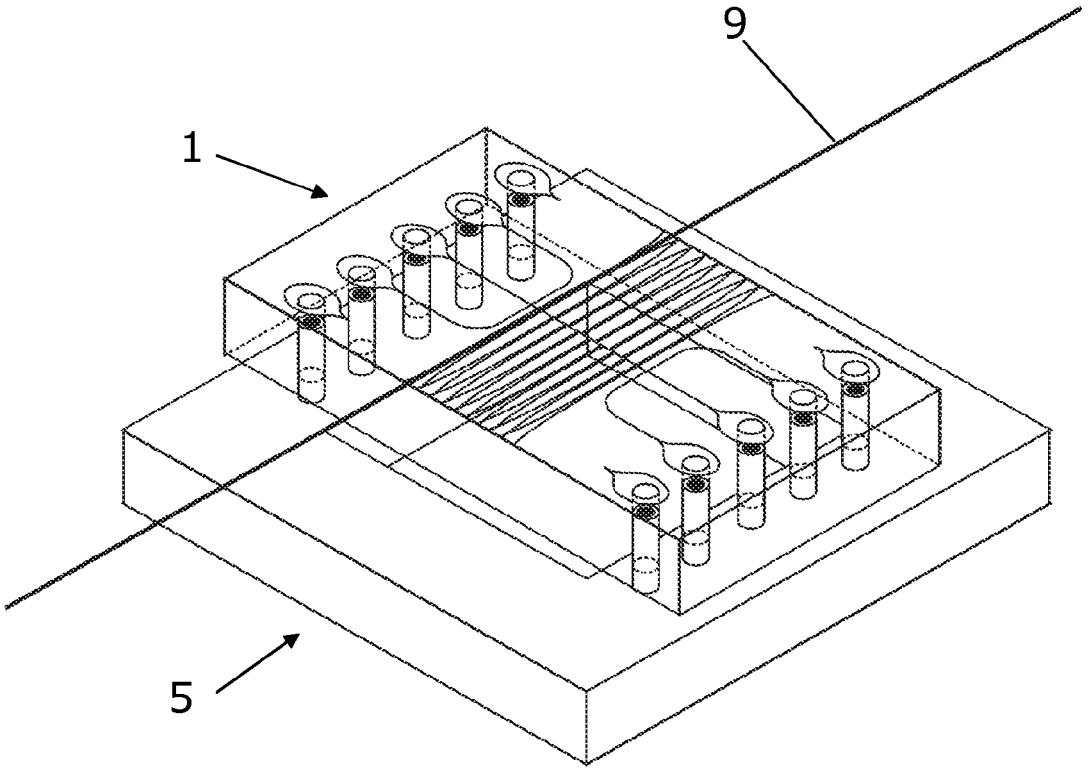


Fig. 5

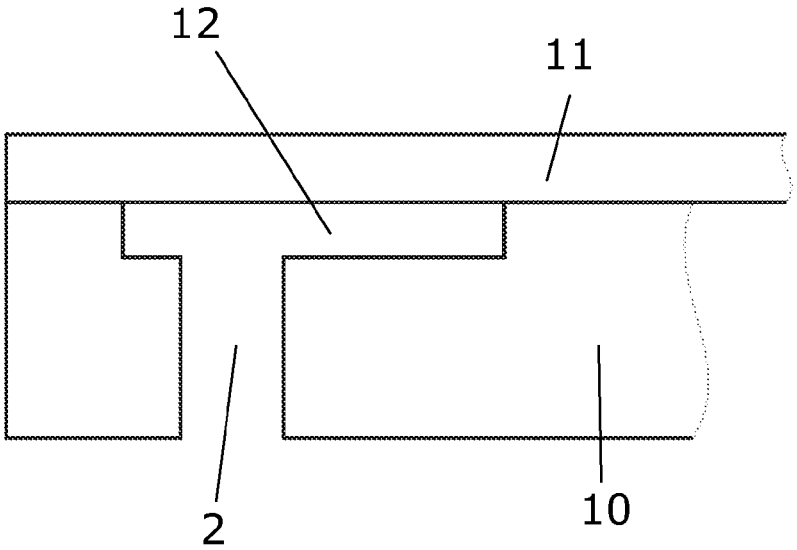


Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 9042

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 01/45843 A2 (GENE LOGIC INC [US]; TORRES MATTHEW [US]; SMITH IAN STUART RICHARD [US) 28 June 2001 (2001-06-28) * page 16, line 12 - line 24 * * page 19, line 3 - line 30; figure 7 *	1,2,4,5, 8,10,13	INV. B01L3/00 B01L9/00
X	WO 02/063288 A1 (STAATS SAU LAN TANG [US]) 15 August 2002 (2002-08-15) * page 9, line 23 - page 10, line 4 * * page 10, line 23 - page 11, line 13 * * page 21, line 27 - page 26, line 18; figures 15a,15b *	1-7, 11-13	
X	US 2009/236226 A1 (YUEN PO KI [US]) 24 September 2009 (2009-09-24) * paragraph [0032] * * paragraph [0035] * * paragraph [0037]; figures 6a-6c *	1-5,8, 10,13,14	
X	US 6 114 122 A (BESEMER DONALD [US] ET AL) 5 September 2000 (2000-09-05) * column 28, line 56 - column 29, line 27; figures 1,2,7a-8 *	1,4, 8-10,12	TECHNICAL FIELDS SEARCHED (IPC) B01L
X	US 2006/024702 A1 (CONNOLLY DENNIS M [US] ET AL) 2 February 2006 (2006-02-02) * the whole document *	1,4,8, 10,12	
X	US 2008/017306 A1 (LIU CHANG [US] ET AL) 24 January 2008 (2008-01-24) * the whole document *	1-5,7,8, 10-14	
X	US 2006/032746 A1 (KNOTT THOMAS [DE] ET AL) 16 February 2006 (2006-02-16) * the whole document *	1,4,5,8, 10	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 September 2010	Marti, Pedro

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EUROPEAN SEARCH REPORT

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EP 10 16 9042

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2009/002334 A1 (WELCH ALLYN INC [US]; DANNA DOMINICK [US]) 31 December 2008 (2008-12-31) * the whole document *	1,4,5,8, 10,13	
X	US 2004/096359 A1 (SARRUT NICOLAS [FR] ET AL) 20 May 2004 (2004-05-20) * the whole document *	1,4,5,8, 10	
			TECHNICAL FIELDS SEARCHED (IPC)

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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document

1 EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 10 16 9042

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 10 16 9042

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-7, 11, 12

   Claims 1-7: Microfluidic chip comprising at least two connection channels each extending from an outer surface of the chip and into the chip, and at least one fluid channel through which fluid and/or particulate suspensions can flow through the chip, each of the at least one fluid channel extending between and in fluid connection with two connection channels.
   Claims 11-12: Method of manufacturing a microfluidic chip according to claim 7.

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2. claims: 9, 10, 13-15

   Claims 8-9: Connector for connecting a microfluidic chip according to any of the preceding claims to one or more fluid supplies or fluid discharges, the connector comprising a body portion extending substantially in a plane parallel to a main plane of the microfluidic chip when in use, and at least two hollow needles arranged in the body portion, extending substantially perpendicular to the plane of the connector and extending beyond two surfaces of the body portion.
   Claims 10, 13-15: System comprising a microfluidic chip according to any of claims 1-7 and a connector according to any of claims 8-9. Use of the system.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 16 9042

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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