

APPARATUS FOR TREATING WASTE WORKING LIQUID

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an apparatus for treating a waste working liquid which is annexed to a machining apparatus such as a cutting apparatus for cutting a work such as a semiconductor wafer and which is operative to treat a waste liquid of a working liquid supplied at the time of machining.

Description of the Related Art

In a semiconductor device manufacturing process, a plurality of regions are demarcated in the face-side surface of a semiconductor wafer having a roughly circular plate-like shape by planned dividing lines called streets arranged in a grid pattern, and devices such as ICs and LSIs are formed in the thus demarcated regions. Then, the semiconductor wafer is cut along the streets to divide the regions with the devices formed therein, to manufacture individual semiconductor devices. Also, an optical device wafer in which a gallium nitride compound semiconductor or the like is laminated on the face-side surface of a sapphire substrate is cut along the streets into individual optical devices such as light

emitting diodes and laser diodes, which are widely used for electric apparatuses.

The cutting along the streets of the semiconductor wafer or the optical device wafer or the like as above-mentioned is usually conducted by use of a cutting apparatus called dicer. The cutting apparatus includes a chuck table for holding a work such as a semiconductor wafer, cutting means having a cutting blade for cutting the work held on the chuck table, and working water supplying means for supplying working water (working fluid) to the cutting blade. Cutting water is supplied to the cutting blade in rotation by the working water supplying means so as to cool the cutting blade, and the working water is supplied to that part of the work which is being cut by the cutting blade, during the cutting operation.

Into the working liquid supplied at the time of cutting as above-mentioned, wastes generated upon cutting of the silicon or gallium nitride compound semiconductor are mixed. Since the waste working liquid in which the wastes of the semiconductor material have mixed would cause environmental pollution, the waste working liquid is deprived of the wastes by use of a waste liquid treating device, before being reused or discarded (refer

to, for example, Japanese Patent Laid-open No. 2004-230527).

While the waste liquid treating apparatus is equipped with a filter for separating the wastes generated on cutting, it may be necessary to use a fine-mesh filter for securely separating the wastes generated upon cutting. However, the fine-mesh filter capable of securely separating the wastes generated upon cutting is expensive, and is not necessarily satisfactory on an economic basis.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a waste liquid treating apparatus by which wastes generated upon machining such as wastes generated upon cutting can be securely separated while using a comparatively coarse-mesh filter.

In accordance with an aspect of the present invention, there is provided an apparatus for treating a waste working liquid, operative to treat a waste working liquid obtained through mixing-in of wastes generated at the time of machining on a machining apparatus into a working liquid supplied at the time of the machining, the apparatus including: a waste liquid tank for containing

the waste working liquid; a pump for feeding the waste working liquid contained in the waste liquid tank; and a filter for filtering the waste working liquid fed by the pump, wherein the filter includes a filter paper formed in a tubular shape, a tubular body which covers an outer periphery of the tubular filter paper and which is provided with a plurality of openings in a side surface thereof, a bottom plate for closing a lower end of the tubular filter paper, and a top plate which closes an upper end of the tubular filter paper and which has a waste liquid inlet port for introducing therethrough the waste working liquid fed by the pump, and a fine powder is placed inside the tubular filter paper.

Preferably, the fine powder includes silica having a particle diameter of 0.5 to 2.0 μm .

According to the present invention, since the fine powder is placed inside the tubular filter paper constituting the filter, the fine powder adheres to the inside surface of the tubular filter paper, whereby filtration efficiency is enhanced. Therefore, the wastes generated upon machining which have mixed in the waste working liquid can be separated assuredly. Accordingly, a comparatively coarse-mesh filter which is inexpensive can be used.

The above and other objects, features and advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claims with reference to the attached drawings showing some preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an essential part perspective view of an apparatus for treating a waste working liquid configured according to the present invention;

FIG. 2 is an exploded perspective view of an essential part of the apparatus for treating a waste working liquid; and

FIG. 3 is a block diagram of an apparatus for treating a waste working liquid configured according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, a preferred embodiment of the apparatus for treating a waste working liquid configured according to the present invention will be described in detail below, referring to the attached drawings. FIG. 1 shows an

essential part perspective view of an apparatus for treating a waste working liquid configured according to the present invention, and FIG. 2 shows an exploded perspective view of an essential part of the apparatus for treating a waste working liquid shown in FIG. 1.

The apparatus for treating a waste working liquid in the embodiment shown includes a waste liquid tank 2 for containing a waste working liquid, a pump 3 for feeding the waste working liquid contained in the waste liquid tank 2, and a first filter 4a and a second filter 4b for filtering the waste working liquid fed by the pump 3.

The waste liquid tank 2 has a waste liquid inflow port 21 at an end wall thereof, and the waste liquid inflow port 21 is connected to waste working liquid feeding-out means provided in a machining device such as a cutting apparatus (not shown). A pump 3 for feeding the waste working liquid is provided at an upper wall of the waste liquid tank 2. The waste liquid tank 2 thus configured is disposed on an upper surface of a support base 5.

