

Title:

Recycling method and device for recycling waste water
containing slurry from a semi-conductor treatment
5 process, in particular from a chemico-mechanical
polishing process

Description:

10 The invention relates to a recycling method and a
recycling device for recycling slurry wastewater from a
semiconductor processing process, in particular from a
chemical-mechanical polishing process.

15 For polishing semiconductor materials, in recent years,
chemical-mechanical polishing (CMP) has established
itself as the standard method. In particular, CMP is
employed after the deposition of functional layers onto
semiconductor wafers in order to compensate for
20 irregularities that have resulted during deposition. In
this case, a chemically and mechanically active,
colloidal polishing agent, what is termed slurry, is
distributed between the semiconductor wafer and a
polishing surface. Supported by relative motions
25 between semiconductor wafer and polishing surface, the
semiconductor wafer surface is chemically attacked and
polished.

In such polishing processes, fresh slurry must be
30 continuously fed to the polishing surface in order to
achieve an optimum polishing performance. In the
polishing process, wastewater is formed which, in
addition to polishing liquid (generally water and
slurry), contains impurities which result from the
35 polishing abrasion. In addition, the wastewater
generally contains additional chemicals which control
the polishing process. These can comprise, depending on
the process type, pH regulators, oxidizing agents

and/or stabilizers. The slurry wastewater is generally removed and disposed of. Since not only the slurry but also the polishing liquid are costly to acquire, slurry recycling processes offer a great cost-savings potential.

In known processes for recovering slurry from the slurry wastewater, the wastewater removed from a CMP device is collected and recycled by mixing and/or filtering processes. Such a method is disclosed, for example, in EP 0 822 033 A1. In this known method, the wastewater is removed from the polishing process by suction using a pump and passed into a type of mixing device, wherein further treatment substances and also fresh slurry are also introduced via lines. The treated mixture resulting therefrom is passed as recycled slurry through a heat exchanger, a plurality of sensors and also finally a filter and fed to the polishing process as fresh slurry. Linear recycling methods of this type, in which the wastewater is fed back to the polishing process after a plurality of process steps that follow one another in time, have the disadvantage that very high requirements of the individual components of the recycling device must be made which are generally not met.

In contrast thereto, US 6 722 958 B2 discloses the recycling of slurry in a cycle method. In accordance therewith, wastewater from a CMP process is charged into a vessel and from there passed through an ultrafilter. In this case, water filtered out from the wastewater is disposed of. The filter product resulting during filtering is passed as concentrated slurry back into the vessel. Then, or simultaneously, a purification process is carried out, in which purification water is regularly introduced into the vessel in order to dilute and wash the concentrated slurry in order in this manner to extract by

dissolution impurities such as salts and organic substances. However, this method is complex and in addition does not fulfill the purpose of obtaining in an efficient manner a high concentration of recycled
5 slurry.

It is therefore the object of the invention to provide a recycling method and a recycling device for a cost- and time-efficient recycling of slurry and/or further
10 fluids such as water, for example, from slurry wastewater.

The object is achieved according to the invention by a recycling method having the features of claim 1 and by
15 a recycling device having the features of claim 12. Advantageous developments of the invention are specified in the subclaims.

The invention is firstly based on the principle of
20 concentrating the slurry-containing wastewater that is to be recycled by fluid removal in a circulation or circuit. For this purpose the wastewater is first passed into a circulation vessel. There it mixes with concentrated wastewater generated in the circuit to
25 form mixed wastewater. In the circulation process, mixed wastewater is removed from the circulation vessel, passed through an ultrafilter device and concentrated wastewater formed in this process is passed back into the circulation vessel.

30

The ultrafilter device therefore comprises at least one entry through which the mixed wastewater that is removed from the circulation vessel is introduced into the ultrafilter device, and at least two exits. In the
35 ultrafilter device, liquid is removed from the mixed wastewater that is introduced, in order thus to achieve a concentration of the wastewater. The concentrated wastewater is then passed through one of the exits of

the ultrafilter device and via a wastewater return line into the circulation vessel. The liquid that is removed from the mixed wastewater is ejected via a second exit of the ultrafilter device and can then preferably be collected and reused.

