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**Datasheet for the decision
of 29 April 2010**

Case Number: T 1098/06 - 3.4.03

Application Number: 00977281.5

Publication Number: 1218936

IPC: H01L 21/66

Language of the proceedings: EN

Title of invention:

Methods and apparatuses for trench depth detection and control

Applicant:

LAM RESEARCH CORPORATION

Opponent:

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Headword:

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Relevant legal provisions:

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Relevant legal provisions (EPC 1973):

EPC Art. 56

Keyword:

"Inventive step (no)"

Decisions cited:

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Catchword:

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Case Number: T 1098/06 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 29 April 2010

Appellant:

LAM RESEARCH CORPORATION
4650 Cushing Parkway
Fremont
CA 94568-6516 (US)

Representative:

Thomson, Paul Anthony
Potts, Kerr & Co.
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Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 12 January 2006
refusing European patent application
No. 00977281.5 pursuant to Article 97(1) EPC
1973.

Composition of the Board:

Chairman: G. Eliasson
Members: E. Wolff
J. Van Moer

Summary of Facts and Submissions

- I. This is an appeal from the decision of the examining division to refuse European patent application 00977281.
- II. On appeal, the appellant filed new claims with the grounds of appeal.
- III. In accordance with the appellants' auxiliary request, oral proceedings were appointed by the board. In a communication appended to the summons, the board referred to a further document, cited in the search report of the application, which the board considered to be exceedingly relevant:

D5: Takada K et al: "Development of a Trench Depth Measurement System for VLSI Dynamic Random Access Memory Vertical Capacitor Cells Using an Interferometric Technique with a Michelson Interferometer" , Applied Optics, Optical Society of America, Washington, US, Vol. 28, Nr. 16, 15 August 1989, Pages 3373-3381.

The board expressed the preliminary view that the invention as claimed *inter alia* did not involve an inventive step over document D5 on its own.

- IV. In response to the communication by the board, the appellants filed with letter dated 29 March 2010 a fresh set of claims of which independent claim 1 reads as follows, and differs from claim 1 as filed together with the statement of the grounds of appeal, by the following additions (underlined) and deletions (~~struck out~~):

"1. A method for optically ~~measuring~~ detecting a trench depth in a wafer using multi-wavelength light interferometry, the method comprising the operations of:

directing a multi-wavelength light from a multi-wavelength light source to a beam splitter;

splitting the multi-wavelength light along a first light path and a second light path, the first light path including passing through the beam splitter to the wafer and reflecting from the wafer to the beam splitter, the second light path including reflecting off of the beam splitter to a movable mirror and reflecting off the movable mirror to the beam splitter;

recombining the first light path and the second light path at the beam splitter, the recombined light path travels from the beam splitter to a light detector;

positioning a ~~the~~ movable mirror at a first location including rotating the movable mirror through a range to determine a best angle for a second light path reflection, wherein the best angle for the second light path reflection increases a magnitude of a maxima of multi-wavelength light to a desired level in the light detector, ~~wherein said mirror oscillates at a frequency greater than 50 Hz;~~

moving the movable mirror over a range to vary the length of the second light path until ~~a~~ the first maxima in an intensity of multi-wavelength light is detected in the light detector, a portion of the multi-wavelength light being reflected from a top trench surface, a first location of the movable mirror corresponding to the first maxima the first maxima being formed by a constructive interference of the multi-wavelength light passing down both the first light path and the second light path when the first

light path and the second light path have an equal length, moving the movable mirror over the range to vary the length of the second light path includes oscillating the movable mirror through the range at a frequency greater than 50Hz at the first location;

moving the mirror until a second maxima in an intensity of multi-wavelength light is detected, a portion of the multi-wavelength light being reflected from a bottom trench surface, a second location of the movable mirror-corresponding to the second maxima; and

determining a maxima peak separation between the first maxima and the second maxima, the trench depth corresponding to the maxima peak separation the maxima peak separation being equal to a distance between the first location of the movable mirror and the second location of the movable mirror."

The appellants subsequently informed the board that they would not be attending the oral proceedings.

- V. Oral proceedings were held in the absence of the appellants. The appellants requested in writing that the decision of the examining division be set aside and that the patent be granted on the basis of claims 1 to 12 filed with the letter dated 29 March 2010.

