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(54) **DISTRIBUTION SYSTEM FOR CHEMICAL AND/OR ELECTROLYTIC SURFACE TREATMENT OF SIMULTANEOUSLY AT LEAST TWO SUBSTRATES**

(57) The disclosure relates to a distribution system (1) for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrate surfaces (51) of at least two different substrates (5), comprising a substrate holder unit (3), an immersion tank (4), at least two distribution bodies (7), and a control unit, wherein the substrate holder unit (3) comprises two substrate holders (31), each configured to hold one of the at least two substrates (5) in the immersion tank (4), wherein the immersion tank (4) is configured to hold a shared electrolyte for the substrates (5), wherein the two substrate holders (31) are further configured to electrically contact the two substrate surfaces (51), wherein each distribution body (7) is arranged to be designated to one of the two substrate surfaces (51), wherein each distribution body (7) comprises jet holes to direct a flow of the electrolyte onto the designated substrate surface (51) and drain holes to direct a flow of the electric current relative to the designated substrate surface (51), and wherein the control unit is configured to control for each distribution body (7) and/or for each substrate surface (51) individually the flow of the electrolyte and the flow of the electric current. Further, the disclosure relates to a distribution method (20) for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two

substrate surfaces (51) of at least two different substrates (5).

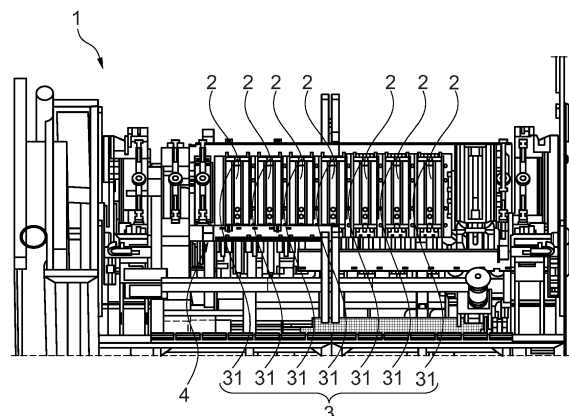


Fig. 1a

Description

Technical Field

[0001] The disclosure relates to a distribution system and a distribution method for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrates.

Background

[0002] Many industrial production processes, especially in the high-volume manufacturing for semiconductor devices, require a very fast and highly reliable processing, which, at the same time, is highly precise and reproducible. Consequently, highly reliable, flexible, and particularly fully automated process equipment is required for such processing to provide high throughput capability for substrates.

[0003] In the prior art, such process equipment, particularly for the electroplating of metallic or conductive material layers onto substrates, e.g., as used for the manufacturing or packaging of micro-, nano- or other types of electronic devices, requires large clean-room space for installation and operation resulting in large clean-room footprint, i.e., high costs for the required for installation and operation. Further, the electroplating may simultaneously plate at least two parts in a series electrical configuration and the used system may use a shared electrolyte by immersing each substrate in aqueous electrolyte shared among the ionically intercommunicating electrodepositioning zones, supplying a negative charge to each substrate, and providing equal current flow to each substrate.

Summary

[0004] Hence, there may be a need to provide an improved distribution system and a distribution method for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrates, which allows reducing the required clean-room footprint for the process equipment, particularly by reducing the geometric dimensions for high-volume, multi-substrate plating systems, particularly between anode(s) and cathode(s) and their required environment.

[0005] This problem is solved by the subject-matters of the independent claims, wherein further embodiments are incorporated in the dependent claims. It should be noted that the aspects of the invention described in the following apply also to a distribution system for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrates, as well as to a distribution method for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrates.

[0006] According to the present disclosure, a distribu-

tion system for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrate surfaces of at least two different substrates is presented. The distribution system comprises a substrate holder unit, an immersion tank, at least two distribution bodies, and a control unit. The substrate holder unit comprises at least two substrate holders, each being configured to hold one of the at least two substrates in the immersion tank. The immersion tank is configured to hold a shared electrolyte for the substrates, and the two substrate holders are further configured to electrically contact the two substrate surfaces. Each distribution body is arranged to be designated to one of the two substrate surfaces, wherein each distribution body comprises jet holes to direct a flow of the electrolyte onto the designated substrate surface and drain holes to direct a flow of the electric current relative to the designated substrate surface. The control unit is configured to control for each distribution body and/or for each substrate surface individually the flow of the electrolyte and the flow of the electric current.

[0007] Thus, the distribution system may allow immersing and/or electrically controlling each of the at least two substrate surfaces from the at least two different substrates independently, and particularly in parallel. Thereby, the distribution system may provide highly homogeneous and/or individual substrate-adjusted, plating-thickness-equivalent-current flows as well as highly homogeneous and/or individually substrate-adjusted, plating-thickness-equivalent-electrolyte flows to and from each individual substrate surface.

[0008] In particular, the distribution system may allow a highly precise and/or highly uniform direct current (DC) or alternating current (AC) electroplating of conductive layers onto multiple, that is, at least two, substrates, in parallel with a high-volume manufacturing character. Therefore, the distribution system may allow reducing and/or minimizing the required floor space, thereby reducing the cost of ownership, while providing full control on the plating results for each individual substrate.

[0009] The distributing bodies may provide electrolyte back-flow through-holes, one on each side of the substrate holder unit for an individual substrate double-side surface treatment, or single-side surface treatment for at least one substrate.

[0010] The high-volume manufacturing result may be achieved by providing an electrolyte distribution system, and/or an electrical current and/or potential control system. The electrolyte distribution system, e.g., a high-speed plate (HSP) system may enable individual and highly precise control of plating-thickness-equivalent-electrolyte flows and flow-speeds, being regulated and optimized or plating uniformity through the HSP-electrolyte-jets to the substrate and through the electrolyte back-flow through-holes away from each individual substrate, thereby allowing a required electrolyte exchange resulting in achieving improved (optimum) results. The electrical current and/or potential control system may enable

an individual and highly precise control of individual, substrate-adjusted, plating-thickness-equivalent-current flows through the electrolyte backflow through-holes of each electrolyte distribution system.

