



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/2488

<p>A. CLASSIFICATION OF SUBJECT MATTER                  IPC(8) - H01L 21/66 (2008.04)                  USPC - 438/16                  According to International Patent Classification (IPC) or to both national classification and IPC</p>																				
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols)                  IPC(8): H01L 21/66 (2008.04)                  USPC: 438/16 (see keywords below)</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                  USPC: 438/14, 17, 54, 308 (see keywords below)</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                  USPTO WEST (USPT, PGPUB, EPAB, JPAB); Google Scholar: measure, calibrate, detect, wafer, temperature, absorption, reflect, SOI, silicon on insulator, grating, incline, texture, uneven, rough</p>																				
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X --- Y</td> <td>US 5,683,180 A (De Lyon et al.) 04 November 1997 (04.11.1997), col 1, ln 40-49, ln 58-63; col 5, ln 10-24; col 6, ln 21-24; col 7, ln 16-27; col 8, ln 62-66; col 9, ln 4-13, ln 22-33; Fig 9</td> <td>1, 2, 4-7, 10, 11, 20-23, 27, 32 ----- 3, 8, 9, 12-19, 24-26, 28-31</td> </tr> <tr> <td>Y</td> <td>US 5,572,314 A (Hyman, Jr. et al.) 05 November 1996 (05.11.1996), Abstract</td> <td>3</td> </tr> <tr> <td>Y</td> <td>US 2003/0236642 A1 (Timans) 25 December 2003 (25.12.2003), para [0088], [0095], [0129], [0155]; Fig 6, 20</td> <td>8, 9, 14, 15, 25, 30</td> </tr> <tr> <td>Y</td> <td>US 6,426,232 B1 (Litvak) 30 July 2002 (30.07.2002), col 13, ln 29-43; Fig 15A, 17</td> <td>12, 26, 29</td> </tr> <tr> <td>Y</td> <td>US 4,062,623 A (Suzuki et al.) 13 December 1977 (13.12.1977), col 3, ln 40-45; col 4, ln 2-5, ln 64-67; col 5, ln 25-32; Fig 1, 2</td> <td>13, 16-19, 24, 28, 31</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X --- Y	US 5,683,180 A (De Lyon et al.) 04 November 1997 (04.11.1997), col 1, ln 40-49, ln 58-63; col 5, ln 10-24; col 6, ln 21-24; col 7, ln 16-27; col 8, ln 62-66; col 9, ln 4-13, ln 22-33; Fig 9	1, 2, 4-7, 10, 11, 20-23, 27, 32 ----- 3, 8, 9, 12-19, 24-26, 28-31	Y	US 5,572,314 A (Hyman, Jr. et al.) 05 November 1996 (05.11.1996), Abstract	3	Y	US 2003/0236642 A1 (Timans) 25 December 2003 (25.12.2003), para [0088], [0095], [0129], [0155]; Fig 6, 20	8, 9, 14, 15, 25, 30	Y	US 6,426,232 B1 (Litvak) 30 July 2002 (30.07.2002), col 13, ln 29-43; Fig 15A, 17	12, 26, 29	Y	US 4,062,623 A (Suzuki et al.) 13 December 1977 (13.12.1977), col 3, ln 40-45; col 4, ln 2-5, ln 64-67; col 5, ln 25-32; Fig 1, 2	13, 16-19, 24, 28, 31
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>																				
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&amp;" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"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)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed									
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<p>Date of the actual completion of the international search 31 December 2008 (31.12.2008)</p>		<p>Date of mailing of the international search report <b>09 JAN 2009</b></p>																		
<p>Name and mailing address of the ISA/US                  Mail Stop PCT, Attn: ISA/US, Commissioner for Patents                  P.O. Box 1450, Alexandria, Virginia 22313-1450                  Facsimile No. 571-273-3201</p>		<p>Authorized officer: Lee W. Young</p> <p>PCT Helpdesk: 571-272-4300                  PCT OSP: 571-272-7774</p>																		

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/72488

**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 extra 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 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.:  
1-32

**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.

INTERNATIONAL SEARCH REPORT  
Information on patent family members

International application No.

