Title: ENHANCEMENT OF ELECTRON AND HOLE MOBILITIES IN 110 UNDER BIAXIAL COMPRESSION STRAIN

Abstract: The present invention provides a semiconductor material that has enhanced electron and hole mobilities that comprises a -containing layer having a 110 crystal orientation and a biaxial compressive strain. The term "biaxial compressive stress" is used herein to describe the net stress caused by longitudinal compressive stress and lateral stress that is induced upon the Si-containing layer during the manufacturing of the semiconductor material. Other aspect of the present invention relates to a method of forming the semiconductor material of the present invention. The method of the present invention includes the steps of providing a silicon-containing 110 layer; and creating a biaxial strain in the silicon-containing 110 layer.

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

Declarations under Rule 4.17:
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
— as to applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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: 30 November 2006

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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**

**A. CLASSIFICATION OF SUBJECT MATTER**

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<th>Inv.</th>
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<th>H01L29/04</th>
<th>H01L21/762</th>
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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)

| H01L |

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 practical search terms used)

EPO-Internal, WPI Data, INSPEC

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<th>Category</th>
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<th>Relevant to claim No.</th>
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<tr>
<td>Y</td>
<td>WO 03/105189 A (AMBERWAVE SYSTEMS CORPORATION) 16 December 2003 (2003-12-18) pages 39-41; figures 40a-41d</td>
<td>4-9, 19-30, 37</td>
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<td>A</td>
<td>US 6 335 231 B1 (YAMAZAKI SHUNPEI ET AL) 1 January 2002 (2002-01-01) column 2, lines 20-57 column 3, lines 27-34 column 4, lines 39-61 column 8, line 39 - column 10, line 21</td>
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Further documents are listed in the continuation of box C.

**X** Patent family members are listed in annex.

| **X** | **X** |

- Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "B" earlier document 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 document or other special reason (as specified)
  - "O" document referred to in the context of an oral disclosure, a show, 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.
  - "A" document member of the same patent family

Date of the actual completion of the International search: 26 July 2005

Date of mailing of the International search report: 06 OCT. 2006

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HU Rijswijk
Tel. (+31-70) 440-4000, Tx. 31 051 epo NL, Fax. (+31-70) 440-0016

Authorized officer:

Ott, André
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| A        | SAKAGUCHI K ET AL: "CURRENT PROGRESS IN EPITAXIAL LAYER TRANSFER (ELTRAN)"
           | IEICE TRANSACTIONS ON ELECTRONICS,
           | ELECTRONICS SOCIETY, TOKYO, JP,
           | pages 378-387, XP000751691
           | ISSN: 0916-8524
           | pages 378-382; figures -----        | 19-30,37  |
INTERNATIONAL SEARCH REPORT

Box 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 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 additional 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.:

   1-10, 18-30, 37

Remark on Protest

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

☐ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10, 18-30, 37

Providing a Si-containing layer with a <110> crystal orientation, said layer being under biaxial compressive strain. A process of creating a biaxial compressive strain using layer transfer method, which utilises a wafer bonding and a porous Si layer.

2. claims: 1, 11-17, 31-36, 38-40

Providing a Si-containing layer with a <110> crystal orientation, said layer being under biaxial compressive strain. A process of creating a biaxial compressive strain using multiply connected trench isolation regions or applying a compressive liner on a surface of a device or combine both the multiply connected trench isolation regions and the compressive liner.
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<tr>
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