[0011] In an embodiment, at least one anode, one cathode and one distribution body may form a cell of the distribution system, and preferably two anodes, at least one cathode and at least one distribution body may form the cell of the distribution system.

[0012] The distribution body may be arranged between the anode(s) and the cathode(s). Such a cell may also be referred to as "electric-field-defined plating cell" (EFD-PC), and may allow precisely controlling a deposition rate, particularly by controlling a current passing the cathode(s), which may be formed by the substrate(s). Additionally, due to the compact assembly, as already mentioned above, a size of such a cell may be reduced significantly compared to common cells. For example, a commonly known cell has a width of around 1100 mm, whereas the cell as described above may have a width of only around 350 mm, preferably of around 250 mm, and more preferably of less than 200 mm. In an embodiment, the at least one anode may be arranged in an anode assembly, which is shared between adjacent cells of the distribution system.

[0013] The anode assembly may be used as a resistive wall between adjacent cells.

[0014] In an embodiment, the anode assembly may comprise one anode being a shared anode between two adjacent cells. Alternatively, the anode assembly may comprise two anodes being individually controllable for each of the two adjacent cells.

[0015] In an embodiment, the distribution body may further comprise an individual power supply for each cell of the distribution system, wherein the individual power supply is controlled by the control unit. In detail, each power supply may allow setting a cathodic current by adjusting the voltages between the anode and the cathode. Thus, by providing an individual power supply for each cell, the anode(s) and the cathode(s) of each cell may be controlled together. Additionally, the power supply may be a two-channel power supply, which may enable controlling a flow of electric current on each substrate surface separately. Further, the individual power supplies may be an individual or an integrated system.

[0016] An individual power supply for each cell may allow controlling the current passing the cathodes, particularly the substrates, thereby allowing precisely controlling the deposition rates.

[0017] In an embodiment, the control unit may be configured to control a potential difference between the anode and the cathode. In an embodiment, the control unit may be configured to control the potential difference between the anode and the cathode to be below a predetermined threshold to achieve a quasi-potentiostatic surface treatment.

[0018] Thus, the distribution system may provide galvanostatic plating which allows controlling the potential

of the plating process and/or limiting the potential to predetermined levels/thresholds. By this, an over-potential-plating of the substrate may be prevented, which may occur when the current is controlled at the cathode.

[0019] In an embodiment, the distribution system may further comprise a separation element arranged to separate two cells of the distribution system. In an embodiment, the separation element may be a membrane anode assembly blocking an electrical connection between the two cells.

[0020] The separation element may be configured to block an electrical connection between the cells, thereby achieving a galvanic separation of the cells. For example, the separation element may be a non-conductive plate. The separation element, e.g., the non-conductive plate or a membrane, or a membrane anode assembly may be arranged in a center of symmetry between the two cells and/or between the anodes.

[0021] In an embodiment, the distribution system may further comprise a resistive element arranged between adjacent cells of the distribution system to control an interaction between these adjacent cells. In an embodiment, the resistive element may comprise a funnel, meander, plate, barrier and/or sealing structure changing a travel distance of the electrolyte and/or the electric current.

[0022] The resistive element may be configured to control stray currents and/or to reduce, particularly eliminate, a potential influence of the adjacent cells on each other. The resistive element may be configured to guide the electrolyte, and/or the current distribution into longer or shorter distances to travel. The resistive element formed as the funnel may be implemented at, or close to the anode and/or the HSP and/or also in closer proximity to the cathode of individual or adjacent cells. The resistive element formed as a sealing structure, particularly an expandable sealing structure, may be arranged around an applicable anode system, containing at least one anode. Such sealing structure may assist in guiding the electrolyte and/or the current distribution into longer or shorter distances to travel. Alternatively, such sealing structure may be expanded in a way that any electrolyte or current exchange with an adjacent cell may be impossible, except through another way of exchange, particularly of a longer distance, in case such other way may be present.

[0023] In an embodiment, the distribution system may further comprise a reference potential system as basis to quantify a cathode potential of the distribution system absolutely relative to a reference potential system, particularly relative to a standard reference potential system.

[0024] Implementing a reference potential system, particularly for each cell, may allow additionally enhancing an electric field distribution control for each cell. The reference potential system may be implemented into each cell or may be one reference potential system for all cells, such that a cathode potential in each cell may be controlled in absolute terms against a standard refer-

ence potential, e.g., the Standard Hydrogen Electrode (SHE), which may act as the basis against which other reduction/oxidation (redox) couples are quantified. Such potential system may be applied in so-called three-electrode applications for enabling "absolute" controllable galvanostatic or potentiostatic surface treatment, as opposed to "quasi" galvanostatic or "quasi" potentiostatic surface treatment, e.g., plating. Thereby, the control for reducing particularly preventing overpotential surface treatment, which can lead to poor deposition results, may be significantly enhanced.

[0025] In an embodiment, the distribution system may further comprise at least one thief anode unit to control an interaction between adjacent cells, wherein the thief anode unit is at least a segment or a pixel of the anode or an additional anode shifted into a cathode mode independent of adjacent segments, pixels or anodes.

[0026] The thief anode unit may have an influence on electrons/anions and/or cations and may prevent the distribution system from so-called stray currents. In other words, enabling anodes, e.g., an adjacent anode or a specifically added anode unit to act as a "thief anode" may allow the electric field control system of adjacent cells to individually control the current flows.

[0027] The thief anode unit may comprise or be a temporarily unused anode being turned into a temporary cathode and/or an additional anode being placed at specific location for respective specific purposes. Additionally, or alternatively, the anode unit may have a segmented anode design, in which parts of the anode can be turned independently into a cathode mode while some parts of the anode remain in the anode mode, and/or the anode unit may be a pixilated anode, in which individual pixels can be tuned into anode or cathode mode, by applying varying potentials, thereby supporting and/or improving a uniformity of the surface treatment result. Pixel numbers may be any number from 2 to several thousand or even millions, depending in the requirements of the application.

[0028] In an embodiment, the substrate holder unit may comprise substrate holder components configured to independently move the at least two substrate holders relative to the immersion tank.

