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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: GRADIENT STRUCTURES INTERFACING MICROFLUIDICS AND NANOFLUIDICS, METHODS FOR FABRICATION AND USES THEREOF

(57) Abstract: The present invention relates to a device for interfacing nanofluidic and microfluidic components suitable for use in performing high throughput macromolecular analysis. Diffraction gradient lithography (DGL) is used to form a gradient interface between a microfluidic area and a nanofluidic area. The gradient interface area reduces the local entropic barrier to anochannels formed in the nanofluidic area. In one embodiment, the gradient interface area is formed of lateral spatial gradient structures for narrowing the cross section of a value from the micron to the nanometer length scale. In another embodiment, the gradient interface area is formed of a vertical sloped gradient structure. Additionally, the gradient structure can provide both a lateral and vertical gradient.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/11721

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C12M 1/34
US CL : 435/287.2

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 435/6, 287.2; 435/94

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST (USPAT, USPGP, EPO, JPO, DERWENT)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,263,286 B1 (GILMANSHIN et al.) 17 July 2001 (17.07.2001), see figures 8 and 9.	1-20
Y,P	US 2002/0072243 A1 (CRAIGHEAD et al.) 13 June 2002 (13.06.2002), see figures 9 amd 28, paragraphs 66-71, and82.	1-12 and 15-20
Y,P	US 2003/0012657 A1 (MARR et al.) 16 January 2003 (16.01.2003), see Figs. 6-8 and 42, and paragraphs 116-125.	1-20
Y,T,E	US 2005/0023156 A1 (RAMSEWY et al.) 03 February 2005 (03.02.2005), see Figure 1 and paragraphs 29-31.	1-12 and 15-20

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
04 April 2005 (04.04.2005)

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/11721

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-20, drawn to a method of fabricating a fluid device; and claim 21, drawn to a fluidic ddevice made by said method.

Group II, claim(s) 22-25, drawn to a method of forming a microfluidic/nanofluidic device.

Group III, claim(s) 26, drawn to a fluidic device.

Group IV, claim(s) 27-44, drawn to a system for fabricating a fluidic device.

Group V, claim(s) 45-46, drawn to a fluidic chip.

Group VI, claim(s) 47-68, drawn to a method of analyzing at least one macromolecule.

Group VII, claim(s) 69, drawn to a cartridge.

The inventions listed as Groups I-VII do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The method of Claim 1 does not result in the cartridge of claim 69. In particular, claim 1 does not result in nanofluidic area on a "surface," the existence of a sample reservoir, the presence of a waste reservoir, nor does it include an apparatus for detecting at least one signal. Accordingly, the inventions are not so linked by a special technical feature so to have unity of invention under PCT Rule 13.1.