The recycling method comprises in this case substantially two process phases, namely a first phase in which the filtration step is carried out, and a second phase in which the concentration step is carried out. In the filtration step, while the wastewater is concentrated in the circuit between the circulation vessel and the ultrafilter device, fresh slurry wastewater is passed into the circulation vessel, which slurry wastewater mixes with the concentrated wastewater.

In contrast, the concentration step is distinguished in that, during the concentration of the wastewater in the circuit, the feed of fresh slurry wastewater into the circulation vessel is decreased or substantially shut off. A switchover between the first phase and the second phase proceeds using a control device of the recycling device. The switchover operation can be, for example, controlled with respect to time, or triggered. Preferably, however, it is controlled on the basis of measurements which are determined using sensors arranged in the recycling device and comparison thereof with theoretical values.

The expression "fresh wastewater" means that in this case this is wastewater which is introduced by passing it into the circulation vessel of the previously described circuit for concentrating the wastewater. This fresh wastewater therefore differs from the concentrated wastewater which is passed from the exit of the ultrafilter device to the circulation vessel. The fresh wastewater is the slurry-containing

wastewater which is produced in the semiconductor processing, for example in the chemical-mechanical polishing process (CMP process) and comprises slurry contaminated by eroded material and other chemicals.

5

The fresh wastewater can also be prefiltered wastewater which, for example, is first stored in a preliminary storage tank and is passed from there via one or more prefilter stages to the circulation vessel. Preferably, 10 prefiltration proceeds in a two-stage manner and with very small retention rates in such a manner that particulate contaminations, for example owing to pad wear in a CMP process, are kept away from the circulation vessel. By this means a rapid blocking of 15 the ultrafilter device is prevented. This is of great importance, in particular in membrane-based ultrafilter devices having hollow-fiber membranes.

The ultrafilter device is a filter device which is 20 suitable for taking off liquid from the mixed wastewater introduced herein and flowing through it. Generally, this liquid is water, but other liquids or liquid mixtures can also be removed from the mixed wastewater which will possibly be used in the 25 semiconductor processing process. In the ultrafilter device it is ensured that particles which are located in the liquid removed from the mixed wastewater have particle sizes of at most about 0.01 μm to about 0.1 μm . This is in contrast, for example, to 30 microfiltration in which the liquid that is removed can have particles in the order of magnitude of above 0.1 μm . In other words, in this case the expression "ultra" in the expression "ultrafilter device" is used to characterize the particle size separated off from 35 the mixed water together with the liquid by the filter device.

On passage through the ultrafilter device, the mixed

wastewater is concentrated to give a concentrated wastewater. This means that the slurry in the concentrated wastewater is present in a higher volume concentration than in the mixed wastewater which was introduced into the ultrafilter device. The concentration proceeds by fluid removal in the ultrafilter device and leads to an increase in the solids concentration in the concentrated wastewater compared with the mixed wastewater.

10

In a preferred embodiment, it is provided that the mixed wastewater that is removed from the circulation vessel is passed through a membrane-based ultrafilter device and concentrated thereby by removal of a permeate to give concentrated wastewater. In particular, this can be in this case a cross-flow filtration device, also called tangential-flow or cross-current filtration. The membrane of the ultrafilter device is preferably made of a polymer, for example of polyacrylonitrile.

20

In an advantageous development it is provided that the concentration step is carried out immediately after the filtration step. This means that no further process steps are carried out in time between the concentration step and the filtration step. While the mixed wastewater in the filtration step is removed from the circulation vessel and then passed through the ultrafilter device and back into the circulation vessel, the feed of the fresh wastewater into the circulation vessel, controlled by the control device, is decreased or preferably completely shut off, in order to initiate the concentration step.

