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(54) Benævnelse: **Elektrolysecelle med en gasdiffusionselektrode og fremgangsmåde til drift deraf**

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Description

Electrolysis cell with a gas diffusion electrode, and method for operating same

The invention relates to an electrolysis cell comprising a housing with an anode and a gas diffusion electrode (hereinafter also referred to as GDE for short) connected as cathode. Both electrodes can be brought into contact with an electrolyte in an electrolyte space formed by the housing. The GDE functions as dividing wall between the electrolyte space and a gas space provided in the housing for a reaction gas. Here, the GDE adjoins on an electrolyte side the electrolyte space and on a gas side the gas space, i.e. separates these two spaces. The invention also relates to an electrode plate which can be used in the electrolysis cell mentioned.

The invention further relates to a method for operating such an electrolysis cell of the type indicated at the outset. In this method, the electrolyte side of the GDE is brought into contact with an electrolyte and the gas side of the GDE is brought into contact with a reaction gas.

Electrolysis cells having electrode plates of the type indicated at the outset and methods for the operation thereof are generally known. Gas diffusion electrodes are used, for example, in fuel cells for generating energy from hydrogen and oxygen. Another use of GDEs is in electrochemical cells for the reaction of reaction gases. In such electrochemical cells, a feed gas (reaction gas) is introduced and a product gas, which can also be a gas mixture, is discharged. The GDE here forms the cathode which is gas-permeable (microporous structure). The electrolyte space between anode and cathode is filled with an electrolyte and can additionally have a separating membrane, for example a membrane made of Nafion®. In this case, the electrolyte is fed separately to the two subspaces.

The GDE allows diffusion of the reaction gas which can be provided at the cathode in this way. For the gas to be able to penetrate into the cathode, the concentration gradient which is established by the continual reaction of the gas in the interior of the GDE is exploited. A further possibility is to increase the gas pressure on the gas side of the GDE, as a result of which the conversion of gas in the GDE increases.

The reaction gas is reacted in the GDE. This can form a product gas which, depending on the pressure prevailing on the gas side, passes through the GDE and can be transported together with the electrolyte out from the electrolyte space or exits into the gas space and is transported away there. In the latter case, a continuous gas flow in the gas space is necessary, with reaction gas being introduced and a mixture of reaction gas and product gas being discharged.

Operation of the abovementioned electrolysis cells thus consists of feeding in the reaction gas as starting material, introducing it into the GDE and subsequently discharging the reaction gas or a product gas formed. The possible ways of influencing this process by means of the diffusion processes in the GDE and by means of pressure differences between gas side and electrolyte side of the GDE are limited. Gas can be pushed through the porous GDE by means of the pressure difference. However, undesirable effects also have to be accepted here. Depending on the pressure gradient, reaction gas can also exit from the GDE on the electrolyte side. Conversely, the electrolyte can exit from the GDE on the gas side. Since the electrolyte is usually a salt solution, there is then a risk that salts will crystallize out on the gas side of the GDE. In addition, the exiting liquid has to be removed from the gas space and possibly humidifies the reaction gas.

DE19954247 describes an electrolysis cell having at least one gas diffusion electrode. The gas space adjacent to the gas diffusion electrode consists of a multitude of mutually superposed gas channels connected to one another by reduction pieces, through which the gas stream flows successively in a meandering manner from the bottom upwards. EP2730638 describes a gas-to-liquid reactor, wherein a bipolar plate separates the individual cells from one another and is configured such that it provides flow channels. DE102011007759 describes an electrolysis cell having a laminated stack of mutually superposed sheets with recesses between two bipolar plates. The sheets are arranged one on top of another such that recesses between adjacent sheets overlap partly but not completely, as a result of which continuous channels are formed in the direction of the plane of the sheets.

It is an object of the invention to provide an electrolysis cell having a gas diffusion electrode, an electrode plate which can be used in this electrolysis cell and a method for the operation thereof, by means of which the gas throughput of reaction gas in the GDE can be set very flexibly and undesirable throughput of electrolyte and/or reaction gas through the GDE is very largely avoided.

This object is achieved according to the invention using the electrolysis cell indicated at the outset by the gas diffusion electrode (GDE) adjoining on the gas side a contact side of a support body, with the gas space being formed by a first channel system and by a second channel system. Here, the first channel system and the second channel system run separately from one another, i.e. the reaction gas cannot switch directly between the first channel system and the second channel system. Rather, the first channel system and the second channel system each have openings in the contact side which directly adjoin the gas side of the GDE. In this way, the reaction gas advantageously flows through the GDE in order to switch between the first channel system and the second channel system. Flow of the reaction gas through the GDE is forced as a result, with this flow running laterally along the gas side of the GDE. This gives additional possible ways of controlling the gas flow in the GDE. As a result of the first channel system and the second channel system being separated from one another, it is possible to set a different pressure in the two channel systems. This gives a controllable pressure gradient which directly influences the flow of the reaction gas in the GDE. An increase in the pressure difference here primarily leads to an increase in the reaction gas flow laterally to the gas side of the GDE and only indirectly to an increase in the flow of the reaction gas orthogonally to the gas side. It is therefore easier to avoid or at least reduce passage of the reaction gas through to the electrolyte space even in the case of high pressure differences between the first channel system and the second channel system. The pressure difference can also be altered during operation of the electrolysis cell.

