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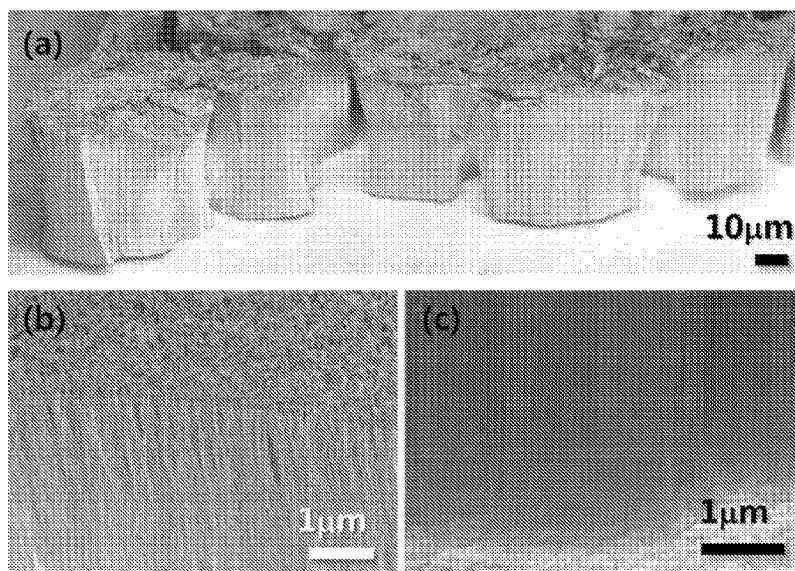
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- with international search report (Art. 21(3))
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[Continued on next page]

(54) Title: HIGH DENSITY ALIGNED SILICON NANOWIRE



Figures 1(a)-(c)

(57) Abstract: A simple, economical method of producing nanowire arrays is described. The method produces high density arrays having nanowires with diameters below 10 nm and does not require templating, catalysts, or surface pre/post-treatment. The disclosed methods and systems can be used, for example, for optoelectronic devices and photovoltaic cells, Li-ion batteries, chemical/bio sensors and transistors.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/47394

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01L 31/00(2013.01)

USPC - 136/261

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): H01L 31/00(2013.01)

USPC: 136/261

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 257/E31.032,784; 250/227.14 (keywords limited; search terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST(PGPB, USPT, EPAB, JPAB); PatBase; Google Scholar; Google Patents

Search terms: silicon Si nanowire\$2 "silicon nanowires" "Si nanowires" "Si nanowire" "template free" heated ?silicon substrate? "carrier gas" hydrogen and chlorine chloride "catalyst free" aligned diameter "oxygen content"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0273316 A1 (Renard et al.) 28 October 2010 (28.10.2010), especially, para [0024], [0029], [0038], [0039], [0042], [0046], [0062] and [0063].	1-3
Y	US 2011/0151290 A1 (Cui et al.) 23 June 2011 (23.06.2011), especially, para [0039] and [0048].	1-3
Y	US 2009/0152527 A1 (Lee et al.) 18 June 2009 (18.06.2009), especially, para [0003] and [0007].	1-3
Y	WO 2011/047455 A1 (Sivonthaman et al.) 28 April 2011 (28.04.2011), especially, claim 19.	2, 3/2
Y	US 2005/0176264 A1 (Lai et al.) 11 August 2005 (11.08.2005), especially, para [0008], [0009] and [0022].	3
A	Hu, J. et al., "The First Template-Free Growth of Crystalline Silicon Microtubes", Advanced Functional Materials, 2004, 14(6), 610-614.	1-3
A	Shao, M. et al., "Fabrication of large-scale, layer-deposited, low oxygen-content and uniform silicon nanowires", Journal of Crystal Growth, 2007, 303(2), 391-394.	1-3
A	US 2011/0309306 A1 (Zhou et al.) 22 December 2011 (22.12.2011).	1-3



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

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/47394

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.: 4-18
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:

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.