

IR INSPECTION SYSTEM AND METHOD THEREFOR

Field of the Invention

[0001] The present invention relates to the semiconductor manufacture, and more specifically to an IR inspection system.

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Background of the Invention

[0002] Wafer inspection is critical in the semiconductor manufacture industry for assuring chip quality and reducing production cost.

[0003] US 8,428,337 B2 discloses an apparatus for detecting micro-cracks in wafers, where the apparatus comprises a first light source directing light substantially along a first axis towards a first surface of a wafer to thereby obtain light emanating along the first axis from a second surface of the wafer, and a second light source directing light substantially along a second axis towards the first surface of the wafer to thereby obtain light emanating along the second axis from the second surface of the wafer. The microcracks of the wafer are detected using lights passing through the wafer.

15 **[0004]** US 2010/0181483 A1 discloses a through-substrate optical imaging device for through-imaging of translucent work objects, in which a radiation source outputs radiation that will be transmissive through the work object. The microcracks of the translucent work objects such as wafers are detected using the radiation (e.g. light source) passing through the wafer.

[0005] US 2011/0280470 A1 discloses a wafer defect inspection apparatus in which a light source passes through the wafer so as to detect the defects in the wafer.

Summary

[0006] One aspect of the present invention provides an IR inspection system for inspecting diced wafer adhered on a holding tape. The IR inspection system comprises an IR imaging device; a liquid pool disposed below the IR imaging device; and a rotatable table for holding diced wafer adhered on a holding tape with an unadhered surface of the holding tape facing the IR imaging device, wherein the rotatable table coupled with a ring wall forming the liquid pool with the unadhered surface of the holding tape submerged in the liquid pool. Operationally, the IR imaging device inspect the diced wafer through the holding tape having a layer of liquid covered thereon.

[0007] In one embodiment, the IR imaging device is a near infrared (NIR) imaging device. In another embodiment, the IR imaging device is a shortwave infrared (SWIR) imaging device.

[0008] In yet another embodiment, the IR imaging device is mounted on two axes tracks movable horizontally across an inspection surface of the diced wafer.

[0009] In a further embodiment, the liquid comprising water. In yet a further embodiment, the liquid comprising a mixture of water and solvent, such as IPA.

[00010] In another embodiment, the IR inspection system further comprising a liquid dispenser for dispensing liquid into the liquid pool.

[00011] In another aspect of the present invention, there is provided a method of inspecting diced wafer adhered on a holding tape. The method comprises disposing the diced wafer adhered on the holding tape below an IR imaging device with an unadhered surface of the holding tape facing the IR imaging device; covering the unadhered surface of the holding tape with a liquid; and inspecting the diced wafer from a bottom side through the holding tape having a layer of liquid covered thereon.

[00012] In one embodiment, the aforesaid method is carried out by the aforesaid the IR inspection system.

[00013] The objectives of and advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings.

Brief Description of the Drawings

[00014] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[00015] FIG. 1 shows a schematic view of the IR inspection system in accordance with one embodiment of the present invention.

[00016] FIG. 2A provides a perspective view of the IR inspection system in accordance with one embodiment of the present invention.

[00017] FIG. 2B provides a cross-section view of the IR inspection system in accordance with one embodiment of the present invention.

[00018] FIG. 3 provides images captured by the IR inspection system.

Detailed Description

5 **[00019]** The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

[00020] Throughout this application, where publications are referenced, the disclosures of these publications are hereby incorporated by reference, in their entireties, into this application in order to more fully describe the state of art to which this invention
10 pertains.

[00021] During semiconductor manufacture process, a holding tape is adhered to one surface of a wafer so that when the wafer is diced into dies, the holding tape holds the diced dies in place. In a microscopic view, the unadhered surface of the holding tape however is not evenly flat. When an image is taken directly through the tape to inspect the
15 wafer or diced died, the image is greatly distorted due to the uneven unadhered surface of the holding tape.

[00022] The inventors of the present invention discovered that when a liquid is added to cover or overlay the unadhered surface of the holding tape, the image distortion caused by the uneven unadhered surface of the holding tape is eliminated; therefore,
20 inspection of wafer or diced dies can be achieved. Furthermore, the inspection does not need dedicated external light or radiation source to heat up the wafer or diced dies.

[00023] The present invention provides an IR inspection system. In brief, the IR inspection system is able to inspect a diced wafer that is still remains on a holding tape by inspecting from the back side of the wafer through the holding tape.

[00024] FIG. 1 illustrates a schematic diagram of an IR inspection system for inspecting diced wafer in accordance with one embodiment of the present invention. As shown in FIG. 1, the IR inspection system **100** comprises an imaging device **102**, being disposed on top of the wafer to be inspected; a liquid pool **104**, being disposed beneath the imaging device **102**, for holding liquid **108**; and a rotatable table **125** (also known as turntable), being disposed further under the liquid pool **104**, for holding diced wafer **121** adhered on a holding tape **122**. In certain embodiments, the imaging device **102** is an IR inspection system. In yet further embodiments, the IR inspection system is near infrared (NIR) or Shortwave IR (SWIR) imaging device. Preferably, the imaging device **102** is supported on a two axes tracks which allows the device to move across the inspection area horizontally. In another embodiment, the device may also be supported on a track that allows the imaging device to move in a lateral axis in relation to the two axes track, allowing the imaging device to move closer or further away from the wafer to be inspected.

