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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 February 2008 (21.02.2008)

PCT

(10) International Publication Number
WO 2008/021073 A3

(51) International Patent Classification:
H05B 3/10 (2006.01)

(21) International Application Number:
PCT/US2007/017524

(22) International Filing Date: 7 August 2007 (07.08.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/836,027 7 August 2006 (07.08.2006) US

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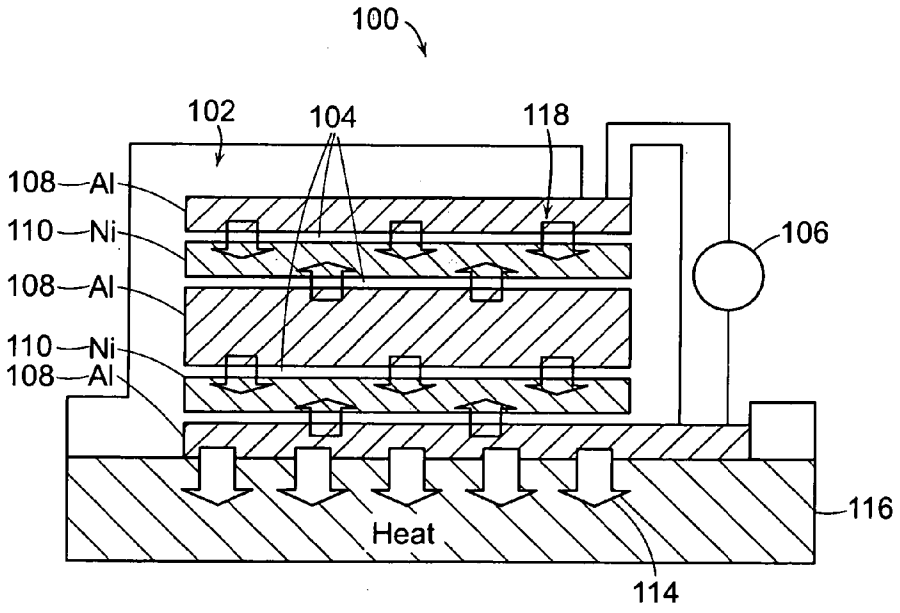
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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: NANOHEATER ELEMENTS, SYSTEMS AND METHODS OF USE THEREOF



(57) Abstract: The present invention provides devices and methods for making nano structures such a nanoheater. In one embodiment, the nanoheater element comprises a first reactive member and interlayer disposed in communication with at least a portion thereof. Preferably, contact between the first and second reactive members of the nanoheater element can yield at least one exothermic reaction. A nanoheater device of the invention can optionally comprise a substrate on which the first reactive member is positioned in combination with other components. The invention also provides a nanoheater system comprising a plurality of nanoheater elements. Exemplary nanoheater elements and systems can be used to perform a method of the invention in which heat is produced. Methods includes processes for fabricating nanostructures such as layered devices, nanorods and nanowires.

WO 2008/021073 A3

European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

— *of inventorship (Rule 4.17(iv))*

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:
10 July 2008

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US07/017524

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H05B 3/10 (2008.04)
USPC - 977/833
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)
IPC(8) - H05B 3/10,12,14,16,18,20,22,24,26,28,30,32 (2008.04)
USPC - 219/538,546-548,553,553; 228; 338/306-314,333

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)
USPTO EAST System (US, USPG-PUB, EPO, JPO, FPRS, DERWENT), GoogleScholar, DialogPro, IEEExplore

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 6,736,942 B2 (WEIHS et al) 18 May 2004 (18.05.2004) entire document	1-3, 5, 6-12, 14, 18, 20-32, 34, 35, 37, 38, 41-49 ---- 4, 17, 19, 33, 36
Y	US 6,621,159 B2 (KURAMACHI) 16 September 2003 (16.09.2003) column 4, lines 3-5	4
Y	US 4,783,903 A (FERNQUIST et al) 15 November 1988 (15.11.1988) column 4, lines 49-56	19, 33
Y	US 5,089,356 A (CHUNG) 18 February 1992 (18.02.1992) column 2, lines 8-22	17, 36
X --- Y	US 6,004,450 A (NORTHRUP et al) 21 December 1999 (21.12.1999) Fig.7a,7b,8, column 1, lines 43-57, column 7, lines 35-37, and column 7, lines 48-50	50-52,55-56,59 ---------- 53-54, 57-58,60
Y	US 2005/0276743 A1 (LACOMBE et al) 15 December 2005 (15.12.2005) entire document	53-54, 57-58, 60
A	US 6,705,152 B2 (ROUTKEVITCH et al) 16 March 2004 (16.03.2004) entire document	13, 15, 16, 39, 40
A	US 6,914,220 B2 (TIAN et al) 05 July 2005 (05.07.2005) column 7, lines 60-62; column 8, lines 60-64	1-60

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

* 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 but 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
17 April 2008	16 MAY 2008

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US07/017524

Continuation of Box III.

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, claims 1-27, 45-60, drawn to a nanoheater element or method comprising first and second reactive members and an interlayer between the first and second reactive members.
Group II, claims 28-44, drawn to a nanoheater element positiioned on a substrate.

The inventions listed as Groups I and II 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 special technical feature of the Group I invention: first and second reactive members and an interlayer between the first and second reactive members as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: a nanoheater element positioned on a substrate as claimed therein is not present in the invention of Group I as a novel linking special technical feature.

The limitation of "a nanoheater element positioned on a substrate" is not considered a novel linking special technical feature as this limitation is clearly disclosed by US 6,914,220 B2 (TIAN et al) 05 July 2005, column 7, lines 60-62; column 8, lines 60-64.

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US07/017524

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

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

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

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

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra 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 additional fees, this Authority did not invite payment of additional fees.

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.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.