On the other hand, the pressure gradient between gas side and electrolyte side of the GDE can be set independently of the pressure gradient prevailing between the first channel system and the second channel system in order to influence firstly the orthogonal component of the flow of the reaction gas and the flow of the electrolyte orthogonally to the electrolyte side in the direction of the gas space. Passage of electrolyte at the

GDE can thus advantageously be prevented or at least reduced without significantly influencing the throughput rate of the reaction gas. Of course, further influencing factors can also be varied. The thickness of the GDE, the layer structure and the porosity thereof can, for example, likewise be altered in order to influence the flow conditions in the GDE.

In addition, the support body advantageously contributes to the mechanical and electrical contacting of the GDE. This advantageously makes it possible to produce large-area GDEs because these can both be reliably electrically contacted and be mechanically stabilized by means of the support body. The mechanical stabilization in turn allows greater pressure gradients between gas side and electrolyte side of the GDE, which in turn advantageously increases the latitude in the setting of the process parameters.

The reaction gas can be conveyed from the first channel system via the openings into the GDE and out from the GDE through the openings into the second channel system. However, the reverse direction is also conceivable. In addition, in accordance with the above-described method, it is also possible according to the invention for the flow direction of the reaction gas in the first channel system on the gas side and in the second channel system to be reversed at least once during the electrolysis. Thus, the first channel system and the second channel system can each be used both for introduction of the reaction gas and for discharge of the reaction gas and any product gas formed. Reversal of the flow direction during the electrolysis has the advantage that performance decreases in the GDE, which can occur by establishment of a steady state in the GDE, can be compensated for.

The setting of the respective pressure gradients between the first channel system and the second channel system and between the electrolyte side and the gas side of the GDE can also be utilized for controlling the path of a product gas which is formed in the GDE. As a result of the product gas having different properties than the reaction gas (which is fed in as feed gas), it is possible for the product gas to pass through the GDE and leave the electrolysis cell by the electrolyte space or for the product gas to be largely discharged via the first channel system or the second channel system. This event can also be influenced directly by setting of the pressure ratios between the first channel system and the second channel system and also between electrolyte side and gas side of the GDE.

The gas diffusion electrode is fastened on a gas side to a contact side of a plate-like support body, with a gas space adjoining the gas side being formed by a first channel system and by a second channel system. The first channel system and the second channel system run, as described above, separately from one another. In addition, the first channel system and the second channel system each have openings in the contact side which is adjoined by the GDE. Such an electrode plate is suitable for installation in the above-described electrolysis cell, as a result of which the advantages described above are achieved.

A side of the support body located opposite the contact side is electrically conductive and is electrically connected to the contact side. In this way, the electrode plate can be used as bipolar plate, as a result of which a particularly simple construction of the electrolysis cell in a stack configuration is advantageously made possible. Here, electrolyte spaces are arranged alternately with the gas spaces formed by the first channel system and the second channel system, with the gas space being integrated into the electrode plate. Between the electrode plates there are thus the electrode spaces, preferably separated by a separating membrane into an anode space and a cathode space. The electrode plate serves, in each case together with the GDE joined to its one side, as cathode and in an adjacent electrolyte space with its opposite side as anode. The contact side of the support body at the same time serves for electrical contacting of the GDE.

Another possibility is for both sides of the support body to be configured as contact sides for a GDE in each case. This means that the first channel system and the second channel system also have to have openings in the two contact sides. In this way, the electrode plate can advantageously serve to make a GDE available as cathode for each of two adjacent electrode spaces.

In further embodiments of the electrode plate of the invention, the electrode plate can be configured as described above, with the abovementioned advantages being achieved. In particular, it is possible for the first channel system to have first channels and the second channel system to have second channels, with the first channels and the second channels being arranged alternately and parallel to one another and parallel to the contact side in the support body. It is particularly advantageous for the first channel system and the second channel system to have a comb-like structure and intermesh with one another. It is advantageously possible for the openings in the contact side to be formed by the first channels which are open in the direction of the contact side and the second channels which are open in the direction of the contact side. As an alternative, it is possible for the openings in the contact side to be configured as holes which connect the first channel system and the second channel system respectively to the contact side.

In an advantageous embodiment of the electrolysis cell of the invention, the electrolyte space is separated by a dividing wall separately configured as ion-permeable separating membrane or as ion- and liquid-permeable separating membrane into an anode space and a cathode space, with the anode space having an anolyte inlet and an anolyte outlet for an anolyte and the cathode space having a catholyte inlet and a catholyte outlet for a catholyte. Such a configuration of the electrolyte space is advantageous when different gases which should not mix with one another in the electrolyte space are formed at the anode and the cathode (GDE) or pass through the GDE. The dividing wall is of particular importance when an electrolysis of water is carried out in the electrolyte space and the gases oxygen and hydrogen formed should not mix to form an explosive H_2/O_2 gas mixture.