[00025] The liquid pool **104** comprises a ring wall adapted to couple with the rotatably table **125** to form a top opened reservoir/pool. The bottom rim of the ring wall may further comprise a gasket **106** to seal the bottom of the reservoir to prevent liquid from leaking out. When the ring wall is coupled on the rotatable table **125** with the diced wafer **121** held on the holding tape **122**, the holding tape is submerged within the reservoir. The liquid **108** can then be injected into the reservoir to completely immersing the holding tape **122** therein. At this point, the diced wafer **121** that is held on the other side of the holding

tape is not in contact with the liquid **108**. With the liquid complete covering at least the top major surface of the holding tape **122**, the wafer inspection process may be started.

[00026] In one embodiment, the liquid is water. In another embodiment, the liquid is mixture of water and solvent, such as Isopropyl Alcohol liquid (IPA).

5 **[00027]** Also in a further embodiment, only a thin coat of the liquid is required on the holding tape **122** to smoothen the surface thereof.

[00028] FIG. 2A illustrates an explored perspective view of an IR inspection system **200** in accordance with an alternative embodiment of the present invention. FIG. 2B illustrates a crossed sectional view of the IR inspection system **200** of FIG. 2A. As shown
10 in FIG. 2A, the IR inspection system comprises an IR imaging device **202**, a liquid pool **208**, a liquid dispenser **212**. The IR imaging device **202** is mounted on a support **214** manuvable horizontally on two axes tracks. In another embodiment, the support **214** may comprise a verical track adapted for rising and lowering the IR imaging device **202** relative to the liquid pool **208**. The liquid pool **208** is formed when a ring wall **204** is coupled with
15 a rotatable table **225** for holding the diced wafer.

[00029] When the rotatable table **225** carrying the diced wafer is in placed coupled to the ring wall **204**, the unadhered surface of the holding tape is exposed within the liquid pool **208** facing the IR imaging device **202**.

[00030] Then, the liquid dispenser **212** dispenses liquids into the liquid pool **208** to
20 form at least a thin layer over the unadhered surface of the holding tape.

[00031] In certain embodiments, the liquid is water. In certain embodiments, the liquid is water plus IPA. The thin layer of liquid, such as water or mixtures or etc. is added or coated to the entire surface to eliminate the uneven surface distortion. In other word, with the liquid added, the holding tape is nullified under the IR imaging device **202** to
5 obtain a clear image of the underside of the diced wafer to be inspected.

[00032] In the present invention, the holding tape **122** is UV tape adapted for wafer wafer dicing. During dicing process, the wafer is held by the UV tape on a ring frame of the rotatable table **125**.

[00033] Once the inspection is done, in one embodiment, the liquid dispenser **212**
10 may further be adapted to drain the liquid from the liquid pool **208**.

[00034] FIG. 3 exemplifies images captured by through the IR inspection system.

[00035] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will
15 become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. An IR inspection system for inspection diced wafer held on a holding tape,
5 comprising:

an IR imaging device;

a liquid pool disposed below the IR imaging device; and

a rotatable table for holding diced wafer adhered on a holding tape with an
unadhered surface of the holding tape facing the IR imaging device, wherein the rotatable
10 table coupled with a ring wall forming the liquid pool with the unadhered surface of the
holding tape submerged in the liquid pool,

wherein operationally, the IR imaging device inspect the diced wafer through
the holding tape having a layer of liquid covered thereon.

2. The IR inspection system according to claim 1, wherein the IR imaging
15 device is a near infrared (NIR) imaging device.

3. The IR inspection system according to claim 1, wherein the IR imaging
device is a shortwave infrared (SWIR) imaging device.

4. The IR inspection system according to claim 1, wherein the IR imaging device is mounted on on two axes tracks movable horizontally across an inspection surface of the diced wafer.

5. The IR insprection system according to claim 1, wherein the liquid
5 comprising water.

6. The IR inspection system according to claim 1, wherein the liquid comprising a mixture of water and IPA.

7. The IR inspection system according to claim 1, further comprising a liquid dispenser for dispensing liquid into the liquid pool.

10 8. A method of inspecting diced wafer adhered on a holding tape, the method comprising:

disposing the diced wafer adhered on the holding tape below an IR imaging device with an unadhered surface of the holding tape facing the IR imaging device;

covering the unadhered surface of the holding tape with a liquid;

15 inspecting the diced wafer from a bottom side through the holding tape having a layer of liquid covered thereon.

9. The method of claim 8, carried out with the IR inspection system according to claim 1.