[0029] In other words, such specific substrate holders may allow physical and/or electrical connection as well as control of each substrate as an individual, even though, the at least two substrates may be immersed into a common, particularly exchangeable and/or agitable, electrolyte/immersing tank.

[0030] In an embodiment, the substrate holder unit is segmented to provide an individual power supply to each of the at least two substrate surfaces.

[0031] The segmented substrate holder unit may be electrically segmented, thereby enabling individually controllable electrical contact between the substrate holder and the substrate surfaces. Such electrical contact may be achieved by small contact fingers, when all fingers are connected to the same power supply. By elec-

trically separating the fingers, e.g., in several zones, each of which being connected to an individual power control, an in-panel uniformity may be improved.

[0032] In an embodiment, at least one of the substrate holders is configured for a single-side surface treatment of a substrate and/or a double-side surface treatment of a substrate.

[0033] According to the present disclosure, also a distribution method for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrate surfaces of at least two different substrates is presented. The method comprises the following steps, not necessarily in the presented order:

- providing a substrate holder unit comprising at least two substrate holders, each holding one of the two substrates in an immersion tank, which holds a shared electrolyte for the substrates,
- arranging at least two distribution bodies in the immersion tank, each distribution body being designated to one of the substrate surfaces, wherein each distribution body comprises jet holes to direct a flow of the electrolyte onto the designated substrate surface and drain holes to direct a flow of the electric current relative to the designated substrate surface,
- electrically contacting the substrate surfaces by means of the substrate holders, and
- controlling for each distribution body and/or for each substrate surface individually the flow of the electrolyte and the flow of the electric current by means of a control unit.

[0034] The distribution method may allow immersing and/or electrically controlling each of the at least two substrate surfaces independently, and particularly in parallel. Thereby, the distribution method may allow highly homogeneous and/or individual substrate-adjusted, plating-thickness-equivalent-current flows as well as highly homogeneous and/or individually substrate-adjusted, plating-thickness-equivalent-electrolyte flows to and from each individual substrate surface.

[0035] In particular, the distribution method may allow a highly precise and/or highly uniform direct current (DC) or alternating current (AC) electroplating of conductive layers onto multiple, that is, at least two, substrates, in parallel with a high-volume manufacturing character.

[0036] Therefore, the distribution method may allow reducing and/or minimizing the required floor space, thereby reducing the cost of ownership, while providing full control on the plating results for each individual substrate.

[0037] It shall be understood that the system, and the method according to the independent claims have similar and/or identical preferred embodiments, in particular, as defined in the dependent claims. It shall be understood further that a preferred embodiment of the disclosure can also be any combination of the dependent claims with the respective independent claim.

[0038] These and other aspects of the present disclosure will become apparent from and be elucidated with reference to the embodiments described hereinafter.

Brief description of the drawings

[0039] Exemplary embodiments of the invention will be described in the following with reference to the accompanying drawing:

- Figure 1a shows schematically and exemplarily a distribution system according to the disclosure.
- Figure 1b shows schematically and exemplarily a distribution system according to the disclosure.
- Figure 2a shows schematically and exemplarily a cell according to the disclosure for a distribution system.
- Figure 2b shows schematically and exemplarily a cell according to the disclosure for a distribution system.
- Figure 3 shows schematically and exemplarily a cell according to the disclosure in an exploded view.
- Figure 4a shows schematically and exemplarily a distribution system according to the disclosure.
- Figure 4b shows schematically and exemplarily a distribution system according to the disclosure.
- Figure 5 shows schematically and exemplarily a diagram illustrating a thief anode concept according to the disclosure.
- Figure 6 shows schematically and exemplarily a flow diagram of a method according to the disclosure.

Detailed description of embodiments

[0040] Figures 1a and 1b show schematically and exemplarily embodiments of a distribution system 1 comprising seven cells 2 (Figure 1a), and seven cells 2 (Figure 1b), respectively. The distribution system 1 further comprises a substrate holder unit 3, and an immersion tank 4 (see Figure 1b). The substrate holder unit 3 comprises six substrate holders 31 (Figure 1a), and seven substrate holders 31 (Figure 1b), respectively. Each of the cells 2 as shown in Figures 1a and 1b is configured to accommodate at least one substrate 5 having at least

one substrate surface 51 to be treated and comprises two anodes 6, two distribution bodies 7 and two cathodes 8 (see Figure 2a). Alternatively, each cell 2 may comprise only one distribution body 7.

[0041] Each of those cells 2 allows double-side surface treatment, e.g., double-side plating, of one single substrate 5 or allows single-side surface treatment, e.g., single-side plating of at least one substrate 5, particularly of two substrates 5. In other words, each substrate holder 31 is configured to hold either one substrate 5 or two substrates 5, wherein when holding one substrate 5, only one substrate surface 51 of the one substrate 5 (single-side plating of one substrate 5 in one cell 2) or two substrate surfaces 51 of the one substrate 5 (double-side plating of one substrate 5 in one cell 2) may be treated, and when holding two substrates 5, one substrate surface 51 of each of the two substrates 5 may be treated (single-side plating of two substrates 5 in one cell 2). The distribution system 1 comprises at least two cells 2, as exemplarily shown in Figures 4a and 4b, which will be described in detail further below. Therefore, the distribution system 1 is configured to treat at least two substrates 5, namely at least one substrate 5 per cell 2, in parallel, and may be further configured to treat at least two substrate surfaces 51 of at least two substrates 5, namely at least one substrate surface 51 of the at least one substrate 5 per cell 2.

[0042] Alternatively, as shown in Figure 2b, a cell 2 may comprise one anode 6, one distribution body 7 and one cathode 8, and may allow single-side surface treatment of one single substrate 5. The cells 2 may also be referred to as electric-field-defined plating cell" (EFDPC) 2. Regarding Figures 1a and 1b, it can be seen, that the cells 2, as exemplarily shown in Figure 2a are formed as vertical electroplating cells 2 particularly, for very large substrates 5. The cells 2 are arranged adjacent to each other, thereby requiring a small space for double-side plating single substrates 5 or single-side plating of at least one substrate 5 per cell 2. Therefore, the distribution system 1 as exemplarily shown in Figures 1a and 1b enables a high-volume electroplating manufacturing for double-side plating of one substrate 5 and/or single-side plating of at least one substrate 5 per cell 2 resulting in low clean-room footprint.