In a further embodiment of the invention, the first channel system has first channels and the second channel system has second channels, with the first channels and the second channels being arranged alternately and parallel to one another and parallel to the contact side in the support body. The parallel arrangement relative to one another advantageously results in the distances between the first channels and the second channels each remaining constant and being able to be designed according to the criterion that a required path length of the gas is covered in the GDE. In this case, the reaction gas flows in each case from the channels used as inlet to the channels used as outlet. A parallel orientation of the channels relative to the contact side advantageously further assists the uniformed distribution of the reaction gas over the entire GDE whose surface rests against the support body via the contact side of the latter.

The support body advantageously performs the task of supporting the GDE in addition to the task of accommodating the channels and distributing the reaction gas. The GDE can therefore advantageously be made thinner or with a greater porosity and thus greater internal surface area for reaction of the reaction gas. The efficiency of the GDE is advantageously increased, while the mechanical stability of the GDE is ensured by the support body. The regions of the contact side which are not provided with the openings and thus rest directly against the gas side of the GDE are sufficient for this purpose.

When the support body is made of an electrically conductive material, it can, according to a further advantageous embodiment of the invention, also perform electrical contacting and not only mechanical contacting of the GDE. Particularly in the case of large-area GDEs, which are intended for industrial use, electrical contacting of the GDE having a low transition resistance can be achieved in this way. The support body is also suitable, in particular, to support a stack structure of the electrolysis cell (more on this subject below).

A particular embodiment of the channel arrangement is obtained when the first channel system and the second channel system have a comb-like configuration and intermesh. The course of the channels here corresponds to the teeth of the comb which are in each case supplied via a common distributed channel. The distances between the respectively adjacent channels of one comb-like arrangement are so large that the respective adjacent channels of the other comb-like arrangement find room in the intermediate spaces. The spacing of the first channels and second channels is in each case so great that the reaction gas covers a sufficient path length in the adjacent GDE. The advantage of a comb-like configuration of the channel system is a hydrodynamically advantageous structure in which the individual first channels and second channels can be supplied uniformly with the reaction gas. This can be additionally assisted by a cross section which tapers toward the ends of the respective first channels and second channels.

A further embodiment of the invention provides for the openings in the contact side to be formed by the first channels which are open in the direction of the contact side and the second channels which are open in the direction of the contact side. In other words, the channels in the contact side are configured as grooves or valleys so that, in other words, the missing wall of the channels forms the opening in the contact side. This has the advantage that the opening has a sufficiently large cross-sectional area for the reaction gas to be able to switch between the respective channels and the GDE with a low flow resistance. The remaining contact side between the channels serves for supporting of the GDE by the support body in this embodiment.

Another embodiment of the invention provides for the openings in the contact side to be formed by holes which connect the first channel system and the second channel system to the contact side. In other words, the first channels and the second channels are configured in such a way that they run in the interior of the support body, with the holes creating connections through which the reaction gas can flow out from the channels into the GDE and out from the GDE back into the channels. In this embodiment, a comparatively large proportion of the area of the contact side is advantageously available for supporting of the GDE by the support body.

In a particularly advantageous embodiment of the electrolysis cell, at least two electrolyte spaces are arranged in the housing. Far more than two electrolyte spaces can advantageously also be provided, for example ten electrolyte spaces, twenty electrolyte spaces or fifty electrolyte spaces. For the purposes of the present invention, a stack construction is a construction in which the electrolyte spaces are arranged alternately with the electrodes (i.e. the anode and the GDE configured as cathode) and the gas spaces, with, in particular in the case of industrial applications, sufficient electrode area being able to be made available in a comparatively tight construction space. The configuration of the electrolysis cell in a stacked manner can be configured differently, as will be explained further below.

In one embodiment of the electrolysis cell having a stack construction, adjacent electrolyte spaces are separated from one another by a support body which on both sides has a contact side which is adjoined in each case by a gas diffusion electrode. This means that a GDE has to be arranged on both sides of the support body, with the first channel system and the second channel system in the support body supplying both GDEs with the reaction gas. The two adjacent electrode spaces then each have a preferably plate-like anode, which likewise adjoins a cathode space on each side, on the opposite sides of the GDE. In the stacking order, there are thus in each case a cathode space, a GDE-support body composite, a cathode space, an anode, a cathode space, a GDE-support body composite, etc. The advantage of this design is that the pressure of the reaction gas can be applied symmetrically to the support bodies and the number of support bodies used can be reduced.

In another embodiment of the invention, adjacent electrolyte spaces are separated from one another by a support body, the contact side of which is adjoined by the gas diffusion electrode of the one of the neighboring electrode spaces and the opposite side of which is configured as anode of the other neighboring electrode spaces. This forms a bipolar plate which on one side has a surface serving as anode for an electrolyte space and on the other side is provided with the channel system and the GDE for a neighboring electrolyte space. In this stack construction, the electrolyte spaces alternate with the cathode-anode unit (having the support body with the gas space and the GDE), as a result of which a particularly simple construction is advantageously obtained. In particular, the electrical contacting is simplified since the bipolar plates can be connected electrically in series, so that an electrical connection to a voltage source has to be provided only at the outermost anode and the outermost cathode formed by a support plate and a GDE. For this purpose, the support bodies have to be electrically conductive.