PCT/US 07/72488

Box No. III: Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: claim(s) 1-32, drawn to a method of calibrating a temperature measurement device, including: directing an incident ray of light towards a first side of a calibration wafer, detecting light energy reflected, determining the absorption of the wafer based on the detected energy, determining the temperature of the wafer based on the absorption; and calibrating a temperature measurement device based on the determined temperature.

Group II: claim(s) 33-36, drawn to a system for calibrating a temperature measurement device, including: a chamber adapted to receive a semiconductor wafer; a calibration wafer; a heating device in communication with the chamber and configured to heat the wafer; a temperature measuring device configured to monitor the temperature of the wafer; a calibrating light source configured to emit energy comprising at least one selected wavelength towards the wafer; and a light detector to detect reflected light energy.

Group III: claim(s) 37-42, drawn to a method of calibrating a temperature measurement device, the method comprising: determining, for a first selected temperature range, the absolute temperature of an object based upon measurement of the energy transmitted through the object from a calibration light source; determining, for a second selected temperature range, the absolute temperature of the object based upon light reflected from the object after light has traversed a path comprising at least one reflection inside the object; and calibrating at least one temperature measurement device to account for variation from the absolute temperature in the first and second selected temperature ranges.

Group IV: claim(s) 43-48, drawn to a method for determining the temperature of an object, including: directing coherent energy towards an object; directing incoherent energy towards the object; performing a first measurement of the coherent energy after interaction with the object; changing the temperature of the object to a second temperature; performing a second measurement of the coherent energy after interaction with the object at the second temperature; determining a change in an optical path length within the object based on the first and second optical measurements; and determining the temperature change based on the difference in the optical path length.

Group V: claim(s) 49-53, drawn to a method of determining the temperature of a semiconductor wafer, including: positioning a semiconductor wafer in view of an imaging system, the wafer comprising a pattern; using the imaging system to obtain an image of the pattern; and determining the absolute temperature of the wafer based on the degree of contrast in the image.

The inventions listed as Groups I - V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups II to V do not include the inventive concept of a method of calibrating a temperature measurement device, including directing an incident ray of light towards a wafer, detecting light energy reflected, determining the absorption, determining the temperature of the wafer based on the absorption; and calibrating based on that temperature, as required by Group I.

Groups I and III-V do not include the inventive concept of a system for calibrating a temperature measurement device, the device having a chamber adapted for a semiconductor wafer; a heating device to heat the wafer; a temperature measuring device configured to monitor the temperature of the wafer; a calibrating light source; and a light detector to detect reflected light energy, as required by Group II.

Groups I-II and IV-V do not include the inventive concept of a method of calibrating a temperature measurement device, including determining the absolute temperature of an object based on first and second selected temperature ranges, as required by Group III.

Groups I-III and V do not include the inventive concept of a method for determining the temperature of an object, including the use of coherent and incoherent energies and measuring the changes in those energies and determining optical path lengths, as required by Group IV.

Groups I-IV do not include the inventive concept of a method of determining the temperature of a semiconductor wafer with the use of an imaging system and obtaining an image of the wafer pattern; and determining the absolute temperature of the wafer based on the degree of contrast in the image, as required by Group V.

Even though Groups I-III all include generic calibration of a temperature measurement device and a light source, and all groups, I-V, include a generic temperature measurement of a wafer, generic calibration and temperature measurement methods are well known as evidenced by US 2003/0236642 A1 to Timans, published December 25, 2003, entitled "System and process for calibrating pyrometers in thermal processing chambers." Timans discloses calibration of a temperature measurement device and temperature measurement of a wafer including a light source (abstract and para. [0007]-[0011]). Additionally the calibration and temperature measurement of each individual claim group is distinct and not required by the other.

Groups I to V therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.