25

30

According to an expedient embodiment, it is provided that the concentration step is introduced when a solids concentration in the circulation vessel exceeds a predetermined low-concentration threshold value. In

35

other words, the introduction of fresh slurry wastewater into the circulation vessel is stopped as soon as the low-concentration threshold value is reached which has a value of between about 1% and 3%,
5 preferably a value of about 2%. The solids concentration is measured in the circulation vessel and/or in a mixed wastewater removal line, for example using an optical online analysis device.

10 Preferably, it is provided that the concentration step comprises a continuous addition of an agglomeration inhibitor to the mixed wastewater removed from the circulation vessel. The agglomeration inhibitor used is preferably a lye. It serves for stabilizing the
15 colloidal slurry in order to maintain a distance as high as possible from what is termed the isoelectric point (IEP). Preferably, a lye is used which was also present in the original slurry, that is to say during use of the slurry in the semiconductor processing. An
20 example of an effective agglomeration inhibitor is ammonia (NH_3).

It must be noted here that as little lye as possible should pass into the permeate in order to reduce the
25 costs for the lye and in addition avoid contamination of the permeate. In the present recycling method this is achieved by the agglomeration inhibitor being added only over a very short time, namely in the course of the concentration step, during which the feed of fresh
30 wastewater to the circulation vessel is stopped. Lines used for the inflow of the agglomeration inhibitor can be formed of plastic and preferably comprise perfluoroalkoxyalkane.

35 In an expedient embodiment it is provided that during passage through the ultrafilter device, liquid removed from the mixed wastewater is introduced into a liquid vessel and from there is fed to the semiconductor

processing process. Before the introduction into the liquid vessel and/or before being passed onto the semiconductor processing process, the liquid can be subjected to further treatments, for example further
5 filter or purification steps. If a membrane-based ultrafilter device is used, the liquid that is removed can be termed permeate and the storage device therefore termed permeate vessel.

10 In an advantageous embodiment it is provided that a ratio between a concentration time period during which the concentration step is carried out and a filtration time period during which the filtration step is carried out is less than about 5%, preferably less than about
15 3%. In other words, the recycling device spends about 97% of the total process duration, considered in terms of time, in a filtration phase during which the filtration step is carried out, and only about 3% of the total process time in a concentration phase during
20 which the concentration step is carried out.

According to a preferred development, it is provided that the concentration step is carried out until a solids concentration in the circulation vessel exceeds
25 a predetermined high-concentration threshold value, whereupon, in a filling step following later in time, the mixed wastewater is removed from the circulation vessel as recycling slurry. The filling step in this case can comprise further filter steps and/or treatment
30 steps, for example in order to separate out relatively large particles from the recycling slurry, for example particles which exceed a particle size of about 1 μm .

More advantageously it is provided that the wastewater,
35 the mixed wastewater, the concentrated wastewater, the liquid removed from the mixed wastewater by the ultrafilter device and/or the recycling slurry are conducted and/or stored substantially metal-free. In

other words, the lines and vessels used therefor have metal-free inner surfaces which are preferably completely formed of plastic. Preferably, this applies to all of the lines, vessels and/or pumps used in the recycling device. A metal-free conducting and/or storage of the differing wastewaters and liquids has the advantage that no metallic impurities pass into the wastewaters. The restriction to a "substantially" metal-free conduction or storage means that inner surfaces of the respective components or the respective components in their entirety are produced in such a manner that they have metallic substances only as necessitated by production, and only in traces.

According to a preferred embodiment, it is provided that the mixed wastewater is blanketed with inert gas in the circulation vessel. In other words, the inert gas is introduced into the circulation vessel, above a mixed wastewater filling level, in such a manner that an inert gas layer forms there. Alternatively, the circulation vessel can be charged with inert gas above the filling level. The inert gas is preferably moistened. The blanketing with inert gas, in particular with moist inert gas, has the advantage that drying or crust formation of the mixed wastewater on inner walls of the circulation vessel is prevented. Preferably, therefore, all other vessels and tanks in the recycling device are charged with moist inert gas. Lines used for the inflow of the inert gas can be formed of plastic and preferably comprise perfluoroalkoxyalkane. The inert gas can be, for example, nitrogen (N_2).