Further details of the invention are described below with the aid of the drawing. Identical or corresponding elements in the drawing are in each case provided with the same reference symbols and are explained repeatedly only insofar as there are differences between the individual figures. The figures show:

Figure 1 an electrolysis cell having a structure according to the prior art,

Figure 2 a composite of support body and GDE, as can be used in a working example according to the prior art,

Figures 3 and 4 working examples of the electrolysis cell of the invention in section, where a working example of the process of the invention proceeds as shown in Figure 3, and

Figures 5 and 6 working examples of support bodies in section with different courses of the first channels and second channels, as can be used in the electrolysis cell of the invention.

Figure 1 depicts an electrolysis cell according to the prior art. An electrolyte space which is divided by a gas-impermeable dividing wall 12 into an anode space 13 and a cathode space 14 is provided in a housing 11. The electrolyte space is thus formed jointly by the anode space 13 and the cathode space 14. The anode space 13 is also delimited by an anode 15 and the cathode space 14 by a gas diffusion electrode (GDE) 16 connected as cathode. In order to be able to pass an anolyte (A) through the anode space, an anolyte inlet 17 and an anolyte outlet 18 are provided. Likewise, the catholyte space 14 has a catholyte inlet 19 and a catholyte outlet 20 in order to make it possible for a catholyte (K) to be passed through.

The GDE 16 adjoins on an electrolyte side 21 the catholyte space 14. On a gas side 22 opposite the electrolyte side 21, the GDE 16 adjoins a gas space 23 which is likewise accommodated in the housing 11. This gas space 23 has a gas inlet 24 for a reaction gas which can diffuse into the GDE 16 owing to the porosity of the latter (indicated in Figure 1).

The arrangement according to the invention of the GDE 16 on a support body 25 can be seen in Figure 2. This support body is shown in the section II-II in Figure 5, where Figure 5 is depicted in the section V-V (drawn in in Figure 2). The support body 25 has a contact side 26 against which the gas side 22 of the GDE 16 rests. In addition, first channels 27 and second channels 28 are provided in the contact side 26. The first channels 27 and second channels 28 differ in that the first channels belong to a first channel system 29 and the second channels belong to a second channel system 30 (cf. Figure 5), where the first channel system runs fluidically separately from the second channel system. The gas space is thus divided into two separate volumes.

As can be seen from Figure 5, the first channel system can, as indicated by the arrows with solid lines, be utilized for feeding in the reaction gas and the second channel system 30 can be used for discharging reaction gas which has not been consumed during the reaction. During the reaction, the reaction gas switches from the first channel system to the second channel system on passage through the pores in the GDE 16, which is likewise indicated by the arrows. These arrows thus indicate passage through the GDE 16, with the GDE not being shown in Figure 5. During passage through the GDE 16, the reaction gas is at least partially converted in a reaction (cf. also the arrows in Figure 2). The broken-line arrows in Figure 5 indicate that the flow direction in the support body can also be reversed, as a result of which the flow through the GDE 16 also occurs in the reverse direction.

The unit shown in Figure 2 forms an electrode plate which can be installed in the housing of an electrolysis cell. Such an installation example can be seen in Figure 3. Here, the electrode plate as shown in Figure 2 forms a bipolar plate, i.e. the side of the support body 25 opposite the contact side 26 is configured as anode 15. If the electrode plate as shown in Figure 2 is installed in an electrolysis cell having a stack construction, the anode 15 and the cathode formed by the GDE 16 are in each case used in adjacent electrolyte spaces (cf. also Figure 3).

Different construction principles are fundamentally possible for the electrolysis cell of the invention, and these are depicted by way of example in Figure 3 and in Figure 4. Both arrangements show a possible stacked construction of the electrolysis cell.

In Figure 3, electrode plates having a structure as shown in Figure 2 are used. The following stacking order is realized in the electrolysis cell. The support body 25 is followed on the side employed as anode 15 by an anode space 13 which is separated by a dividing wall 12 from a subsequent cathode space 14. A GDE 16, which is supported by a subsequent support body 25, adjoins the cathode space 14. First channels 27 and second channels 28 are also present in the support body 25. The stacking order is then repeated.

Anolyte inlets 17 and anolyte outlets 18 are provided for each of the anode spaces 13 and the catholyte inlets 19 and catholyte outlets 20 are provided for the cathode spaces. In addition, a connection port 31 which is connected in a manner not shown in more detail to the first channels 27 can be seen. In the case of the flow direction depicted in Figure 3, the connection port is used as gas inlet, while in the case of the reverse flow direction indicated by broken-line arrows it is used as gas outlet for the reaction gas with which the GDE is supplied. A comparable connection port for the second channels 28 is located in front of the drawing plane depicted in Figure 3 and is therefore not shown.

Furthermore, the electrical contacting of the electrolysis cell is indicated in Figure 3. The design of the composite of support body 25 and GDE 16 as bipolar plate in each case makes it possible for the electrolysis cells consisting of the respective anode spaces 13 and the cathode spaces 14 to be connected in series.

Only the outermost anode of the stack in each case is connected to the plus pole of a voltage source and the outermost GDE is connected via the outermost support body to the minus pole of the voltage source 32.

