

Device for the UV treatment of a wafer or substrate

FIELD OF THE INVENTION

The invention concerns a device for UV treatment of a wafer or substrate. UV light means ultraviolet light.

The term wafer relates originally to thin disks made of a semiconductor material, but currently also generally includes thin disks made of other materials such as glass. The shape of a wafer is round. In contrast to this, similar objects that are rectangular are called substrate. The term substrate also includes printed circuit boards.

BACKGROUND OF THE INVENTION

Such devices for UV treatment are used for example in the semiconductor industry in order to deactivate adhesives, i.e. to reduce their adhesive capacity in part or in full. Gas-discharge lamps or UV ultraviolet tubes are used as UV light sources. Gas-discharge lamps require a long warm-up time until they are ready for operation and generate a high amount of lost heat. UV tubes are inefficient.

SUMMARY OF THE INVENTION

The invention is based on the object of developing such a device with improved properties.

The invention proposes to use a device for UV treatment of an object, like especially a wafer or substrate, which device comprises a UV light source, the UV light source comprising a plurality of LEDs and a heat sink, wherein the LEDs emit UV light or light containing UV light and wherein the heat sink serves to emit the lost heat generated by the LEDs to the ambient environment. Preferably, the heat sink consists of ceramics. In a preferred embodiment, the device further comprises a glass plate for receiving the object, i.e. the wafer or substrate, and the UV light source is arranged in a stationary way beneath the glass plate and illuminates a predetermined surface area of the glass plate.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate one or more embodiments of the present invention and, together with the detailed description, serve to explain the principles and implementations of the invention. The figures are not to scale.

In the drawings:

- Figs. 1, 2 show a first embodiment of a device in accordance with the invention for the UV treatment of an object, especially a wafer or substrate;
- Figs. 3, 4 shows a second embodiment of such a device;

- Fig. 5 shows a third embodiment of such a device, and
 Fig. 6 shows a fourth embodiment of such a device.

DETAILED DESCRIPTION OF THE INVENTION

The statements made below apply similarly to wafers as well as to substrates. For simplicity's sake only the term wafer will be used below. Fig. 1 and Fig. 2 schematically show a top view and a side view of a first embodiment of a device for UV treatment of a wafer or substrate. The device comprises a chassis 1 in which a transport system 2 and a UV light source 3 are arranged, with the UV light source 3 radiating UV light upwardly. The transport system 2 comprises a motor 4, rollers 5 and conveyor belts 6. The motor 4 drives at least one of the conveyor belts 6. The UV light source 3 is arranged in the middle of the transport system 2. In the example, the left half of the transport system 2 is used as a loading surface 7 and the right half as an unloading surface 8. One wafer after the other is placed on the loading surface 7 during operation, conveyed by the transport system 2 in a transport plane 9 in the transport direction 10 indicated by the arrow to the unloading surface 8 and taken from the unloading surface 8. The loading and unloading can occur by hand or by a fully automatic loading and unloading station.

The UV light source 3 comprises a plurality of LEDs 11 which emit ultraviolet light in a predetermined angular area which in the example is approximately 120°. Different types of LEDs 11 can be used depending on requirements and application. UV LEDs are especially suitable which emit light in the UV range mainly or nearly exclusively. A UV LED which emits light of wavelength of approximately 365 nm and achieves a light output power of 310 mW can be obtained from the company Nichia. This UV LED is available with integrated lens system packed in a housing. The integrated lens system serves to emit the UV light in the predetermined angular area. In certain applications, a white-light LED can be used as LED 11 which emits white light which contains a comparatively high amount of UV radiation.

The LEDs 11 not only generate UV light but also lost heat. In order to achieve the longest possible life of the LEDs 11, it is necessary to keep the operating temperature of the LEDs 11 as low as possible. The UV light source 3 therefore comprises a passive cooling in the form of a heat sink 12 or an active cooling in the form of a heat sink 12 and a fan 13, with the fan 13 allowing the air to flow past the heat sink 12. The lost heat generated by the LEDs 11 can thus efficiently be passed to the surrounding environment. The LEDs 11 are mounted for example on a printed circuit board 14 and the printed circuit board 14 is fastened to the heat sink 12. The printed circuit board 14 is chosen in such a way that it will guide the lost heat generated by the LEDs 11 in the best possible way to the heat sink 12.

