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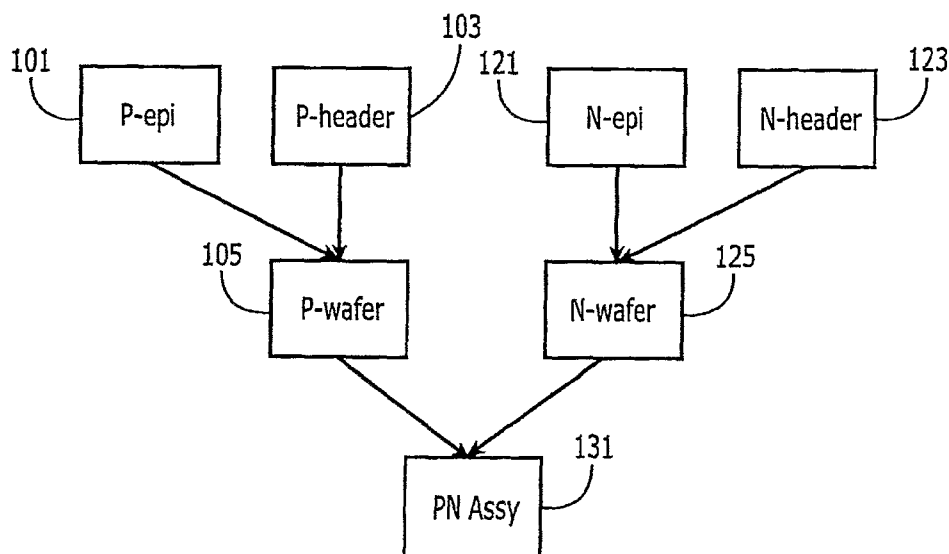
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(54) Title: METHODS OF FORMING THERMOELECTRIC DEVICES USING ISLANDS OF THERMOELECTRIC MATERIAL AND RELATED STRUCTURES



(57) Abstract: A method of forming a thermoelectric device may include forming a plurality of islands of thermoelectric material on a deposition substrate. The plurality of islands of thermoelectric material may be bonded to a header substrate so that the plurality of islands are between the deposition substrate and the header substrate. More particularly, the islands of thermoelectric material may be epitaxial islands of thermoelectric material having crystal structures aligned with a crystal structure of the deposition substrate. Related structures are also discussed.

WO 2007/103249 A3



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FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL,
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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

INV. H01L35/00 H01L35/32 H01L35/34

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003/230332 A1 (VENKATASUBRAMANIAN RAMA [US] ET AL) 18 December 2003 (2003-12-18)	1-5, 8, 9, 14, 17-20, 22, 23
A	paragraph [0051] - paragraph [0054]; figures 9-13	16, 21
X	US 5 897 330 A (WATANABE SHIGERU [JP] ET AL) 27 April 1999 (1999-04-27)	1, 4, 17, 18, 20-23
A	column 30, line 58 - column 36, line 14; figures 37-45	8-16
X	US 6 818 470 B1 (ACKLIN BRUNO [DE] ET AL) 16 November 2004 (2004-11-16)	1, 3, 17, 18, 20-23
	column 3, line 56 - column 6, line 24; figures 1-4	
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* 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 document but published on or after the international filing date
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- *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.
- *Z* document member of the same patent family

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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.
X	US 5 837 929 A (ADELMAN LONNIE W [US]) 17 November 1998 (1998-11-17) figures 1a-1i -----	1-3, 17-23
X	EP 1 079 445 A (SEIKO INSTR INC [JP]) 28 February 2001 (2001-02-28) paragraph [0050] - paragraph [0067]; figures 8-13 -----	1,17,18, 20-23
X	WO 2004/105146 A (KONINKL PHILIPS ELECTRONICS NV [NL]; OUWERKERK MARTIN [NL]; DEKKER RON) 2 December 2004 (2004-12-02) page 5, line 22 - page 7, line 7; figures 3-10 -----	1,3,4, 17,18, 20,22,23
P,X	WO 2007/002342 A (NEXTREME THERMAL SOLUTIONS [US]; ALLEY RANDALL G [US]; KOESTER DAVID A) 4 January 2007 (2007-01-04) paragraph [0045] - paragraph [0100]; figures 3-7 -----	1-7, 17-23
P,X	WO 2007/002337 A (NEXTREME THERMAL SOLUTIONS [US]; O'QUINN BROOKS C [US]; VENKATASUBRAMA) 4 January 2007 (2007-01-04) paragraph [0060] - paragraph [0101]; figures 2-8 -----	1-6, 17-23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/005490

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 additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an 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 reportcovers 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.:

1-23

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-23

A method of forming a thermoelectric device, comprising:
forming a plurality of islands of thermoelectric material on a deposition substrate; and bonding the plurality of islands of thermoelectric material to a header substrate so that the plurality of islands are between the deposition substrate and the header substrate; and
a thermoelectric structure comprising such features.

2. claims: 24-40

A method of forming a thermoelectric device, comprising:
forming a first plurality of conductive traces; bonding a first plurality of thermoelectric elements to the first plurality of conductive traces, wherein the first plurality of thermoelectric elements have a first conductivity type; bonding a second plurality of thermoelectric elements to the first plurality of conductive traces, wherein the second plurality of thermoelectric elements have a second conductivity type opposite the first conductivity type; and forming a second plurality of conductive traces on the first and second pluralities - of thermoelectric elements so that the first and second pluralities of thermoelectric elements are between the first and second pluralities of conductive traces, wherein surfaces of the second plurality of conductive traces opposite the first and second pluralities of thermoelectric elements are free of materials having a thickness greater than about 100 micrometers spanning multiple ones of the second plurality of conductive traces; and
a thermoelectric structure comprising such features.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2007/005490

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