A similar structure as in Figure 3 is described in Figure 4, and only the differences will be explained below. The support body 25 has two contact sides 26 located opposite one another, on each of which a GDE 16 is arranged. This gives the following stacking order for the stacked construction. An electrode plate is provided as anode 15 which is adjoined by an anolyte space 13. This is separated by a dividing wall 12 from a catholyte space 14. This is followed by a GDE 16 which is arranged on a support body 25. On the other side of the support body 25, there is a further GDE 16. This is followed by a further cathode space 14, a further dividing wall 12 and a further anode space 13. Subsequently, the stacking order recommences with a further anode 15.

In this arrangement of the electrolysis cells consisting of anode space 13 and cathode space 14, the electrolysis cells are connected in parallel. An electrical connection of all anodes 15 and all GDEs 16, in each case via the support bodies 25, is therefore necessary in each case. This is indicated in Figure 4. As can be seen, the plus pole of the voltage source 32 is electrically connected to the anodes 15 and the minus pole of the voltage source 32 is electrically connected to the electrically conductive support bodies 25.

The first channels 27 and second channels 28 are in the case of the support body 25 shown in Figure 4 configured so that they open in the direction of both sides of the support body. The first channels 27 and second channels 28 thus simultaneously supply both opposite GDEs 16 with the reaction gas. The fluidic connections (17, 18, 19, 20, 31) of the electrolysis cell are no different from the structure shown in Figure 3 and are therefore not explained in more detail in connection with Figure 4.

A possible course of the first channel system 29 and of the second channel system 30 can be seen from Figure 5. Both channel systems have a comb-like course, which means that the first channels 27 and the second channels 28 form the teeth of this comb-like arrangement. These in each case run alternately parallel to one another, which is achieved by the comb-like structures intermeshing. In addition, the first channels 27 and the second channels 28 are also arranged parallel to the drawing plane depicted, so that they also run parallel to the contact side 26 located above the same plane (cf. Figure 2).

As a result of the parallel course of the first channels 27 and second channels 28, there is, as can be seen from Figure 2, a constant path length which has to be covered in the GDE 16 by the reaction gas conveyed through said channels in order to switch from the first channel system 29 into the second channel system 30 (or vice versa). The GDE is in this way uniformly supplied with reaction gas, with the gas flow occurring primarily parallel to the gas side 22 of the GDE 16. Exit of the reaction gas from the electrolyte side 21 of the GDE 16 can in this way be prevented more easily.

As can also be seen from Figure 5, the first channel system 29 and the second channel system 30 has a cross-sectional profile which narrows continually in the direction of the dead ends of the first channels 27 and second channels 28. In this way, a uniform pressure distribution for the reaction gas in said channel system can be ensured, such that the local pressure drop between the openings of the first channels 27 and second channels 28 over the area of the GDE 16 can be kept constant.

Figure 6 depicts an alternative embodiment of the support body 25, in which the openings in the contact side are formed by holes 33. The holes can, for example, be drilled holes which connect the first channels 27 and second channels 28 in each case to the contact side of the support body 25 located behind the drawing plane in Figure 6. In the working example as shown in Figure 6, the first channels 27 and second channels 28 run diagonally in the depicted square sectional area of the support body 25. The holes 33 are arranged on a square grid in the support body 25, so that adjacent holes are also in each case connected alternately to one of the first channels 27 or one of the second channels 28. This results, as indicated by the vertical and horizontal arrows shown in Figure 6, in each case in short paths for the reaction gas in the GDE located behind the drawing plane, in each case from one of the holes 33 to the four vertically and horizontally adjacent holes 33.

To connect the first channels 27 and the second channels 28 to a first channel system 29 and a second channel system 30, respectively, said channel systems are continued and combined in the housing which surrounds the support body and is not shown in detail. The course of the first channel system 29 and the second channel system 30 is indicated by dot-dashed lines at the periphery of the support body.

An example of the use of the electrolysis cell will be described for the example of Figure 1 and can equally well be carried out using the electrolysis cells configured as shown in Figures 2 – 6. Carbon dioxide is used as reaction gas and is converted into carbon monoxide in the GDE 16. The carbon monoxide preferably passes through the GDE on the electrolyte side 21 and is transported away with the catholyte (K) passed through. Due to an electrochemical dissociation of water, hydrogen is additionally formed in the cathode space 14 and is discharged together with the carbon monoxide. Oxygen is formed in the anode space 13. The dividing wall 12 prevents the hydrogen gas from mixing with the oxygen gas.

In the case of the electrolysis cells as shown in Figures 2 – 6, the carbon dioxide is, as a difference from the apparatus shown in Figure 1, fed in via one of the two channel systems (first channel system 29, second channel system 30) and unreacted carbon dioxide gas is discharged again through the other of the two channel systems (29, 30). This makes it possible to set the pressure difference between the two channel systems mentioned and utilize it as control parameter for the throughput of carbon dioxide in the GDE 16. The carbon dioxide gas discharged can also contain carbon monoxide gas which has not passed through to the electrolyte side 21 of the GDE 16.