In order that the differing circuits in the recycling device are as tight and leak-free as possible, some or all of the pumps used here for transporting liquids and/or gases should preferably be devoid of bearings and seals. This applies not only to pumps for transporting the fresh wastewater, the wastewater, the

mixed wastewater and/or the concentrated wastewater, but also to pumps which are used for transporting the agglomeration inhibitor and also the inert gas.

5 Preferably, regularly introduced backwash steps are provided in which, on passage through the ultrafilter device, liquid removed from the wastewater is passed in the reverse direction through the ultrafilter device for detaching filter membrane accretions. Such filter
10 membrane accretions can, as what is termed a filter cake, impair the effective functioning of the filter device. The backwash steps can be carried out at fixed, equidistant time intervals. Alternatively, or in addition, backwash steps can be triggered by a measured
15 value which indicates the degree of fouling of the membrane, for example by a flow resistance.

In order to make the method cost effective, care must be taken to ensure an effective backwashing. In
20 particular, it is advantageous for the backwashing to use a gas in addition to or alternatively to the liquid removed from the wastewater. Preferably, inert gas, for example nitrogen, or a mixture of inert gas and liquid, is used for the backwashing. The liquid, the gas or the
25 mixture is preferably forced through the hollow fibers in order to shear off the filter cake formed at the filter membrane. The backwash wastewater resulting from the backwashing is preferably not fed back to the circuit.

30

The invention will be described hereinafter on the basis of working examples, with reference to the figures. In the figures:

35 fig. 1 shows a diagram of a recycling device for slurry wastewater;

fig. 2 shows the implementation of a filtration step on the basis of the diagram from fig. 1;

fig. 3 shows the implementation of a backwash step on the basis of the diagram of fig. 1;

fig. 4 shows the implementation of a concentration step on the basis of the diagram of fig. 1;

5 fig. 5 shows the implementation of a filling step on the basis of the diagram of fig. 1;

fig. 6 shows a diagram of a slurry dispensing arrangement which is connected downstream of the recycling device.

10

Fig. 1 shows a diagram having the schematic makeup of a recycling device for slurry wastewater. Central components of the recycling device form a circulation vessel 10 and an ultrafilter device 20. The circulation
15 vessel 10 and the ultrafilter device 20, together with a mixed wastewater removal line 105, an ultrafilter feed line 201 and a wastewater return line 103, form a circuit for concentrating the wastewater previously passed into the circulation vessel 10. The circulation
20 vessel 10 has in the present case a capacity of about 500 liters.

On passage through the ultrafilter device 20, liquid is removed from the mixed wastewater, this liquid being
25 situated in a liquid circuit comprising a liquid vessel 30, a fluid removal line 203 and a backwash line 205, wherein the latter, however, is only used at intervals. The ultrafilter device 20 in the present embodiment is a membrane filter having a membrane 207, preferably a
30 polymer membrane, for example made of inexpensive and durable polyacrylonitrile. The liquid removed from the mixed wastewater is therefore a permeate. The liquid vessel 30 is therefore also termed hereinafter a permeate tank 30. The permeate tank 30, in the present
35 example, has a capacity of about 200 liters.

Furthermore, in fig. 1, reservoir tanks 40 are shown in

which the slurry-containing wastewater is stored before it passes via prefilters 42 along a wastewater feed line 101 into the circulation vessel 10.

