(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 March 2004 (18.03.2004)

PCT

(10) International Publication Number
WO 2004/023490 A3

(51) International Patent Classification[7]: B81B 7/00, 7/02, G01N 13/10, B81C 5/00, B82B 3/00

(21) International Application Number:
PCT/US2003/028506

(22) International Filing Date:
9 September 2003 (09.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/409,403 9 September 2002 (09.09.2002) US
60/433,242 12 December 2002 (12.12.2002) US

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(81) Designated States *(national)*: CN, JP, KR.

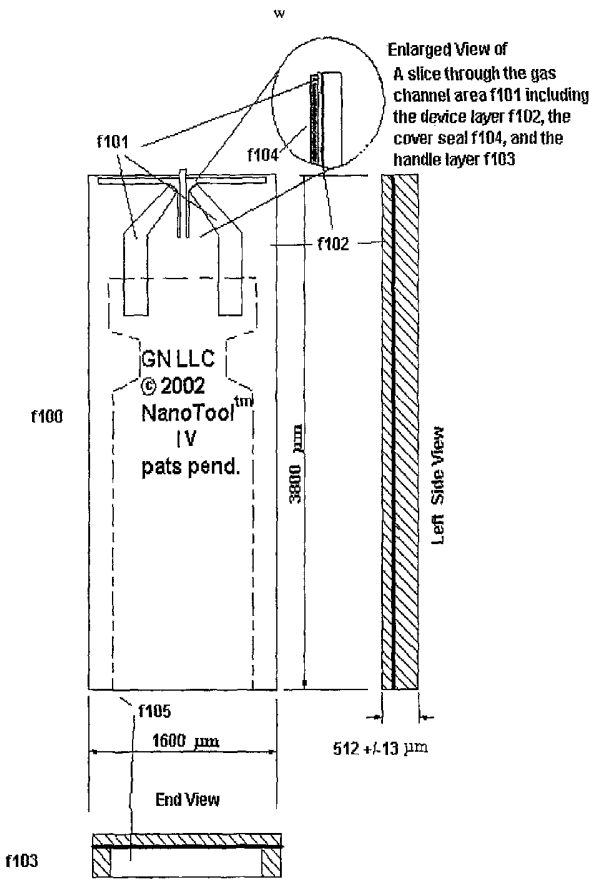
(84) Designated States *(regional)*: European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
2 December 2004

[Continued on next page]

(54) Title: FLUID DELIVERY FOR SCANNING PROBE MICROSCOPY



(57) Abstract: The following invention pertains to the introduction of a gas (or fluid) around a MEMS cantilever (f100) having an SPM probe or Nanotool (TM) to control chemical activity, e.g. oxygen to promote oxidation, argon to inhibit oxidation or clean dry air (CDA) to inhibit moisture to control static charging due to the action of the probe or Nanotools and to provide vacuum at and around the tip and substrate area. The invention can also produce electrical current for use with active electronic devices on, in or near the body of the device. In addition by use of a fluid like water, certain oils, and other liquids in conjunction with specific tip structure either electric discharge machining can be used at the tip area on the tip itself (in conjunction with a form structure on the work piece) or on a work piece beneath the tip to shape, polish and remove material at very small scales (10 microns to 1nm or less). The fluid handling strucutre includes gas channels (f101) formed in devide layer (f102). Each channel is fed via a recess (f105), shown in phantom, formed in the body of in the handle layer (f103) of the cantilever (f100). The recess is therefore in fluid communication with the channels (f101). As can be seen in the enlarged view, a cover seal, or cover layer (f104) can be provided to contain the gas pressure that can be developed at the tip.

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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.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/28506

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B81B 7/00, 7/02; G01N 13/10; B81C 5/00; B82B 3/00
US CL : 257/414; 73/105; 250/306; 29/700; 435/6, 287.2, 288.4

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. : 257/414; 73/105; 250/306; 29/700; 435/6, 287.2, 288.4, 288.5; 137/557

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)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	WO 98/34092 (RAVE, L.L.C.) 06 August 1998 (06.08.1998), page 11, lines 15-24, page 13, line 20-page 14, line 12, page 21, line 37 page 22, line 6, page 57, lines 6-16, page 66, lines 7-11 and especially page 141.	1-2, 4-5, 12, 15-22, 29-35 --- 8-9
A		3, 10, 26-28
X,P	US 2003/0089182 A (THAYSEN et al) 15 May 2003 (15.05.2003), abstract, paragraphs 2 and 24-26	1-2
X	US 2003/0012657 A (MARR et al), abstract, Figs. 4A-4B and paragraph 156	1-2, 16-21
X --- Y	US Re 34,708 E (HANSMA et al) 30 August 1994 (30.08.1994), abstract, Fig. 2	1 --- 2