Patentkrav

1. Elektrolysecelle, omfattende et hus (11) med en anode (15) og en gasdiffusionselektrode (16), som er forbundet som katode, hvor de begge kan forsynes med en elektrolyt i et elektrolytrum, der er dannet af huset (11), hvor

• gasdiffusionselektroden (16) er anbragt som separator mellem elektrolytrummet og et i huset (11) tilvejebragt gasrum til en reaktionsgas, og

• gasdiffusionselektroden grænser op til en elektrolytside (21) ved elektrolytrummet og til en gasside (22) ved gasrummet,

kendetegnet ved,

at gasdiffusionselektroden (16) grænser op til gassiden (22) ved en kontaktside (26) af et støttelegeme (25), hvor gasrummet er dannet af et første kanalsystem (29) og af et andet kanalsystem (30), hvor

• det første kanalsystem (29) og det andet kanalsystem (30) løber adskilt fra hinanden og danner således to separate volumener af gasrummet, og

• det første kanalsystem (29) og det andet kanalsystem (30) hver især har åbninger i kontaktsiden (26).

2. Elektrolysecelle ifølge krav 1,

kendetegnet ved,

at elektrolytrummet er opdelt af en skillevæg (12), der er udført som iongennemtrængelig separationsmembran eller som ion- og væskegennemtrængelig separator, i et anoderum (13) og et katoderum (14), hvor anoderummet (13) har et anolytindløb (17) og et anolytudløb (18) til en anolyt, og katoderummet har et katolytindløb (19) og et katolytudløb (20) til en katolyt.

3. Elektrolysecelle ifølge et af de foregående krav,

kendetegnet ved,

at det første kanalsystem (29) har første kanaler (27), og det andet kanalsystem (30) har andre kanaler (28), hvor de første kanaler (27) og de andre kanaler (28) er anbragt i støttelegemet (25), hvor de strækker sig skiftevis og parallelt med hinanden til kontaktsiden (26).

4. Elektrolysecelle ifølge krav 3,
kendetegnet ved,
at det første kanalsystem (29) og det andet kanalsystem (30) er udført som kamme og griber ind i hinanden.

5. Elektrolysecelle ifølge krav 3 eller 4,
kendetegnet ved,
at åbningerne i kontaktsiden (26) er dannet af de første kanaler (25), som er åbne i retning af kontaktsiden (26), og de andre kanaler (28), som er åbne i retning af kontaktsiden (26).

6. Elektrolysecelle ifølge krav 3 eller 4,
kendetegnet ved,
at åbningerne i kontaktsiden (26) er dannet af huller (33), som forbinder det første kanalsystem (29) og det andet kanalsystem (30) hver især med kontaktsiden (26).

7. Elektrolysecelle ifølge et af de foregående krav,
kendetegnet ved,
at der er anbragt mindst to elektrolytrum i huset (11).

8. Elektrolysecelle ifølge krav 7,
kendetegnet ved,
at naboliggende elektrolytrum er indbyrdes adskilt af et støttelegeme (25), som

på begge sider har en kontaktside (26), som hver især grænser op til en gasdiffusionselektrode (16).

9. Elektrolysecelle ifølge krav 7,
kendetegnet ved,
at naboliggende elektrolytrum er indbyrdes adskilt af et støttelegeme (25), som på sin kontaktside (26) grænser op til gasdiffusionselektroden (16) af et af de naboliggende elektroderum, og hvis modsatte side er udformet som anode (15) af det andet af de naboliggende elektroderum.

10. Elektrolysecelle ifølge et af de foregående krav,
kendetegnet ved,
at støttelegemet (25) består af et elektrisk ledende materiale.

11. Fremgangsmåde til drift af en elektrolysecelle ifølge et hvilket som helst af de foregående krav, hvor elektrolytsiden (21) af gasdiffusionselektroden (16) forsynes med en elektrolyt, og gassiden (22) af gasdiffusionselektroden (16) forsynes med en reaktionsgas,
kendetegnet ved,
at strømningsretningen af reaktionsgassen i det første kanalsystem (29) på gassiden (22) og i det andet kanalsystem (30) vendes mindst én gang under elektrolysen.

