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**Datasheet for the decision  
of 12 June 2012**

**Case Number:** T 2159/08 - 3.4.03

**Application Number:** 04252328.2

**Publication Number:** 1471565

**IPC:** H01L 21/00, H01L 21/68

**Language of the proceedings:** EN

**Title of invention:**  
Mapping device for semiconductor wafers

**Applicant:**  
KAWASAKI JUKOGYO KABUSHIKI KAISHA

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 123(2)

**Relevant legal provisions (EPC 1973):**  
EPC Art. 54(1)(2), 56

**Keyword:**  
"Inventive step (yes)"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 2159/08 - 3.4.03

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.03  
of 12 June 2012

**Appellant:**  
(Applicant)

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**Decision under appeal:**

Decision of the Examining Division of the  
European Patent Office posted 8 May 2008  
refusing European patent application  
No. 04252328.2 pursuant to Article 97(2) EPC.

**Composition of the Board:**

**Chairman:** G. Eliasson  
**Members:** R. Q. Bekkering  
T. Karamanli

## Summary of Facts and Submissions

- I. This is an appeal against the refusal of application No. 04 252 328.
- II. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents according to the main request:

Description: Pages 2, 8 and 10 to 21 as originally filed;  
Page 9 filed with letter of 12 December 2006;  
Pages 3 to 7 filed on 2 May 2012;  
Pages 1, 22, 23 filed on 28 May 2012;

Claims: Nos. 1 to 5 filed on 2 May 2012;

Drawings: Sheets 1/7 to 7/7 as originally filed,

or on the basis of the first to fifth auxiliary request filed with the statement setting out the grounds of appeal of 12 September 2008.

- III. Claim 1 according to the main request reads as follows:

*"A robot for carrying a plate-shaped object comprising: a robot hand (36) for carrying a plate-shaped object, the robot hand being movable relative to the plate-shaped object and being movable to carry the plate-shaped object, wherein the robot hand includes first and second arms (38,39); and a mapping device; wherein the mapping device comprises:*

a detecting unit (22) including a reflecting member (31) and an optical sensing unit (32) including a light projector (33) projecting light onto the reflecting member and a light receiver (34) receiving the light projected by the light projector and reflected by the reflecting member (31), the light projector (33) and the light receiver (34) being combined in a unitary unit, the detecting unit (22) being configured to move relative to the plate-shaped object (27) in a moving direction intersecting an optical path along which the light projected by the light projector travels to the light receiver (33) so that the plate-shaped object lies in a moving region of the optical path, the reflecting member (31) and the optical sensing unit (32) being arranged respectively at end parts (41, 42) of the first and second arms (38,39) of the robot hand (36);

a position information acquiring means (24) for acquiring a position information about a position of the plate-shaped object (27) relative to the detecting unit (22); and

an arithmetic means (25) for calculating a mapping information about an arrangement of the plate-shaped object based on the position information provided by the position information acquiring means (24) and a light-reception information provided by the light receiver (34);

characterised in that the reflecting member (31) has a plurality of corner cubes (61) having the shape of a tetrahedron, each corner cube having one transparent surface and three reflecting surfaces perpendicularly intersecting each other, the corner cubes being arranged contiguously with their transparent surfaces included in an imaginary plane, whereby incoming light

*falling on the transparent surface is reflected by the reflecting surfaces and outgoing light leaves the corner cubes through the transparent surface, the reflecting member reflecting a projected light travelling in an incident direction in a reflecting direction opposite the incident direction; and that the reflecting member (31) is formed in the shape of a band having a size in a first direction perpendicular to the upper/lower surface of the plate-shaped object which is small relative to its size in a second direction perpendicular to the first direction."*

IV. Reference is made to the following documents:

D2: US 6 053 983 A

D4: PATENT ABSTRACTS OF JAPAN, vol. 1998, no. 10,  
31 August 1998 & JP 10 135 306

D10: JP 2000 124 289 and PATENT ABSTRACTS OF JAPAN

V. The appellant in substance provided the following arguments:

The principal objection in the decision to refuse the application was that the claims lacked an inventive step over a combination of documents D10 and D4. The summary of D10 set out in the decision was accepted. However, it appeared that with knowledge of the solution provided by the invention, the Examining Division had identified D4 as a document which would provide a useful teaching to the skilled person when faced with the technical problem addressed in the application. However, an objective reading of D4 showed

that it would not have been found useful to the skilled person as D4 concerned a very different structure for detecting and carrying wafers. The technical problem of the application was not addressed in D4 and the solution in D4 to a different problem (detecting the presence of both opaque and transparent substrates) provided no useful teaching to the skilled person when considering the problem of the application because the shape of the mirror did not contribute to the solution of D4. Accordingly, the subject-matter of claim 1 involved an inventive step.

