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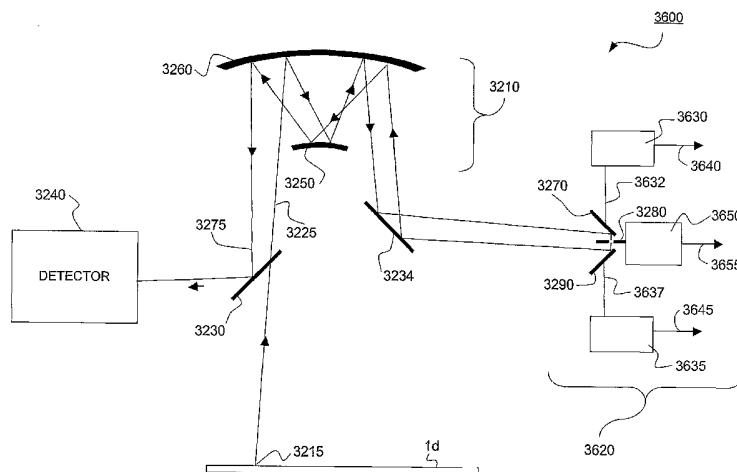
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR HIGH-SPEED THICKNESS MAPPING OF PATTERNED THIN FILMS



(57) Abstract: An apparatus or method captures reflectance spectrum for each of a plurality of spatial locations on the surface of a patterned wafer. A spectrometer system having a wavelength-dispersive element receives light reflected from the locations and separates the light into its constituent wavelength components. A one-dimensional imager scans the reflected light during translation of the wafer with respect to the spectrometer to obtain a set of successive, spatially contiguous, one-spatial dimension spectral images. A processor aggregates the images to form a two-spatial dimension spectral image. One or more properties of the wafer, such as film thickness, are determined from the spectral image. The apparatus or method may provide for relatively translating the wafer at a desired angle with respect to the line being imaged by the spectrometer to enhance measurement spot density, and may provide for automatic focusing of the wafer image by displacement sensor feedback control. The spectrometer system may include an Offner optical system configured to twice pass light reflected from the wafer and received by the imager.

WO 2006/014263 A3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/22911

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC: **G01B 11/06( 2006.01);G01J 3/18( 2006.01)**

USPC: 356/318,326,630,632,128,614,630

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)

U.S. : 356/318, 326, 630, 632, 128, 614, 630, 445-448; 250/201.1,

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 practicable, search terms used)  
Please See Continuation Sheet

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,291,269 (LEDGER) 01 March 1994 (01.03.1994), figures 1 and 9.	1-22
Y	US 5,856,871 (CABIB et al.) 05 January 1999 (05.-1.1999), column 2, lines 8-23, figure 1.	1-3, 12-16
Y	ImSpector Imaging Spectrograph brochure including specifications, Spectral Imaging Ltd., Oulu, Finland, (3 pages).	1-3 and 12-16
Y	US 6,288,781 B1 (LOBB) 11 September 2001 (11.09.2001) figures 4, 6, 10.	4-7, 15-18
Y	US 5,910,842 (PIWONKA-CORLE et al) 08 June 1999 (08.06.1999), figures 1 and 8-9.	8-11, 19-22

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	"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 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	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search

20 July 2006 (20.07.2006)

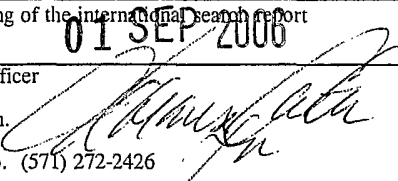
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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/22911

## 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:  
Please See Continuation 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 any 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.: 1-22

- 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

International application No.  
PCT/US05/22911

### BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

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, claims 1-22, drawn to a system for forming a two-dimensional spectral image of a patterned wafer comprises a light source for illuminating the wafer; a one-dimensional line imaging spectrometer configured to receive light reflected from a pattern of spatial locations on the wafer; a translation mechanism for relatively translating the wafer at a desired angle with respect to line being imaged by the spectrometer and a processor for obtaining from the spectrometer reflectance spectra for a plurality of spatial locations on the wafer and aggregating the plurality to form a two-dimensional spectral image.

Group II, claims 23-56, drawn to an optical system for forming a spatial sub-image of an object comprises an Offner group having a first focal point and a second focal point; an aperture coinciding with the second focal point; one or more reflectors.

Group III, claims 57-64, drawn to a method for imaging a portion of a patterned wafer comprises steps of: (a) positioning the wafer at a predetermined height relative to an image and (b) acquiring spectral image data while ensuring the wafer remains at a predetermined height and repeating steps (a) and (b) until a desired amount of spectral image data has been acquired.

Group IV, claims 65-78, drawn to an auto-focusing, one dimensional spectral imaging system comprises a line imaging spectrometer having a focal position; a distance sensor for measuring a relative distance between the object and positioned at a reference distance between the object and the line imaging spectrometer and means for adjusting the focal position relative to the object position based on the measured relative distance.

The inventions listed as Groups I, II, III and IV 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 within the meaning of PCT Rule 13.2, second sentence. PCT Rule 13.2, second sentence states that Rule 13.1 shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical feature. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, make over the prior art. As mentioned above, the claims of four Groups are directed to different inventions which are not so linked to form a single general inventive concept. The inventions are not linked in operation and perform completely different operations. 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 With respect to the "INVITATION TO PAY ADDITION FEES" mailed on 5/24/06, applicant did not respond; therefore, main group (claims 1-22) will be examined.

**INTERNATIONAL SEARCH REPORT**

International application No.  
PCT/US05/22911

Continuation of B. FIELDS SEARCHED Item 3:

EAST, WEST, IBM, IEBE

Search terms: spectrometer, Offner, focusing, thickness (measur\$4 or determin\$4)