5 Via an N₂ feed 603, the recycling device is supplied with nitrogen which is moistened by means of an N₂ humidifier 60, and via N₂ lines 501 is fed to the reservoir tanks 40, the circulation vessel 10 and to the NH₃ vessels 50, 503. In the reservoir tank 40 and
10 the circulation vessel 10 such a moist N₂ blanketing prevents crust formation of dry slurry on tank walls or vessel walls. Otherwise there would be the risk that dry slurry particles could pass back into the recycled slurry and later cause serious scratches on the
15 semiconductor substrates processed in the semiconductor processing process. Slurry that has been dried once cannot be stabilized again.

The components of the recycling device cited here, and
20 further components thereof, are explained in more detail hereinafter with reference to individual steps of the recycling method. In the associated fig. 2 to fig. 5, the most important active lines, that is to say those through which flow passes, of the recycling
25 device are represented using broad lines and are therefore emphasized against the remaining lines. Furthermore, figs. 2 to 5 show the same features of the recycling device as fig. 1.

30 Fig. 2 illustrates the implementation of a filtration step on the basis of the diagram of fig. 1. Using a fresh wastewater pump 73, fresh wastewater stored in one of the reservoir tanks 40 is introduced via the wastewater feed line 101 into the circulation vessel
35 10. The feed of fresh wastewater proceeds continuously, while mixed wastewater is pumped by the circulation pump 70 out of the circulation vessel 10 via the mixed wastewater removal line 105 and passed via the ultra

filter feed line 201 through the ultrafilter device 20. The concentrated wastewater exiting from the ultrafilter device 20 is passed via the wastewater return line 103 back into the circulation vessel 10.

5

During passage through the ultrafilter device 20, liquid or permeate is removed from the wastewater, and is passed via the fluid removal line 203 into the permeate tank 30. The permeate can then, using a pump
10 71, be removed from the permeate tank 30 via the liquid vessel exit 301 and made available via the liquid use line 303 to a user. For example, the permeate can be returned to a semiconductor processing device. For this purpose it can be necessary first to subject the
15 permeate to further treatment steps. Preferably, however, the permeate is removed from the liquid use line 303 and, without additional treatment, in particular without further filtering, fed to the semiconductor processing process, from which the fresh
20 wastewater originates, for example a CMP process.

The filter activity in the ultrafilter device 20 is performed by a membrane 207 which is permeable to the permeate. In order to avoid a filter cake forming on
25 the membrane 207 from the filter accretions, the membrane 207 must be cleaned at regular time intervals. Fig. 3 illustrates, on the basis of the diagram of fig. 1, the implementation of such a backwash step for cleaning the membrane 207. For this purpose, the
30 permeate removed from the permeate tank 30 using the permeate pump 71 via the liquid vessel exit 301 is forced via the backwash line 205 in the reverse direction through the membrane 207 in order to detach and flush out any accretions which have accumulated
35 there. The permeate which is contaminated with the accretions is conducted via the ultrafilter feed line 201 into the circulation vessel 10.

Fig. 4 illustrates the implementation of a concentration step on the basis of the diagram of fig. 1. The circuit of the wastewater which is described hereinbefore in connection with fig. 2
5 between the circulation vessel 10 and the ultrafilter device 20 is, furthermore, substantially maintained also during the concentration step. Therefore, in addition, mixed wastewater is removed from the circulation vessel 10 via the mixed wastewater removal
10 line 105 and passed via the ultrafilter feed line 201 through the ultrafilter device 20. From there, concentrated wastewater is passed via the wastewater return line 103 into the circulation vessel 10. The permeate removed from the mixed wastewater in the
15 ultrafilter device 20 is passed via the fluid removal line 203 into the permeate tank 30, and from there is provided via the liquid vessel exit 301 and the liquid use line 303 for further use.

20 However, in contrast to the filtration step, fresh wastewater is not passed into the circulation vessel 10. The fresh wastewater pump 73 therefore remains inactive in this phase of the recycling method. Instead, however, ammonia (NH_3) from the NH_3 vessel 50,
25 via one of the NH_3 lines 601, is added to the mixed wastewater in the mixed wastewater removal line 105. If the NH_3 vessel 50 is exhausted, an NH_3 reservoir vessel 503 ensures the supply with NH_3 . Ammonia acts as agglomeration inhibitor and prevents clumping of the
30 solids in the mixed wastewater, the solids concentration of which in the concentration step increases rapidly owing to the absence of the fresh slurry wastewater.