[0043] Figure 3 schematically and exemplarily shows an embodiment of the cell 2 in an exploded view. Here, the cell 2 comprises one cathode 8 being electrically connected to two substrate surfaces 51 of one substrate 5 or to one substrate surface 51 of each of two substrates 5, wherein the cathode 8 is substantially arranged in a center of the cell 2 and integrally formed with the substrate holder 31. When seen in an axial direction A, on each side, one distribution body 7 is arranged adjacent to the cathode 8, whereas further in the axial direction A, an anode assembly 9 is arranged adjacent to each distribution body 7. Between the cathode 8 with the substrate(s) 5 and each of the distribution bodies 7 as well as between each of the distribution bodies 7 and the re-

spective adjacent anode assembly 9, there are arranged resistive elements 10 which are configured to control stray currents and/or to reduce potential influence of neighboring cells 2 on each other. Further, the resistive elements 10 are formed for guiding the electrolyte and/or the current distribution into longer or shorter distances to travel. For example, resistive elements 10 are formed as funnels, meander structures, barrier plates or the like. In particular, the resistive elements 10 between the anode assembly 9 and the distribution body 7 may be formed as funnels.

[0044] The anode assembly 9 defines an assembly or a group of multiple parts being pre-assembled and mounted as one part on the distribution system 1. The anode assembly 9 may be used as a resistive wall between adjacent cells 2 (see also Figure 4a), blocking an electrical connection between the adjacent cells 2. Further, the anode assembly 9 comprises either one anode 6 being a shared anode, which is shared with the neighboring cell 2 (see Figure 4a), or at least two separate anodes 6, being controlled individually and being electrically isolated from each other. Having the shared anode for two neighboring cells 2 results in that the potential of each of those two cells can only be controlled by this one shared anode. This means, those two neighboring cells always have substantially the same potential. In case, of two separate anodes 6, one anode 6 is for the one cell 2 and the other anode 6 is for the neighboring cell 2, which allows controlling the potential for each of the neighboring cells 2 individually. In other words, the anode assembly 9 comprising two separate anodes 6 allows controlling the potential of each cell 2 individually, and facilitates assembling the distribution system 1 by pre-assembling the two separated anodes 6 and an electrically separating element 11 as one component or module or subassembly, particularly compared to an individual assembly of each anode 6, as exemplarily shown in Figure 4b.

[0045] Figure 4a exemplarily shows the anode assembly 9 comprising the shared anode. The anode assembly 9 may not extend along an entire height of the cell, such that the anode assembly 9 is connected or integrally formed with a plate 11, acting as an electrical barrier between the cells 2. Thus, two adjacent cells 2 are electrically separated from each other by the anode assembly 9 and the plate 11. The plate 11 may be an example for the resistive element 10. In Figure 4b, each cell 2 has its own, separate anode 6, which can be controlled individually. Those adjacent anodes 6 are electrically separated by a plate 12, which substantially extends along the entire height of the cells 2 and the anodes 6, respectively. The plate 12 acts as an electric barrier between the adjacent cells 2 and the respective anodes 6.

[0046] In case, at least one of the plurality of cells 2 of the distribution system 1 is temporarily, or permanently, established at a lower potential difference, cross talking of the potentials may occur due to a narrow spacing between the adjacent cells 2 resulting in non-uniformities

on the surrounding cathode substrates 5. In such case, a "thief anode concept", as schematically and exemplarily shown in Figure 5, may be applied. In Figure 5, four cells 2 are arranged adjacent to each other, wherein the first, third and fourth cell 2 (2.1, 2.3 and 2.4 in Figure 4) have fixed potentials, particularly 15 V for the anodes 6 and 0 V for the cathodes 8. The anodes 6 of the second cell 2 (cell 2.2) in Figure 5 are currently unused, such that the thief anode concept is applied.

[0047] Applying the thief anode concept may comprise switching one or multiple currently un-used anode(s) 6 into a cathode mode, resulting in the example of Figure 4 in a cathode potential of 5 V for the second cell 2.2. This may support equilibrating the current distribution thereby increasing uniformity during the plating processes in each individual cell 2. Additionally, or alternatively, the "thief anode" concept may also be implemented by adding additional anodes or anode elements, which can be independently and separately turned into temporary cathode mode, when not required to carry out their anode function. Further, in case, the anode 6 is formed as a segmented, it is possible to only turn at least one segment of the segmented anode temporarily into the cathode mode, while the other parts of the segmented anode are continuing to fulfil the anode function or be in the anode mode, respectively. In a very specific case, the anode is pixilated, wherein individual pixels can be turned into the anode mode, while other individual pixels can be turned into a cathode mode to equilibrate the power distribution, increasing uniform plating within each cell 2 and its neighboring cells 2.

[0048] In other words, the "thief anode" may be a temporarily unused anode 6 turned into a temporary cathode; an additional anode placed at specific locations for the specific purpose, may be a segmented anode, wherein parts of the anode can be turned independently into cathode modes, while some parts of the anode remain in the anode mode, or can be a pixilated anode, where individual pixels can be tuned into anode or cathode mode, with varying potentials in order to support or increase the uniformity of the plating result. Pixel numbers can be any from 2 to several thousand or even millions, depending on the requirements from the application.

[0049] Figure 6 shows a flow diagram of an exemplary method 20 for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrate surfaces 51. According to the method 20, in a step S1, there is provided a substrate holder unit 3 comprising at least two substrate holders (31), each holding one of the two substrates 5 in an immersion tank 4, which holds a shared electrolyte for the substrates. In a step S2, at least two distribution bodies 7 are arranged in the immersion tank 4, each distribution body 7 being designated to one of the substrate surfaces 51. Each distribution body 7 is designated to one of the substrate surfaces 51, wherein each distribution body 7 comprises jet holes to direct a flow of the electric current relative to the designated substrate sur-

face 51. In a step S3, the substrate surfaces 51 electrically connect or contact by means of the substrate holders 31, and in a step S4, for each distribution body 7 and/or substrate surface 51, the flow of the electrolyte and the flow of the electric current are controlled individually by means of a control unit.