FIG 1

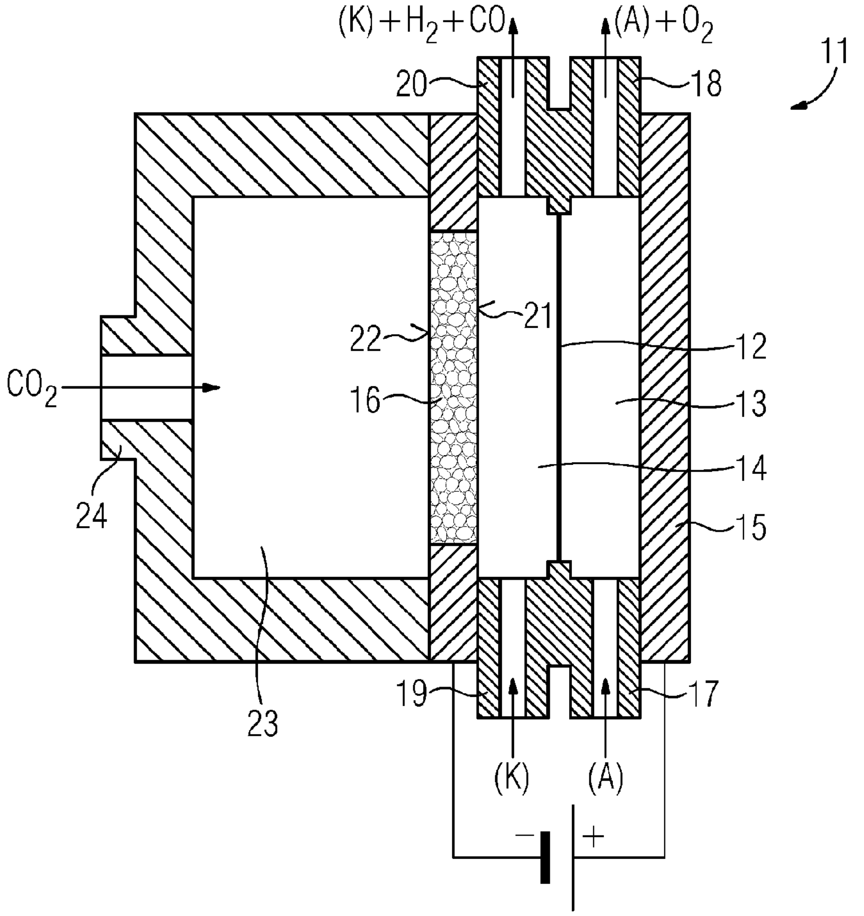

(K)+H2+CO
(A)+O2
11
20
18
21
22
12
CO2
16
13
14
24
15
23
19
17
(K)
(A)
−
+

FIG 2

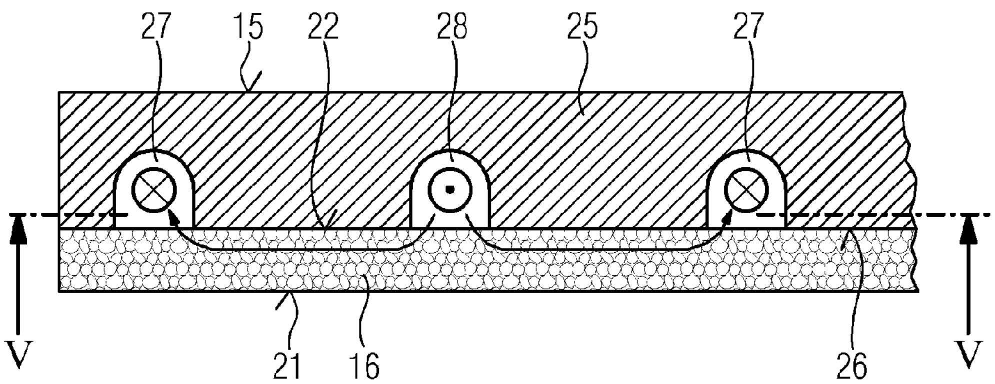
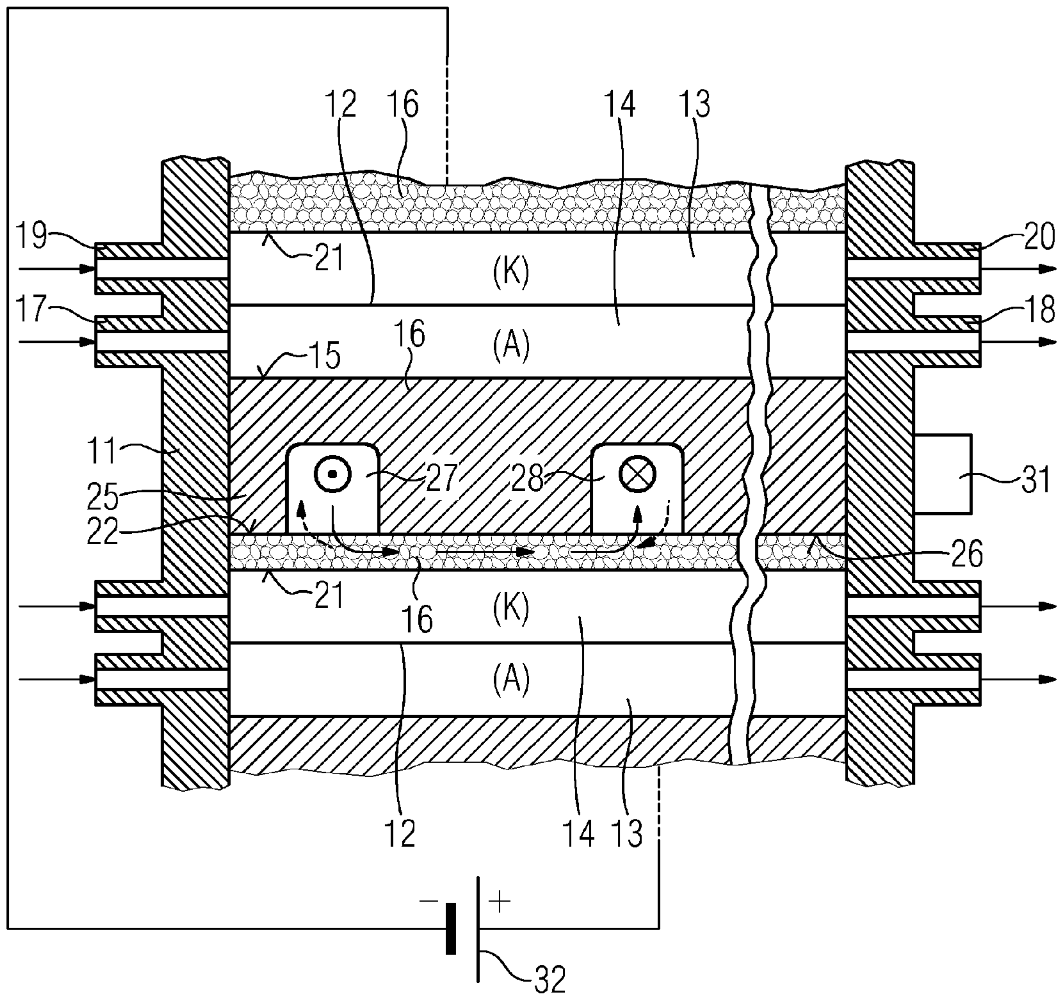