35 Fig. 5 illustrates the implementation of a filling step, likewise on the basis of the diagram of fig. 2. This step is initiated after the mixed wastewater in the circulation vessel 10 has been concentrated by the

concentration step in such a manner that the solids concentration thereof exceeds a predetermined high-concentration threshold value. The recycling device is monitored by a plurality of measuring instruments 72
5 which can comprise flow sensors, temperature sensors, concentration sensors, moisture sensors and the like. The solids concentration is determined on the basis of concentration measuring instruments and is compared in the control device (which is not shown in the figures)
10 with the high-concentration threshold value.

In the diagram of fig. 6, a slurry dispensing arrangement is schematically shown. It serves for dispensing the recycled slurry, which is taken out of
15 the circulation vessel 10 in the filling step shown in fig. 5 via the dispensing line 107, into recycling slurry vessels 82 provided therefor. Optionally, the recycled slurry is previously subjected to an after-treatment such as filtering via one or more filter
20 stages, for example. In the present case, the dispensing arrangement shown in fig. 6 comprises filters 83 of a first filter stage for removing particles having a particle size of at least 2 μm and also filters 84 of a second filter stage for removing
25 particles having a particle size of at least 0.5 μm .

Using valves 74, the recycled slurry, after passing through the filters 83, 84, is charged into the recycling slurry vessels 82. There is also the
30 possibility, in the case of corresponding actuation of a concentrate pump 85 and the valves 74, of passing on the recycled slurry via an exit 87 to a concentrate wastewater treatment. By appropriately actuating the valves 74, in addition, the particle size of the
35 particles in the dispensed slurry can in addition be controlled, likewise, optionally, their particle density and composition. These parameters are controlled and monitored by means of an online analysis

device 89.

The slurry dispensing arrangement shown in fig. 6 in addition comprises a fresh slurry vessel 81 and an
5 entry 86 for deionized water. Using fresh slurry and/or deionized water, and also optionally using further chemicals, the recycled slurry can be optimally conditioned for further use. Finally, the recycling
10 slurry vessels 82 each have a nitrogen feed line 88 in order to charge the vessels 82 with preferably moist nitrogen.

List of reference signs:

	10	Circulation vessel
	101	Wastewater feed line
5	103	Wastewater return line
	105	Mixed wastewater removal line
	107	Dispensing line
	20	Ultrafilter device
10	201	Ultrafilter feed line
	203	Fluid removal line
	205	Backwash line
	207	Membrane
15	30	Liquid vessel (permeate tank)
	301	Liquid vessel exit
	303	Liquid use line
	40	Reservoir tanks
20	42	Prefilters
	50	NH ₃ vessels
	501	NH ₃ line
	503	NH ₃ reservoir vessels
25	60	N ₂ humidifier
	601	N ₂ lines
	603	N ₂ feed
30	70	Circulation pump
	71	Permeate pump
	72	Measuring instruments
	73	Fresh wastewater pump
	74	Valves
35	81	Fresh slurry vessel
	82	Recycling slurry vessel
	83	Filters of first filter stage

- 84 Filters of second filter stage
- 85 Concentrate pump
- 86 Entry for deionized water
- 87 Exit for concentrate wastewater treatment
- 5 88 Nitrogen feed line
- 89 Online analysis device

Patent claims:

