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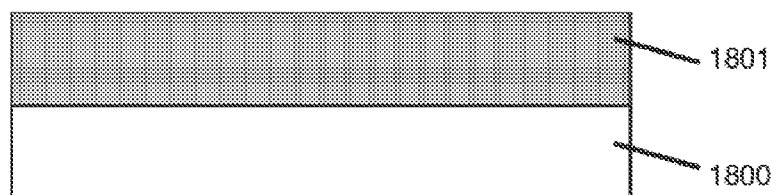
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(54) Title: ZIRCONIUM AND HAFNIUM BORIDE ALLOY TEMPLATES ON SILICON FOR NITRIDE INTEGRATION APPLICATIONS

FIGURE 1



(57) Abstract: Methods are provided for preparing epitaxial AlGaN layers at temperatures less than about 800 °C. Generally, a substrate is contacted with H₂GaN₃, D₂GaN₃, or mixtures thereof in the presence of an Al source at a suitable temperature and pressure to form an epitaxial Al_xGai_{1-x}N layer. Further, semiconductor structures are provided comprising, a stack comprising a plurality of repeating alloy layers, formed over a substrate, wherein the repeating alloy layers comprise two or more alloy layer types, wherein at least one alloy layer type comprises a Zr_zHf_yAl_{1-z-y}B₂, alloy layer, wherein the sum of z and y is less than or equal to 1, and the thickness of the stack is greater than about 50 nm.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 08/50280

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C01B 35/04; C22C 16/00; C22C 27/00 (2008.04)

USPC - 423/111,289,297,411; 420/422

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): C01B 35/04; C22C 16/00; C22C 27/00 (2008.04)

USPC: 423/111,289,297,411; 420/422

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

IPC(8): C01B 35/04; C22C 16/00; C22C 27/00 (2008.04)

USPC: 423/111,289,297,411; 420/422, 438/687 (Keywords limited - See list for keywords)

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

PubWEST(USPT,PGPB,EPAB,JPAB); DialogPRO(Chemistry); Google Scholar

Search Terms: Aluminum, gallium, nitride, AlxGa1-xN, Si, Al2O3, SiC, GaAs, alloy, semiconductor, group, III, thickness, layer\$2, stack\$2, GaN, InGaN, zirconium, hafnium, boride, template\$2, silicon, integration, application\$2, zirconium hafnium aluminum

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 2006/0236923 A1 (Kouvetakis et al.) 26 October 2006 (26.10.2006), entire document especially, para [0014], [0015], [0038]-[0040]	12-14, 16, 17 ----- 15, 18-22
Y	US 2006/0060131 A1 (Atanackovic) 23 March 2006 (23.03.2006), para [0076], [0124], [0134]	15, 18-22
Y	US 2005/0139960 A1 (Shibata) 30 June 2005 (30.06.2005), entire document especially, para [0002], [0030], [0058]	1-4
Y	US 6,207,844 B1 (Kouvetakis et al.) 27 March 2001 (27.03.2001), entire document especially, col 2, ln 19-31; col 3, ln 46-50	1-4
Y	US 2003/0039866 A1 (Mitamura) 27 February 2003 (27.02.2003), entire document especially, para [0007]	4

☐ 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

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 08/50280

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.: 5-11
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.