The first filter 4a and the second filter 4b each include a filter paper 41 formed in a tubular shape, a tubular body 42 covering the outer periphery of the

filter paper 41, a bottom plate 43 closing the lower end of the tubular filter paper 41, and a top plate 44 closing the upper end of the tubular filter paper 41. The tubular filter paper 41 is folded a plurality of times in a radial form so that the filtration area is increased. Incidentally, as the tubular filter paper 41, for example, a comparatively inexpensive filter paper with such a mesh that particles having a particle diameter of not more than 0.3 to 0.4 μm can pass therethrough is used. The tubular body 42 covering the outer periphery of the tubular filter paper 41 is provided with a plurality of openings 421 in its side surface. In addition, the top plate 44 closing the upper end of the tubular filter paper 41 is provided with a waste liquid inlet port 441 in its central part. The first filter 4a and the second filter 4b thus configured are each charged with a fine powder 40 including silica with a particle diameter of 0.5 to 2.0 μm inside the tubular filter paper 41. The first filter 4a and the second filter 4b thus configured are disposed on a filter rack 6 arranged on the upper side of the waste liquid tank 2 disposed on the support base 5.

A filter rack 6 includes a bottom wall 61 formed in a rectangular shape, side walls 62 and 63 erectedly

provided at both side edges of the bottom wall 61, and end walls 64 and 65 erected provided at both end edges of the bottom wall 61, is supported by four support columns 66, and is disposed on the upper side of the waste liquid tank 2 arranged on the support base 5. The filter rack 6 has the bottom wall 61 and the side walls 62, 63 and the end walls 64, 65 thereof forming a working liquid reservoir tank 60 for containing a filtered working liquid obtained by depriving the waste working liquid of the wastes generated upon machining, by the first filter 4a and the second filter 4b. Besides, the bottom wall 61 constituting the filter rack 6 is provided with a discharge port 611 for discharging the filtered working liquid reserved in the working liquid reservoir tank 60. Incidentally, the discharge port 611 is connected to working liquid supplying means or discarding means provided in the machining apparatus (not shown). In addition, the bottom wall 62 constituting the filter rack 6 is provided on its upper surface with first support bases 67a and second support bases 67b for supporting the first filter 4a and the second filter 4b, respectively. The first filter 4a and the second filter 4b are mounted on the first support bases 67a and the second support bases 67b, respectively.

Now, waste working liquid feeding means by which the waste working liquid contained in the above-mentioned waste liquid tank 2 is fed to the first filter 4a and the second filter 4b will be described below, referring to FIG. 3. A waste working liquid feeding means 7 shown in FIG. 3 includes: the pump 3 for feeding the waste working liquid contained in the waste liquid tank 2; a piping 71 connected to the pump 3; pipings 71a and 71b through which the piping 71 is connected to the waste liquid inlet port 441 of the first filter 4a and the waste liquid inlet port 441 of the second filter 4b; and a solenoid-operated selector valve 72 disposed between the piping 71 and the pipings 71a, 71b. The solenoid-operated selector valve 72, in the state of being deenergized (turned OFF), interrupts the communication of the piping 71 with the pipings 71a, 71b. Besides, when a solenoid 72a on one side is energized (turned ON), the piping 71 is caused to communicate with the piping 71a, and, when a solenoid 72b on the other side is energized (turned ON), the piping 71 is caused to communicate with the piping 71b. Incidentally, the piping 71a and the piping 71b are provided with first pressure detecting means 73a and second pressure detecting means 73b for detecting the pressure of the waste working liquid fed to the first

filter 4a and the second filter 4b, respectively. The first pressure detecting means 73a and the second pressure detecting means 73b send their detection signals to control means which will be described later.

Continuing description while referring to FIG. 3, the apparatus for treating a waste working liquid in the embodiment shown in the figure has compressed air supplying means 8 for supplying compressed air to the first filter 4a and the second filter 4b. The compressed air supplying means 8 includes: a compressed air source 81; a piping 82a and a piping 82b through which the compressed air source 81 is connected to the piping 71a and the piping 71b of the waste working liquid feeding means 7; and a first proportional solenoid-operated relief valve 83a and a second proportional solenoid-operated relief valve 83b disposed respectively in the piping 82a and the piping 82b.

In addition, the apparatus for treating a waste working liquid in the embodiment shown in the figure has control means 9 to which pressure signals from the pressure detecting means 73a and 73b are inputted, and which outputs control signals to the pump 3, the solenoid-operated selector valve 72, the first proportional solenoid-operated relief valve 83a and the

second proportional solenoid-operated relief valve 83b. The control means 9 is mounted on the upper surface of the support base 5.