1. A recycling method for slurry wastewater from a semiconductor processing process, in particular from a chemical-mechanical polishing process, comprising the following process steps:
 - a filtration step in which fresh slurry-containing wastewater is continuously fed to a circulation vessel (10), while mixed wastewater is continuously removed from the circulation vessel (10), the mixed wastewater that is removed is passed through an ultrafilter device (20) and concentrated thereby by fluid removal to obtain concentrated wastewater and the concentrated wastewater is passed into the circulation vessel (10) and mixes with the contents of the circulation vessel (10) in order to obtain the mixed wastewater; and
 - a concentration step following the filtration step in time, in which the feed of the fresh wastewater to the circulation vessel (10) is decreased or is substantially shut off, while mixed wastewater is continuously removed from the circulation vessel (10), the mixed wastewater that is removed is passed through the ultrafilter device (20) and concentrated thereby by fluid removal to obtain concentrated wastewater, and the concentrated wastewater is passed into the circulation vessel (10).
2. The recycling method as claimed in claim 1, characterized in that the mixed wastewater removed from the circulation vessel (10) is passed through a membrane-based ultrafilter device and concentrated thereby by removal of a permeate to obtain concentrated wastewater.

3. The recycling method as claimed in claim 1 or 2, characterized in that the concentration step is carried out immediately after the filtration step.
- 5 4. The recycling method as claimed in any one of the preceding claims, characterized in that the concentration step is introduced when a solids concentration in the circulation vessel (10) exceeds a predetermined low-concentration
10 threshold value.
5. The recycling method as claimed in any one of the preceding claims, characterized in that the concentration step comprises a continuous addition
15 of an agglomeration inhibitor to the mixed wastewater removed from the circulation vessel (10).
6. The recycling method as claimed in any one of the preceding claims, characterized in that, during
20 passage through the ultrafilter device, liquid removed from the mixed wastewater is introduced into a liquid vessel and from there is fed to the semiconductor processing process.
- 25 7. The recycling method as claimed in any one of the preceding claims, characterized in that a ratio between a concentration time period during which the concentration step is carried out and a
30 filtration time period during which the filtration step is carried out is less than about 5%, preferably less than about 3%.
8. The recycling method as claimed in any one of the preceding claims, characterized in that the
35 concentration step is carried out until a solids concentration in the circulation vessel (10) exceeds a predetermined high-concentration

threshold value, whereupon, in a filling step following later in time, the mixed wastewater is removed from the circulation vessel (10) as recycling slurry.

5

9. The recycling method as claimed in any one of the preceding claims, characterized in that the wastewater, the mixed wastewater, the concentrated wastewater, the liquid removed from the mixed wastewater by the ultrafilter device and/or the recycling slurry are conducted and/or stored substantially metal-free.

10

10. The recycling method as claimed in any one of the preceding claims, characterized in that the mixed wastewater is blanketed with inert gas in the circulation vessel (10).

15

11. The recycling method as claimed in any one of the preceding claims, characterized by regularly introduced backwash steps, in which, on passage through the ultrafilter device, liquid removed from the wastewater is passed in the reverse direction through the ultrafilter device for detaching filter membrane accretions.

20

25

12. A recycling device for recycling slurry wastewater from a semiconductor processing process, in particular from a chemical-mechanical polishing process, comprising:

30

- a circulation vessel (10) for receiving slurry-containing wastewater;
- a wastewater feed line (101) connected to the circulation vessel (10);
- an ultrafilter device connected via an ultrafilter feed line (201) to the circulation vessel (10) for concentrating mixed wastewater continuously removed from the circulation

35

vessel (10) by means of fluid removal;

- a wastewater return line (105) for passing the concentrated wastewater into the circulation vessel (10); and

- 5 - a control device which is constructed to carry out after one another in time a filtration step, in which, during a continuous removal of mixed wastewater from the circulation vessel (10) and concentration thereof by the
10 ultrafilter device, fresh wastewater is continuously fed to the circulation vessel (10), and a concentration step, in which, during the continuous removal of mixed
15 wastewater from the circulation vessel (10) and concentration thereof by the ultrafilter device, the feed of the fresh wastewater to the circulation vessel (10) is reduced or substantially shut off.