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(54) **MICROFLUIDIC DEVICES**

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(51) **Int. Cl.**

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(52) **U.S. Cl.**

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(58) **Field of Classification Search**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,190,310	A	6/1965	Honsinger
3,352,643	A	11/1967	Ando et al.
3,433,257	A	3/1969	Jensen
3,568,692	A	3/1971	Metzger et al.
3,610,274	A	10/1971	Levesque et al.
4,113,665	A	9/1978	Law et al.
4,558,845	A	12/1985	Hunkapiller
4,703,913	A	11/1987	Hunkapiller
4,847,120	A	7/1989	Gent
4,963,498	A	10/1990	Hillman et al.
5,085,757	A	2/1992	Karger et al.
5,275,645	A	1/1994	Ternoir et al.
5,364,759	A	11/1994	Caskey et al.
5,376,252	A	12/1994	Ekström et al.
5,387,505	A	2/1995	Wu
5,453,163	A	9/1995	Yan
5,482,836	A	1/1996	Cantor et al.
5,523,231	A	6/1996	Reeve
5,571,410	A	11/1996	Swedberg et al.
5,587,128	A	12/1996	Wilding et al.
5,635,358	A	6/1997	Wilding et al.
5,639,428	A	6/1997	Cottingham
5,681,946	A	10/1997	Reeve
5,705,628	A	1/1998	Hawkins
5,705,813	A	1/1998	Apffel et al.
5,726,026	A	3/1998	Wilding et al.
5,741,462	A	4/1998	Nova et al.
5,750,015	A	5/1998	Soane et al.
5,770,029	A	6/1998	Nelson et al.
5,775,371	A	7/1998	Pan et al.
5,776,748	A	7/1998	Singhvi et al.
5,830,662	A	11/1998	Soares et al.
5,842,787	A	12/1998	Kopf-Sill et al.
5,856,174	A	1/1999	Lipshutz et al.
5,863,502	A	1/1999	Southgate et al.
5,872,010	A	2/1999	Karger et al.
5,885,470	A	3/1999	Parce et al.
5,898,071	A	4/1999	Hawkins
5,900,130	A	5/1999	Benvegnu
5,908,552	A	6/1999	Zimmerman et al.
5,922,591	A	7/1999	Anderson et al.
5,942,443	A	8/1999	Parce et al.
5,948,684	A	9/1999	Weigl et al.
5,971,158	A	10/1999	Yager et al.
5,994,064	A	11/1999	Staub et al.
6,001,229	A	12/1999	Ramsey
6,007,690	A	12/1999	Nelson et al.
6,007,775	A	12/1999	Yager
6,010,607	A	1/2000	Ramsey
6,048,100	A	4/2000	Thrall et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2433145	A1	5/2002
EP	0459241	B1	12/1991

(Continued)

OTHER PUBLICATIONS

Office action dated Jun. 18, 2012 for U.S. Appl. No. 12/815,685.
Office action dated Aug. 23, 2012 for U.S. Appl. No. 13/287,398.
Office action dated Aug. 29, 2012 for U.S. Appl. No. 12/605,217.
European search report dated Oct. 29, 2012 for EP Application No. 07853470.8.
U.S. Appl. No. 12/026,510, filed Feb. 5, 2008, Jovanovich et al.
U.S. Appl. No. 12/820,390, filed Jun. 22, 2010, Harrison et al.
U.S. Appl. No. 13/075,165, filed Mar. 29, 2011, Eberhart et al.
U.S. Appl. No. 13/113,968, filed May 23, 2011, Majlof et al.
U.S. Appl. No. 13/202,877, filed Aug. 23, 2011, Vangbo et al.
U.S. Appl. No. 13/202,884, filed Aug. 23, 2011, Jovanovich et al.
U.S. Appl. No. 13/349,832, filed Jan. 13, 2012, Eberhart et al.
U.S. Appl. No. 13/384,753, filed Jan. 18, 2012, Stern et al.
U.S. Appl. No. 90/011,453, filed Jan. 21, 2011, Mathias et al.
Allowed Claims dated May 6, 2010 for U.S. Appl. No. 11/726,701.
Allowed Claims dated Jul. 1, 2010 for U.S. Appl. No. 11/139,018.
Allowed Claims dated Aug. 13, 2008 for U.S. Appl. No. 10/750,533.
Amendment and Request for Correction of Inventorship mailed Jan. 10, 2008 in U.S. Appl. No. 10/750,533.
Anderson, et al. A miniature integrated device for automated multistep genetic assays. Nucleic Acids Research. 2000;28:e60.
Armani, et al. Re-configurable fluid circuits by PDMS elastomer micromachining. Proceedings of IEEE Micro Electro Mechanical Systems: MEMS. 1999; 222-227.

(Continued)

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(57) **ABSTRACT**

Methods and devices for the interfacing of microchips to various types of modules are disclosed. The technology disclosed can be used as sample preparation and analysis systems for various applications, such as DNA sequencing and genotyping, proteomics, pathogen detection, diagnostics and biodefense.

20 Claims, 35 Drawing Sheets