[0050] While the disclosure has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The disclosure is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing a claimed disclosure, from a study of the drawings, the disclosure, and the dependent claims.

[0051] In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single unit may fulfil the functions of several items re-cited in the claims. The mere fact that certain measures are re-cited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A distribution system (1) for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrate surfaces (51) of at least two different substrates (5), comprising:

- a substrate holder unit (3),
- an immersion tank (4),
- at least two distribution bodies (7), and
- a control unit,

wherein the substrate holder unit (3) comprises at least two substrate holders (31), each configured to hold one of the at least two substrates (5) in the immersion tank (4), wherein the immersion tank (4) is configured to hold a shared electrolyte for the substrates (5), wherein the two substrate holders (31) are further configured to electrically contact the two substrate surfaces (51), wherein each distribution body (7) is arranged to be designated to one of the two substrate surfaces (51), wherein each distribution body (7) comprises jet holes to direct a flow of the electrolyte onto the designated substrate surface (51) and drain holes to direct a flow of the electric current relative to the designated substrate surface (51), and

wherein the control unit is configured to control for each distribution body (7) and/or for each substrate surface (51) individually the flow of the electrolyte and the flow of the electric current.

2. Distribution system (1) according to the preceding claim, wherein at least one anode (6), one cathode (8) and one distribution body (7) form a cell (2) of the distribution system (1), and preferably two anodes (6), at least one cathode (8) and at least one distribution body (7) form the cell (2) of the distribution system (1).
3. Distribution system (1) according to the preceding claim, wherein the at least one anode (6) is arranged in an anode assembly (9) which is shared between adjacent cells (2) of the distribution system (1).
4. Distribution system (1) according to the preceding claim, wherein the anode assembly (9) comprises one anode (6) being a shared anode between two adjacent cells (2) or wherein the anode assembly (9) comprises two anodes being individually controllable for each of the two adjacent cells (2).
5. Distribution system (1) according to one of the preceding claims, further comprising an individual power supply for each cell (2) of the distribution system (1), wherein the individual power supply is controlled by the control unit.
6. Distribution system (1) according to one of the preceding claims, wherein the control unit is configured to control a potential difference between the anode (6) and the cathode (8).
7. Distribution system (1) according to one of the preceding claims, wherein the control unit is configured to control the potential difference between the anode (6) and the cathode (8) to be below a predetermined threshold to achieve a quasi-potentiostatic surface treatment.
8. Distribution system (1) according to one of the claims 2 to 7, further comprising a separation element arranged to separate two cells (2) of the distribution system (1).
9. Distribution system (1) according to the preceding claim, wherein the separation element is a membrane anode assembly blocking an electrical connection between the two cells (2).
10. Distribution system (1) according to one of the claims 2 to 9, further comprising a resistive element (10) arranged between adjacent cells (2) of the distribution system (1) to control an interaction between

these adjacent cells (2).

11. Distribution system (1) according to the preceding claim, wherein the resistive element (10) comprises a funnel, meander, plate, barrier and/or sealing structure changing a travel distance of the electrolyte and/or the electric current. 5
12. Distribution system (1) according to one of the preceding claims, further comprising a reference potential system as basis to quantify a cathode potential of the distribution system (1) absolutely relative to the reference potential system. 10
13. Distribution system (1) according to one of the claims 2 to 12, further comprising at least one thief anode unit to control an interaction between adjacent cells (2), wherein the thief anode unit is at least a segment or a pixel of the anode (6) or an additional anode shifted into a cathode mode independent of adjacent segments, pixels or anodes (6). 15 20
14. Distribution system (1) according to one of the preceding claims, wherein the substrate holder unit (3) comprises substrate holder components configured to independently move the at least two substrate holders (31) relative to the immersion tank (4). 25
15. Distribution system (1) according to one of the preceding claims, wherein the substrate holder unit (3) is segmented to provide an individual power supply to each of the at least two substrate surfaces (51). 30
16. Distribution system (1) according to one of the preceding claims, wherein at least one of the substrate holders (31) is configured for a single-side surface treatment of the substrate (5) and/or a double-side surface treatment of the substrate (5). 35
17. A distribution method (20) for an electrolyte and an electric current for chemical and/or electrolytic surface treatment of simultaneously at least two substrate surfaces (51) of at least two different substrates (5), comprising: 40
 - providing a substrate holder unit (3) comprising at least two substrate holders (31), each holding one of the two substrates (5) in an immersion tank (4), which holds a shared electrolyte for the substrates (5), 45 50
 - arranging at least two distribution bodies (7) in the immersion tank (4), each distribution body (7) being designated to one of the substrate surfaces (51), wherein each distribution body (7) comprises jet holes to direct a flow of the electrolyte onto the designated substrate surface (51) and drain holes to direct a flow of the electric current relative to the designated substrate sur- 55

face (51),

- electrically contacting the substrate surfaces (51) by means of the substrate holders (31), and
- controlling for each distribution body (7) and/or for each substrate surface (51) individually the flow of the electrolyte and the flow of the electric current by means of a control unit.