Reasons for the decision

1. The appeal is admissible.

2. *Inventive step*

2.1 Document D5 discloses a practical trench depth measurement system which "is designed for application to the in-line process" (page 3373, right-hand column, second paragraph). Using prisms instead of mirrors as reflectors for the interferometer, it discloses trench depth measurement with the aid of interference of light from a white (i.e., multi-wavelength) light source ("halogen lamp", page 3373, 4th line from the end of right-hand column). It should be noted in passing that the sole purpose of the monochromatic HeNe laser shown in Fig. 2 of document D5 is accurately to monitor the displacement of the prism PR2.

2.2 What distinguishes the invention now claimed in claim 1 from the disclosure in document D5 are the following features:

- (a) the claimed invention uses mirrors as reflectors, document D5 uses prisms;
- (b) document D5 contains no mention of the reflectors being rotated; and
- (c) the frequency at which the respective reflectors are oscillated is greater than 50 Hz as claimed, and about 10 Hz as described in document D5 (page 3374, penultimate paragraph of left-hand column).

It is to be noted that with the exception of reverting from "measuring" the trench depth to "detecting" it, the only distinguishing feature over document D5

resulting from the amendments made by the appellants in response to the communication of the board is feature (b) above. None of the other amendments goes beyond clarifying that the detection utilises interferometry and specifying in greater detail than before the steps which are involved in operating the interferometer, steps which are all disclosed in document D5.

2.3 Features (a) and (b) relate to the use of mirrors as reflectors in the interferometer, whereas feature (c) relates to the speed in which the movable reflector is scanned. Hence the features (a) and (b) on one hand and feature (c) on the other address separate problems. There are no obvious synergies between those features, and the appellants have not argued that there are. Therefore they can be considered separately in the assessment of inventive step.

2.4 Prisms and mirrors are constitute well-known alternative means of reflecting light. In the present case, the conventional Michelson Interferometer features mirrors as reflectors, and therefore, the skilled person would consider mirrors as obvious alternatives to the prisms used in the device of document D5.

2.5 Document D5 does not specify that the reflectors are mounted rotatably, due to the well-known fact that prisms as reflectors in an interferometer, in contrast to mirrors, are insensitive to angular misalignments. In case mirrors would nevertheless be selected as reflectors, the board is in no doubt that the skilled person would immediately appreciate the need for adjustment of the beam direction, and that mounting the

mirrors rotatably provides a simple way of allowing such adjustment.

- 2.6 Moving the mirror to alter the optical path length of one arm of the interferometer is essential to the operation of any interferometer which aims to achieve maximum interference for two optical paths with different optical path lengths. The faster the path length is moved, the shorter time is required for measuring trench depth, a measurement which is obtained from averaging measurements over several scans of the movable reflector (D5, page 3374, paragraph bridging both columns). Hence, as stated by the board in its communication, choosing how rapidly the path length should be altered (at more than 50 Hz as claimed, or at 10 Hz as disclosed in document D5) is an obvious choice.
- 2.7 The board had communicated its preliminary view that the invention as claimed was obvious over the disclosure in document D5. The appellants have made no attempt to refute this with any counter-arguments in support of their invention. Neither do the claim-amendments made by the appellants persuade the board that the invention now claimed involves an inventive step.
- 2.8 Finally, there is the appellants' argument, made before the examining division, that the claimed invention was distinguishable because it measured the depth of a single trench rather than, as the prior art, an average over several trenches. As the board stated already in its communication, this feature is not claimed. Indeed, the feature is unclaimable on account of the fact that there is nothing in the application to support it.

Moreover, the application itself explicitly states that the method of measurement ideally should "*measure an average depth over a reasonable area*" (published application, page 1, lines 31 to 34). There is nothing in the application that states that this "reasonable area" could or should not extend over two or more trenches or other recesses.

2.9 It is therefore the board's judgement that the invention as claimed in claim 1 of the application does not involve an inventive step within the meaning of Article 56 EPC 1973.

Order

For these reasons it is decided that:

The appeal is dismissed.

Registrar:

Chair:

S. Sánchez Chiquero

G. Eliasson