## **Reasons for the Decision**

1. The appeal is admissible.
2. *Main request*
- 2.1 *Amendments*

Claim 1 as amended is based on claims 1, 2 and 9 as originally filed and on the description as originally filed, page 11, lines 9 to 13 as well as page 14, line 32 to page 15, line 22.

Claims 2 to 5 are based on claims 4, 6, 8, 10 and 11 as originally filed.

Accordingly, the amendments comply with Article 123(2) EPC.

## 2.2 *Novelty*

### 2.2.1 *Document D10*

Document D10 discloses a robot for carrying thin substrates. The robot comprises, in the terms of claim 1, a robot hand for carrying a plate-shaped object (3), the robot hand being movable relative to the plate-shaped object and being movable to carry the plate-shaped object, wherein the robot hand includes first and second arms (4A, 4B) and a mapping device (cf figure 2).

In D10 the mapping device comprises a light projector and a light receiver arranged respectively at end parts of the first and second arms of the robot hand.

The subject-matter of claim 1 essentially differs from D10 in that the light projector and the light receiver are arranged at the end part of one of the arms of the robot hand and a reflecting member with corner cubes is arranged at the end part of the other arm of the robot hand. Moreover, the reflecting member is formed in the shape of a band having a size in a first direction perpendicular to the upper/lower surface of the plate-shaped object which is small relative to its size in a second direction perpendicular to the first direction.

The subject-matter of claim 1 is, thus, new over document D10 (Article 54(1) and (2) EPC 1973).

### 2.2.2 *Document D4*

Document D4 discloses a robot for carrying substrates.

The robot comprises, in the terms of claim 1, a robot hand (3) for carrying a plate-shaped object (2), the robot hand being movable relative to the plate-shaped object and being movable to carry the plate-shaped object (cf figure 1).

A reflector plate (9) is mounted at the substrate mounting position in the arm, and a light projector (7) and receptor (8) are disposed at a position, where the substrate is not mounted, above the substrate mounted on the arm.

The subject-matter of claim 1 essentially differs from D4 in that robot comprises a robot hand with first and second arms, the light projector and the light receiver being arranged at the end part of one of the arms of the robot hand and a reflecting member with corner cubes being arranged at the end part of the other arm of the robot hand. Moreover, the reflecting member is formed in the shape of a band having a size in a first direction perpendicular to the upper/lower surface of the plate-shaped object which is small relative to its size in a second direction perpendicular to the first direction.

The subject-matter of claim 1 is, thus, also new over document D4 (Article 54(1) and (2) EPC 1973).

2.2.3 The subject-matter of claim 1 is also new over the remaining available, more remote prior art.



2.3 *Inventive step*

2.3.1 Document D10 is considered to provide the closest prior art. The effect of the above-identified distinguishing features of claim 1 over D10 is, as far as the light projector and receiver as well as the reflecting member are concerned, that accurate positional adjustment is not required.

In particular, as explained in the application as filed, *"As shown in Fig. 12, if the optical axis C1 of the light projector 2 (hereinafter referred to as "projection axis C1") and the optical axis C2 of the light receiver 3 (hereinafter referred to as "reception axis C2) are not aligned in the transmission photoelectric sensor 1 according to the first conventional technique, the transmission photoelectric sensor 1 is unable to achieve correct detection. Positional adjustment of the light projector 2 and the light receiver 3 to bring the optical axes C1 and C2 into alignment needs troublesome work.*