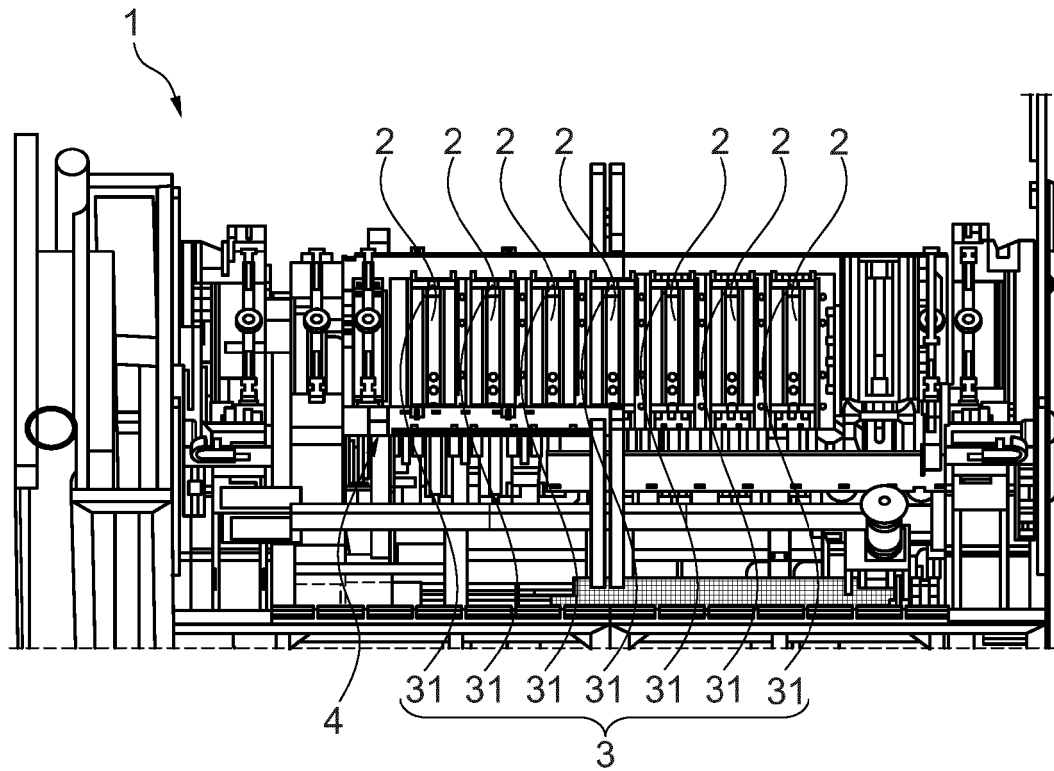


Fig. 1a

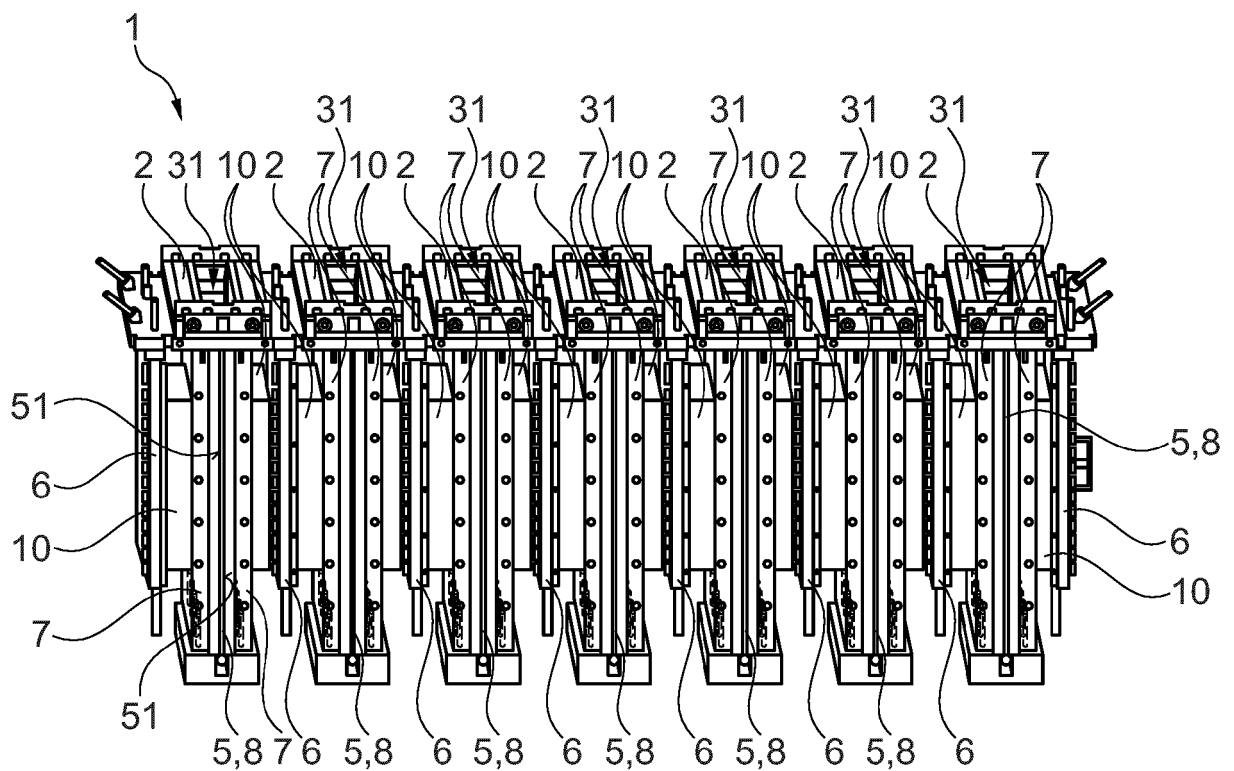


Fig. 1b

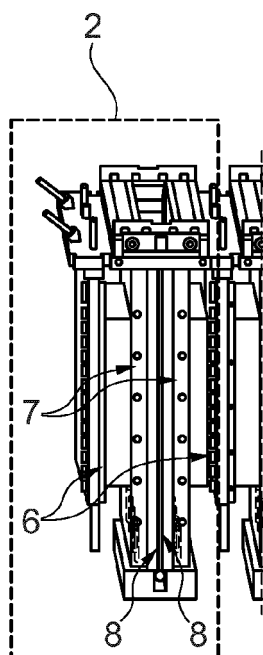


Fig. 2a

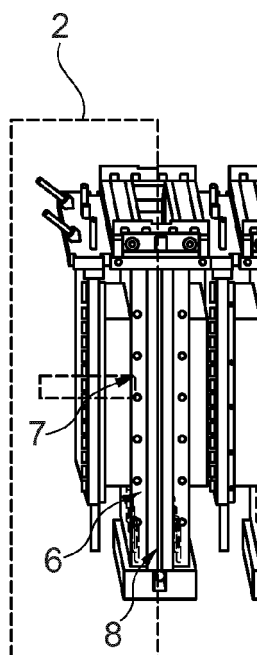


Fig. 2b

