

METROLOGY DEVICE AND METROLOGY METHOD

The present invention relates to a metrology device for inspecting a substrate and a corresponding metrology method.

Purely acoustic measuring methods are used primarily in the prior art, with the aid of which a bonded substrate stack can be investigated with regards to the structure and/or faults thereof. For the most part, the entire substrate stack is placed into a liquid, particularly water, to couple in a sound signal.

In addition, electromagnetic measuring methods and plants also exist, with the aid of which one can measure a substrate stack. In this case, electromagnetic beams are introduced into the substrate stack and the reflection thereof is measured. One such method is disclosed in WO2012062343A1.

Wetting the substrate stack with liquid constitutes the greatest problem. Wetting of this type is undesirable for several reasons.

First, the substrate stack must also be dried after removal from the plant and second, liquid can penetrate into the boundary surface between the substrates.

The electromagnetic measuring methods have the disadvantage that the information is limited by the limited penetration depth of the electromagnetic beams. The beams penetrate only to a relatively short depth of the substrate stack, in particular owing to metallic components with high absorption. Furthermore, the reflected measured signal is severely weakened after exiting the substrate stack. Furthermore, for the most part scanning methods are used, that is to say methods in which the substrate stack completes a relative movement with respect to a sharply focused beam which is scanning the substrate stack. This relative movement is extremely time-intensive and therefore costly.

Embodiments of the present invention disclose a metrology device and a metrology method, using which the investigation of substrate stacks takes place in a fast, dry, highly accurate, reliable and inexpensive manner.

According to a first aspect of the present invention, there is provided a metrology device for inspecting a substrate, particularly a substrate stack, preferably a bonded substrate stack, with the following features: sound application means for applying sound waves to a first substrate stack surface of the substrate, particularly the substrate stack, an optical system having a source for outputting electromagnetic radiation, which are split into at least one first beam path and one second beam path, means for loading a substrate stack measuring surface of the substrate, particularly the substrate stack, with

the first beam path, interference means for forming an interference radiation made up of the first and second beam paths and a detector for detecting the interference radiation, analysing means for analysing the interference radiation detected at the detector, characterized in that the sound application means and the optical system are located on opposite sides of the substrate.

According to a second aspect of the present invention, there is provided a metrology method for inspecting a substrate, particularly a substrate stack, preferably a bonded substrate stack, having the following steps, particularly the following procedure: applying sound waves to a first substrate stack surface of the substrate, particularly the substrate stack, applying a first beam path of electromagnetic radiation output from a source to a substrate stack measuring surface of the substrate applied with sound waves, particularly the substrate stack, forming interference radiation made up of the first beam path and a second beam path of the electromagnetic radiation, detecting the interference radiation at a detector, analysing the interference radiation detected at the detector, characterized in that sound application means and the source are located on opposite sides of the substrate.

All combinations of at least two features specified in the description, the claims and/or the figures also fall within the scope of the invention. When value ranges are specified, values lying within the limits mentioned should also be disclosed as limit values and be claimable in any desired combination.

Embodiments of the present invention in this case carry out a, particularly simultaneous, loading of a substrate stack with sound waves and a first beam path of electromagnetic waves, particularly from different, preferably opposite, sides of the substrate stack. A measurement/analysis of the substrate stack, with regard to voids in particular, is enabled by means of a second beam path of the electromagnetic waves, which is not guided to the substrate stack and is in particular transmitted from a source simultaneously to the first beam path, and interference formation with the first beam path.

In other words, embodiments of the invention in particular teaches a plant and a method, in order to generate a three-dimensional image of a substrate stack by means of (ultra-)sound excitation and interference measurement.

Embodiments of the invention are suitable for measuring individual substrates which are not connected to a substrate stack. The measurement of substrate stacks is the preferred embodiment. Insofar as reference is made to substrate stacks or substrate stacks are described, the description should also apply for, particularly individual, substrates.

The substrates/substrate stacks may have any desired shape, but are preferably circular. The diameter of the substrates is in particular industrially standardized. For wafers, the industry-standard diameters are