☐ 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	Date of mailing of the international search report
30 June 2004 (30.06.2004)	13 OCT 2004
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer Thomas P. Noland Telephone No. (571) 272-2202

Form PCT/ISA/210 (second sheet) (July 1998)

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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.: 1-5, 8-10, 12, 15-22 and 26-35

Remark on Protest

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

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

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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) 1-5, 8-10, 12, 15-22 and 26-35, drawn to a MEMS device, any nanoelectric discharge machining in which the electric discharge device also serves to image or measure the surface to be machined by any scanning probe microscopy method or any application, measurement or operation acts in which such a MEMS device acts in a specific or constrained region.

Group II, claim(s) 6-7, drawn to a MEMS device.

Group III, claim(s) 11, drawn to a nanocavitation technique.

Group IV, claim(s) 13, drawn to any outflow, inflow, circulating or recirculating fluid system in which the scanning probe microscopy means is integrated with the fluid transfer means.

Group V, claim(s) 14, drawn to any outflow, inflow, circulating or recirculating fluid system in which nanomachining or surface modification by any means is conducted by integrated means.

Group VI, claim(s) 23-24, drawn to a system for scanning probe microscopes, nanomachining, nanomanipulator, or multimode operations.

The inventions listed as Groups I-VI 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:

Inventions Group III and Groups (I-II and IV-V) lack unity because Group III does not require the use of an SPM component with at least one fluid channel or the use of an electric discharge tool which serves to image or measure as in group I, the use of a circuit for collecting particles emitted from an isotope disposed on SPM components as in Group II, SPM means integrated with fluid transfer means as in group IV, or a fluid system where nanomachining or surface modification is conducted by means integrated with the system as in Group V. Also the invention Group III lacks unity with the invention of Group VI because Group VI can be used in an operation not requiring the use of a nanocavitation inducing member to image or measure as in Group III.

Invention Group VI and Groups I-II and IV-V lack unity because Group VI does not require: the use of an SPM component with at least one fluid channel or having the electric discharge machining tool serve to image or measure the surface to be machined as in Group I; a circuit for collecting particles emitted from an isotope disposed on an SPM component as in Group II; or a fluid system as in groups IV or V. Groups I-II and IV-V could also be used in a system where changes are induced by chemical means instead of as in claim 23 of Group 6 or in a system not requiring the use of mechanical members interacting with or substituting for the primary sense or interaction structure as in claim 24 of Group 6 but instead such members act with less than primary elements.

Inventions Group II and Groups (I and IV-V) lack unity because Group II does not require the use of at least one fluid channel formed in the SPM component or having the electric discharge tool also serve to image or measure the surface to be machined as in Group I; it does not require the SPM means to be integrated with fluid transfer means as in Group IV and it does not require the use of an integrated fluid system as in group V. Groups I and IV-V do not require the use of a circuit for collecting particles emitted from an isotope disposed on the SPM component as in Group II.

Inventions Group V and Groups (I and IV) lack unity because Group V does not require the particulars of the subcombination as claimed because it does not require the use of an SPM component, method, or means as in groups I and IV. Group V could be used as a MEMS device, for nanoelectric discharge machining, or as an SPM system without necessarily having nanomachining or surface modification done with means integrated with the fluid system as in Group V.

Inventions Group I and Group IV lack unity because Group I does not necessarily require the use of fluid transfer means as in Group IV as evidenced by claims 1-2 of Group 1 only requiring the possession of fluid channels but not requiring them to transfer fluid and claim 12 of Group I not requiring any fluid channels. Also Group IV could be used in an SPM without necessarily having a MEMS device or nanoelectric discharge machining as in Group I.

Continuation of B. FIELDS SEARCHED Item 3:

IBM_TDB, US-PGPUB, EPO, JPO, DERWENT, USOCR, USPAT

search terms: mems!, micro, electromechanical, electromechanically, microelectromechanical, microelectromechanically, micro-electromechanical, micro-electromechanically, SPM, afm, scanning, probe, atomic, force, microscope, microscopy, fluid, fluidic, fluent, gas, gaseous, channel, channelled, channelling