*When determining the position of a very thin, plate-shaped object, such as the wafer 27, the light projected by the light projector 2 needs to be small. Faulty detection will results unless the optical axes C1 and C2 are aligned in a high accuracy when the light projector 2 projects light in a small-diameter light beam. Therefore, the respective positions of the light projector 2 and the light receiver 3 must be accurately adjusted. Such an accurate positional adjustment needs troublesome work.*

*As shown in Fig. 13, if the axis C5 of reflected light reflected by the reflecting mirror 7 (hereinafter referred to as "reflection axis C5") is not aligned with the reception axis C4 of a light receiver 10 in the reflection photoelectric sensor 6 according to the second conventional technique, the transmission photoelectric sensor 6 is unable to achieve correct detection. Accurate positional adjustment of the reflecting mirror 7 and the optical sensing unit 8 to align the reflection axis C5 with the reception axis C4 needs troublesome work, similarly to the positional adjustment of the light projector 2 and the light receiver 3." (page 2, line 13 to page 3, line 10; figures 10 to 13).*

The effect of the above-identified second distinguishing features of claim 1 over D10 is that the position of the wafer with respect to the vertical direction can be more accurately determined.

In particular, as submitted by the appellant, when the regression mirror is formed with the first height WI, the difference in the area of an illuminated region on the regression mirror between a situation where the wafer is at the first position and a state where the wafer is at the second position is large (Fig. 8A). Thereby, the difference in the amount of light received by the light receiver is large. Consequently, the situation where the wafer is at the first position and the situation where the wafer is at the second position can be distinguished from one another. Thus, the position of the wafer with respect to the vertical direction Z can be accurately determined and accurate mapping information can be produced.

Accordingly, the objective problem to be solved relative to document D10 is to eliminate the need for accurate adjustments for the detecting unit and to determine more accurately the position of the substrate.

- 2.3.2 According to the decision under appeal, it would be obvious to the skilled person in the art to derive the subject matter of claim 1 by combining the teaching of documents D10 and D4 in order to increase the sensitivity of the mapping device mounted at the end tip of the two robot arms (cf page 9, second paragraph).

Document D4, however, provides a different arrangement of the robot, which does not have a sensor unit at end parts of two arms. Furthermore, avoidance of the need for alignment accuracy between respective parts of the sensor unit is not explicitly addressed in this document either. Accordingly, the skilled person would have to recognise both the applicability of the teaching of D4 to the arrangement of D10 despite the substantially different arrangement of the sensor unit and the advantage in terms of avoidance of the need for accurate alignment despite the absence of any indication in this respect. In the board's judgement, this goes beyond what can be held to be obvious to a person skilled in the art.

- 2.3.3 The subject-matter of claim 1 is not rendered obvious by any of the remaining cited documents either.

In particular, document D2 discloses an arrangement for detecting wafers in a carrier. The arrangement comprises a sensor unit (55) with a light projector and

a light receiver, and a reflecting member. The wafer intersects the optical path along which light travels from the light projector via the reflecting member to the light receiver, thereby allowing detection of the wafer (cf figures 5, 12 and corresponding description).

Document D2, however, does not provide a robot with a detecting unit. Furthermore, avoidance of the need for alignment accuracy between respective parts of the detecting unit is not explicitly addressed in this document. Accordingly, document D2 does not render the subject-matter of claim 1 obvious either.

- 2.3.4 Accordingly, having regard to the available state of the art, the subject-matter of claim 1 is not obvious to a person skilled in the art and, thus, involves an inventive step (Article 56 EPC 1973).
- 2.4 Claims 2 to 5 are dependent on claim 1, providing further limitations. The subject-matter of these claims, therefore, also involves an inventive step.
3. The patent application documents according to the main request also meet the remaining requirements of the EPC, so that a patent can be granted on the basis of these documents.
4. Under these circumstances, the appellant's auxiliary requests need not be considered.

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent with the following documents:

Description: Pages 2, 8 and 10 to 21 as originally filed;  
Page 9 filed with letter of 12 December 2006;  
Pages 3 to 7 filed on 2 May 2012;  
Pages 1, 22, 23 filed on 28 May 2012;

Claims: Nos. 1 to 5 filed on 2 May 2012;

Drawings: Sheets 1/7 to 7/7 as originally filed.

Registrar:

Chair:

S. Sánchez Chiquero

G. Eliasson