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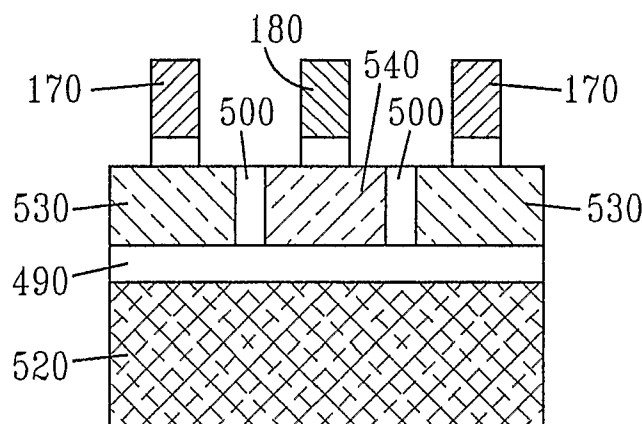
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(54) Title: PLANAR SUBSTRATE WITH SELECTED SEMICONDUCTOR CRYSTAL ORIENTATIONS FORMED BY LOCALIZED AMORPHIZATION AND RECRYSTALLIZATION OF STACKED TEMPLATE LAYERS



(57) Abstract: A method utilizing localized amorphization and recrystallization of stacked template layers is provided for making a planar substrate having semiconductor layers of different crystallographic orientations. Also provided are hybrid-orientation semiconductor substrate structures built with the methods of the invention, as well as such structures integrated with various CMOS circuits comprising at least two semiconductor devices disposed on different surface orientations for enhanced device performance.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H01L27/092 H01L21/8238 H01L27/12 H01L21/762 H01L29/04
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B. FIELDS SEARCHED

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|---------------------------|
| X | EP 0 331 811 A (FUJITSU LIMITED) 13 September 1989 (1989-09-13) | 1-4, 6-12, 14-20,25 |
| Y | the whole document | 5,13, 21-24, 26-34 |
| A | figure 3 | 35-55 |
| X | ----- PATENT ABSTRACTS OF JAPAN vol. 009, no. 321 (E-367), 17 December 1985 (1985-12-17) -& JP 60 154548 A (FUJITSU KK), 14 August 1985 (1985-08-14) | 1-4, 6-12, 14-20,25 |
| Y | abstract | 5,13, 21-24, 26-34 |
| | figures 1-3 | |
| | ----- -/- | |

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| C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT | | |
|--|---|---------------------------|
| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| P,X | US 2004/195646 A1 (YEO YEE-CHIA ET AL) 7 October 2004 (2004-10-07) the whole document paragraphs [0001] - [0038], [0053], [0054], [0057] - [0059] figures 1-3,7,9 ----- | 1-39, 42-47, 50,53 |
| X | US 4 768 076 A (AOKI ET AL) 30 August 1988 (1988-08-30) column 3, line 3 column 3 - column 6; figures 5,7 ----- | 1-4, 6-12, 14-20,25 |
| Y | PATENT ABSTRACTS OF JAPAN vol. 013, no. 435 (E-825), 28 September 1989 (1989-09-28) -& JP 01 162362 A (FUJITSU LTD), 26 June 1989 (1989-06-26) abstract ----- | 1-34 |
| Y | EP 0 535 681 A (KABUSHIKI KAISHA TOSHIBA) 7 April 1993 (1993-04-07) the whole document figures 3G,4F ----- | 1-34 |
| Y | EP 1 174 928 A (HITACHI, LTD) 23 January 2002 (2002-01-23) the whole document figures 7,14,15 paragraph [0028] - paragraph [0036] ----- | 1-34 |
| A | US 4 816 893 A (MAYER ET AL) 28 March 1989 (1989-03-28) the whole document ----- | 35-55 |
| A | US 4 385 937 A (OHMURA ET AL) 31 May 1983 (1983-05-31) the whole document ----- | 35-55 |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/039970

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
|--|----|------------------|-------------------------|------------------|
| EP 0331811 | A | 13-09-1989 | JP 1162376 A | 26-06-1989 |
| | | | JP 1831909 C | 29-03-1994 |
| | | | EP 0331811 A2 | 13-09-1989 |
| | | | KR 9109038 B1 | 28-10-1991 |
| | | | US 4933298 A | 12-06-1990 |
| ----- | | | | |
| JP 60154548 | A | 14-08-1985 | JP 1752070 C | 08-04-1993 |
| | | | JP 4038140 B | 23-06-1992 |
| ----- | | | | |
| US 2004195646 | A1 | 07-10-2004 | CN 1536676 A | 13-10-2004 |
| ----- | | | | |
| US 4768076 | A | 30-08-1988 | JP 61070748 A | 11-04-1986 |
| | | | JP 1941540 C | 23-06-1995 |
| | | | JP 6073366 B | 14-09-1994 |
| | | | JP 61139056 A | 26-06-1986 |
| ----- | | | | |
| JP 01162362 | A | 26-06-1989 | NONE | |
| ----- | | | | |
| EP 0535681 | A | 07-04-1993 | JP 3017860 B2 | 13-03-2000 |
| | | | JP 5094928 A | 16-04-1993 |
| | | | DE 69230458 D1 | 27-01-2000 |
| | | | DE 69230458 T2 | 13-07-2000 |
| | | | EP 0535681 A2 | 07-04-1993 |
| | | | KR 9608733 B1 | 29-06-1996 |
| | | | US 5384473 A | 24-01-1995 |
| ----- | | | | |
| EP 1174928 | A | 23-01-2002 | JP 2000286418 A | 13-10-2000 |
| | | | AU 3330600 A | 23-10-2000 |
| | | | EP 1174928 A1 | 23-01-2002 |
| | | | CN 1349662 A | 15-05-2002 |
| | | | WO 0060671 A1 | 12-10-2000 |
| | | | TW 557577 B | 11-10-2003 |
| | | | US 2005017236 A1 | 27-01-2005 |
| ----- | | | | |
| US 4816893 | A | 28-03-1989 | US 4753895 A | 28-06-1988 |
| | | | DE 3882849 D1 | 09-09-1993 |
| | | | DE 3882849 T2 | 18-11-1993 |
| | | | EP 0305513 A1 | 08-03-1989 |
| | | | IL 85198 A | 06-09-1992 |
| | | | JP 1502379 T | 17-08-1989 |
| | | | WO 8806804 A2 | 07-09-1988 |
| ----- | | | | |
| US 4385937 | A | 31-05-1983 | JP 56162828 A | 15-12-1981 |
| | | | JP 57068064 A | 26-04-1982 |
| | | | DE 3119886 A1 | 11-03-1982 |
| | | | FR 2483127 A1 | 27-11-1981 |
| ----- | | | | |