The apparatus for treating a waste working liquid in the embodiment shown in the figure is configured as above-described, and it operates as follows. In treating the waste working liquid contained in the waste liquid tank 2, the control means 9 first actuates the pump 3, and energizes (turns ON) the solenoid 72a on one side of the solenoid-operated selector valve 72. As a result, the waste working liquid fed by the pump 3 is introduced into the first filter 4a through the piping 71, the solenoid-operated selector valve 72, the piping 71a and the waste liquid inlet port 441. The waste working liquid introduced into the first filter 4a is filtered by the tubular filter paper 41, and flows out into the working liquid reservoir tank 60 of the filter rack 6 through the plurality of openings 421 formed in the side surface of the tubular body 42 covering the outer periphery of the tubular filter paper 41. In this case, the fine powder 40 of silica placed inside the first filter 4a is deposited on the inner surface of the tubular filter paper 41 to enhance the filtration performance, so that the wastes generated upon machining and mixed in the waste working

liquid are separated assuredly. Therefore, the wastes generated upon machining can be securely separated without using any fine-mesh filter paper that is expensive. The filtered working liquid having flowed into the working liquid reservoir tank 60 of the filter rack 6 as above-mentioned is discharged through the discharge port 611, to be recirculated by working liquid supplying means provided in the machining device (not shown) or be discarded through discarding means.

Incidentally, in introducing the waste working liquid into the first filter 4a as above-mentioned, the control means 9 energizes (turns ON) the first proportional solenoid-operated relief valve 83a of the compressed air supplying means 8, and controls an impressed voltage so that the flow-out pressure will be 1.5 atm, for example. As a result, the compressed air from the compressed air source 81 is decompressed to 1.5 atm by the first proportional solenoid-operated relief valve 83a, before being introduced into the first filter 4a through the piping 71b and the waste liquid inlet port 441. Therefore, a pressure of 1.5 atm is exerted on the waste working liquid introduced into the first filter 4a. Consequently, the fine powder 40 of silica placed inside the first filter 4a is securedly deposited on the inner

surface of the tubular filter paper 41, so that filtration efficiency is maintained.

When the treatment of the waste working liquid by the first filter 4a is being carried out as above-described, the wastes generated upon machining are deposited on the inside of the tubular filter paper 41 of the first filter 4a. With the wastes generated upon machining thus deposited on the inside of the tubular filter paper 41, it becomes difficult for the working liquid to pass through the tubular filter paper 41, so that the filtering function is lost. With the wastes generated on machining thus deposited on the inside of the tubular filter paper 41, the pressure inside the tubular filter paper 41 is raised. Then, when the pressure inside the tubular filter paper 41 is raised to 2 atm, for example, the control means 9 supplied with a pressure signal outputted from the first pressure detecting means 73a energizes (turns ON) the solenoid 72b on the other side of the solenoid-operated selector valve 72. Therefore, the communication between the piping 71 and the piping 71a is interrupted, whereas the piping 71 and the piping 71b are made to communicate with each other. As a result, the waste working liquid fed by the pump 3 is introduced into the second filter 4b through

the piping 71, the solenoid-operated selector valve 72, the piping 71b and the waste liquid inlet port 441. In addition, the control means 9 energizes (turns ON) the second proportional solenoid-operated relief valve 83b of the compressed air supplying means 8, and controls the impressed voltage so that the flow-out pressure will be 1.5 atm, for example. Consequently, the waste working liquid fed by the pump 3 is treated by the second filter 4b in the same manner as the treatment by the first filter 4a.

On the other hand, the control means 9 controls an impressed voltage so that the flow-out pressure at the first proportional solenoid-operated relief valve 83a of the compressed air supplying means 8 will be 3 atm, for example. As a result, the waste working liquid stagnating inside the tubular filter paper 41 of the first filter 4a is forcibly filtered and caused to flow out into the working liquid reservoir tank 60 of the filter rack 6 through the plurality of openings 421 formed in the side surface of the tubular body 42 covering the outer periphery of the tubular filter paper 41. When a predetermined period of time has passed from the control of the impressed voltage so that the flow-out pressure at the first proportional solenoid-operated relief valve 83a

will be 3 atm, for example, the control means 9 deenergizes (turns OFF) the first proportional solenoid-operated relief valve 83a. After the waste working liquid stagnating inside the tubular filter paper 41 of the first filter 4a is thus discharged, the filter is discarded and is replaced by a new filter. During this operation, the treatment of the waste working liquid is carried out by the second filter 4b as above-mentioned, so that the operation of the machining device need not be interrupted.

The present invention is not limited to the details of the above described preferred embodiments. The scope of the invention is defined by the appended claims and all changes and modifications as fall within the equivalence of the scope of the claims are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. An apparatus for treating a waste working liquid, operative to treat a waste working liquid obtained through mixing-in of wastes generated at the time of machining on a machining apparatus into a working liquid supplied at the time of the machining, said apparatus comprising:

a waste liquid tank for containing said waste working liquid;

a pump for feeding said waste working liquid contained in said waste liquid tank; and

a filter for filtering said waste working liquid fed by said pump,

wherein said filter includes a filter paper formed in a tubular shape, a tubular body which covers an outer periphery of said tubular filter paper and which is provided with a plurality of openings in a side surface thereof, a bottom plate for closing a lower end of said tubular filter paper, and a top plate which closes an upper end of said tubular filter paper and which has a waste liquid inlet port for introducing therethrough said waste working liquid fed by said pump, and a fine powder is placed inside said tubular filter paper.

2. The apparatus for treating a waste working

liquid as set forth in claim 1, wherein said fine powder comprises silica with a particle diameter of 0.5 to 2.0 μm .