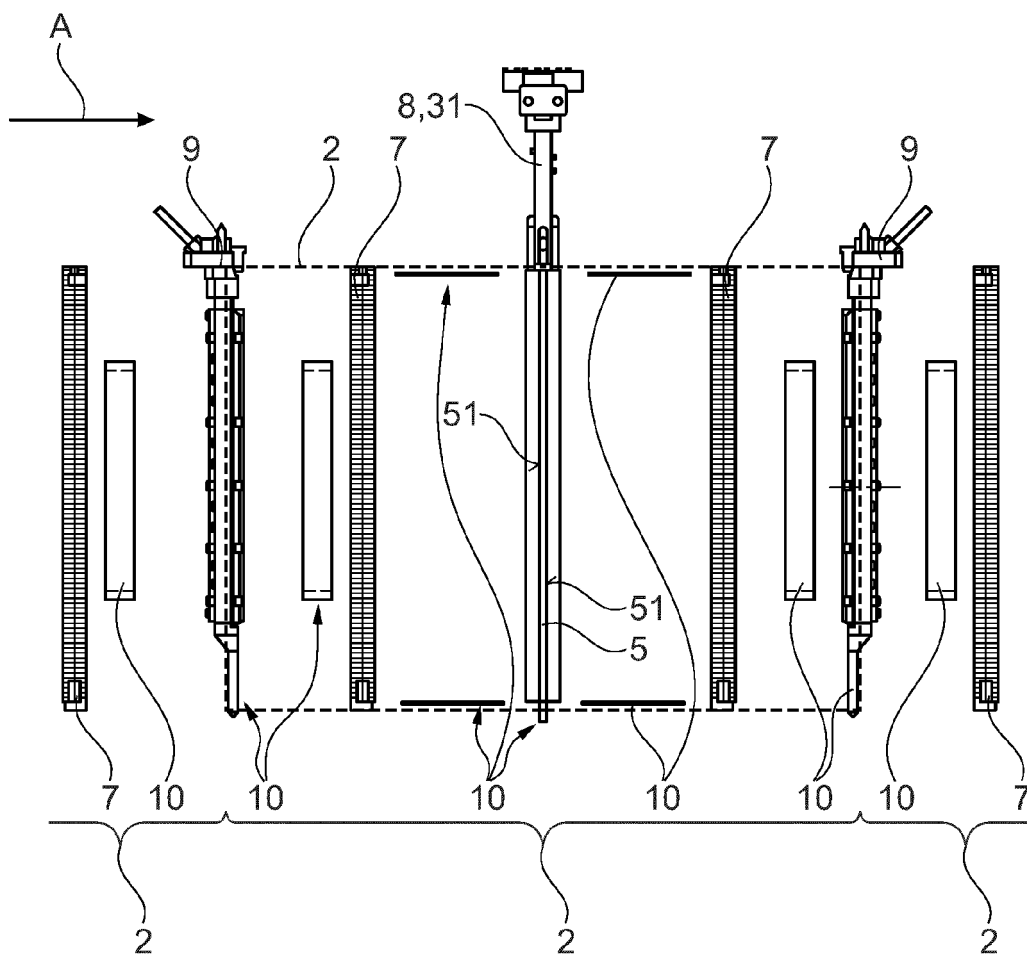


Fig. 3

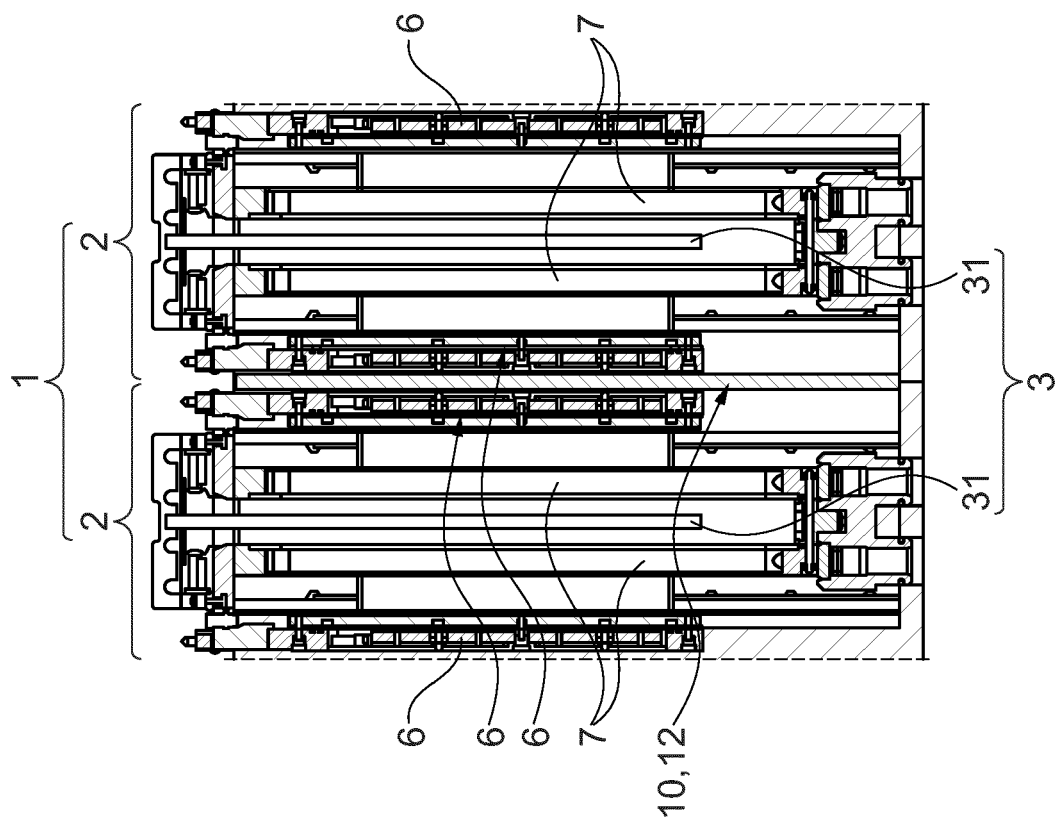


Fig. 4b

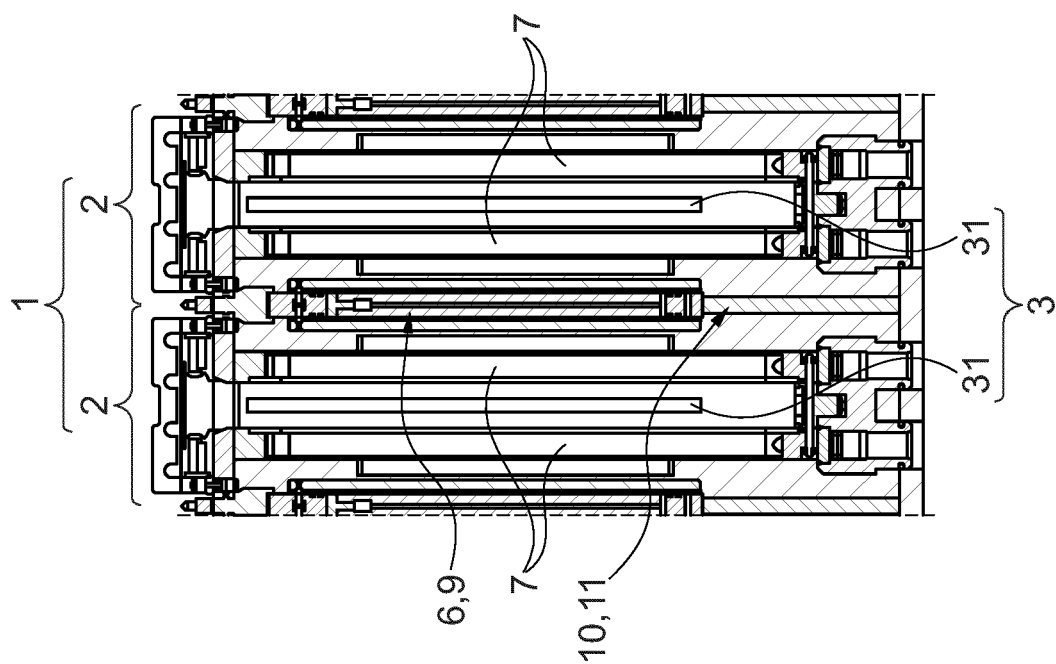


Fig. 4a

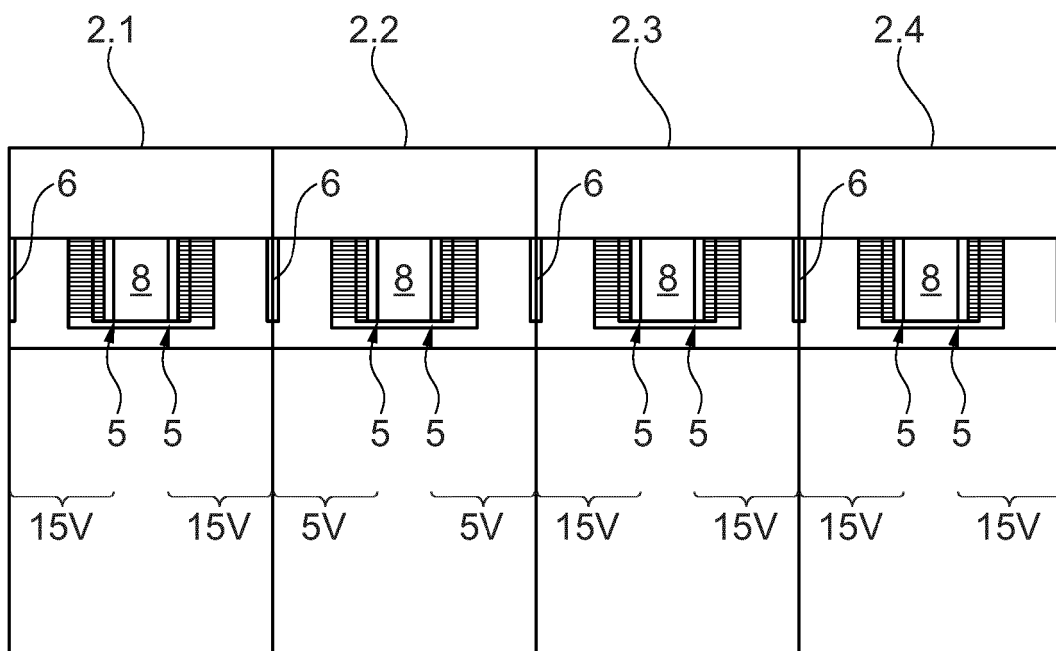


Fig. 5