An especially high cooling performance can be achieved when ceramics are used as the material for the heat sink 12. The heat sink 12 can consist of a single piece of ceramic material or of several ceramic blocks which are arranged between two rails and can be mounted individually.

The LEDs 11 are arranged beneath the transport plane 9, either in a single row or, as shown, in several

rows, three in the example, and laterally offset. The distance A of adjacent LEDs 11 as measured transversally to the transport direction 10 is dimensioned in such a way that their light cones overlap at least at the edges, so that the entire useful width B of the device is illuminated. The distance A amounts to $A = 1$ cm in the example. The LEDs 11 are supplied from a constant current source with current, with preferably eight LEDs 11 each (or any other number) being switched in series.

The following embodiments are based on the same technology, but differ in the embodiment. Therefore, what has been said above thus also applies to them analogously.

Figs. 3 and 4 schematically show a top view and a side view of a second embodiment of a device in accordance with the invention, in which the UV light source 3 is arranged above the transport plane 9 and radiates downwardly. The UV light source 3 is fastened either to the chassis 1 or a lid that can be flipped open. The conveyor belts 6 extend continuously. The UV LEDs 11 are arranged in a single row in this example.

Fig. 5 schematically shows a top view of a third embodiment of a device in accordance with the invention, in which the wafer rests on a glass plate 15 and the UV light source 3 is arranged on a carriage 16 which can be moved back and forth on guide means 17 arranged beneath the glass plate 15. The UV LEDs 11 which are arranged in a row transversally to the driving direction 18 of the carriage radiate upwardly on the other hand.

Fig. 6 schematically shows a top view of a fourth embodiment of a device in accordance with the invention in which there is neither a transport of the wafer nor any movement of the UV light source 3. The UV light source 3 comprises LEDs 11 which are arranged in rows and columns and which illuminate a predetermined area. The light cones of adjacent LEDs 11 overlap at the edges in the plane formed by the surface area. The LEDs 11 are arranged on a heat sink, like in the preceding examples.

The described devices are suitable for UV treatment of any desired object, especially a wafer or substrate. An application of this device is given in the semiconductor industry when it is desired to reduce the adhesive capacity of semiconductor chips on a foil. The semiconductor chips are produced as a plurality of integrated circuits arranged adjacent to one another on a wafer. The wafer is glued at the end to an adhesive foil clamped on a frame and then sawn into the individual semiconductor chips. Thereafter the foil with the individual semiconductor chips is subjected to a UV treatment in order to destroy the adhesive capacity of the foil or to reduce the same to a desired amount. In doing so, the foil faces the UV light source and the semiconductor chips are located on the side of the foil averted from the UV light source.

The device in accordance with the invention is also suitable for the treatment of wafers, substrates and the like which are coated with photoresist and in which the photoresist must be treated with UV light.

The device can also be used when adhesives need to be cured with UV light.

The apparatus in accordance with the invention comes with several advantages:

- Heat development is low, which means that the foil is only subjected to a moderate temperature.
- The service life of the UV light source is very high, which means that maintenance costs are therefore low.
- UV light is distributed homogeneously over the entire surface area.
- The device is immediately ready for operation. Heat-up times are avoided.

While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art having the benefit of this disclosure that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims and their equivalents.

CLAIMS

1. Device for UV treatment of a wafer or substrate, comprising a UV light source (3), the UV light source comprising a plurality of LEDs (11) and a heat sink (12), wherein the LEDs emit UV light or light containing UV light and wherein the heat sink serves to emit the lost heat generated by the LEDs to the ambient environment.
2. Device according to claim 1, wherein the heat sink consists of ceramics.
3. Device according to claim 1 or 2, further comprising a glass plate (1) for receiving the wafer or substrate, wherein the UV light source is arranged in a stationary way beneath the glass plate and illuminates a predetermined surface area of the glass plate.