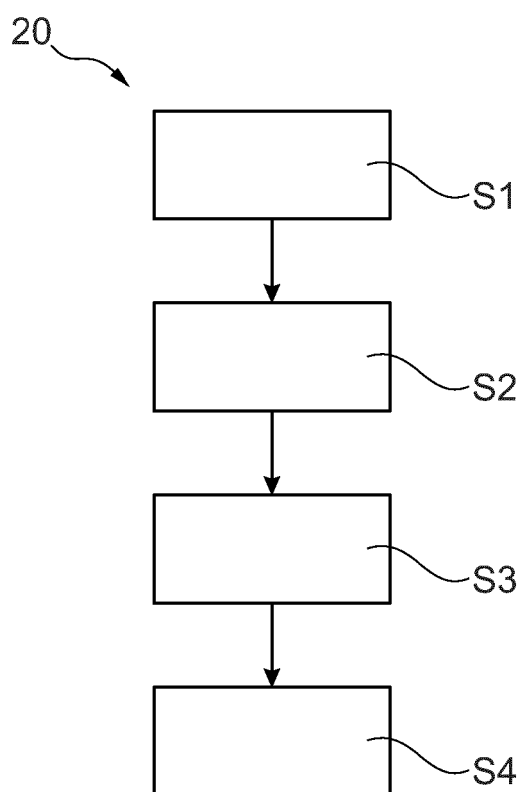


Fig. 6



EUROPEAN SEARCH REPORT

Application Number

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5

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