27
15
22
28
25
27
V
21
16
26
V

FIG 3


12
16
14
13
19
20
21
(K)
17
18
16
(A)
15
11
27
28
31
25
22
26
21
(K)
16
(A)
12
14
13
32
−
+

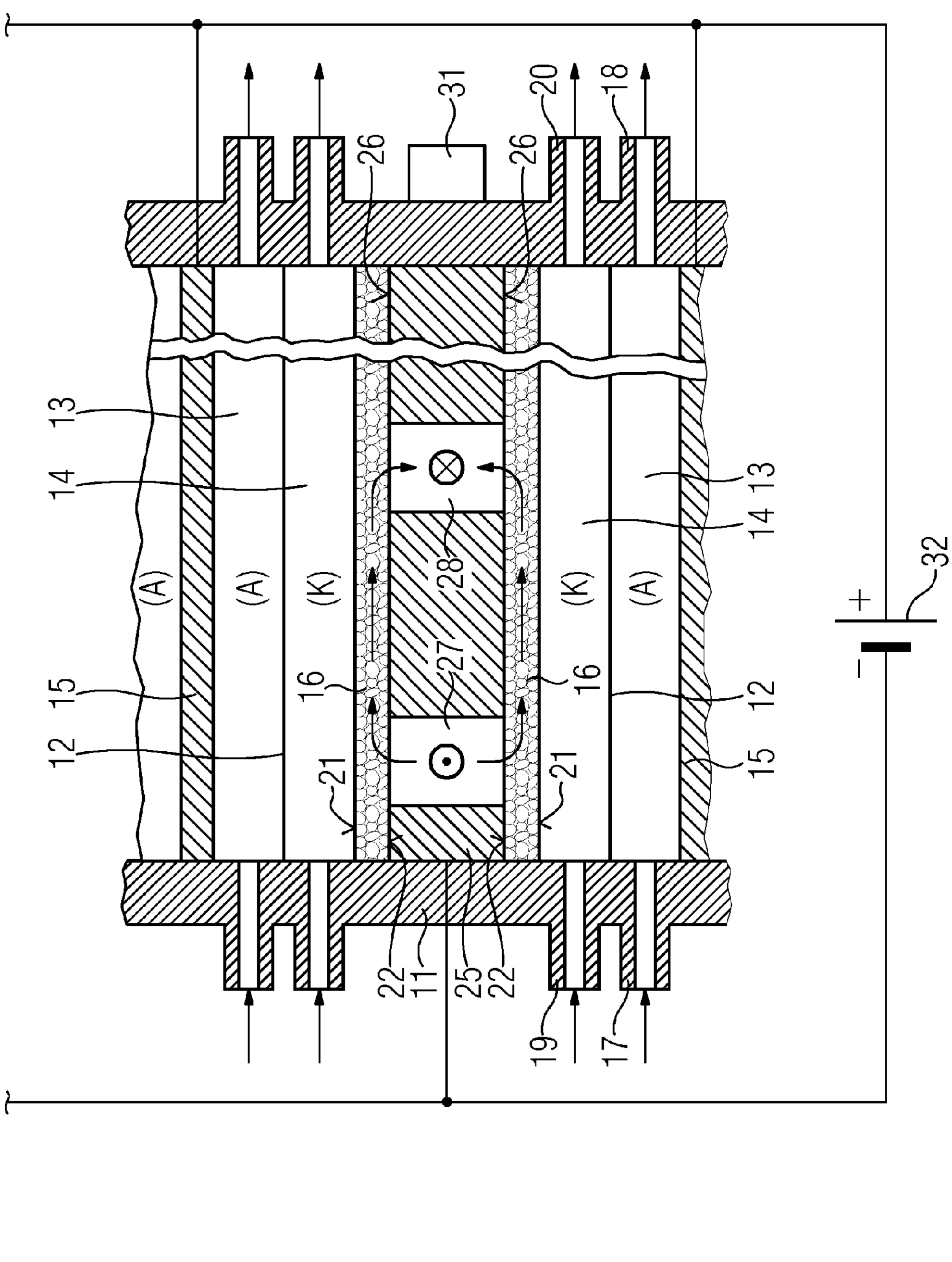


FIG 4

FIG 5

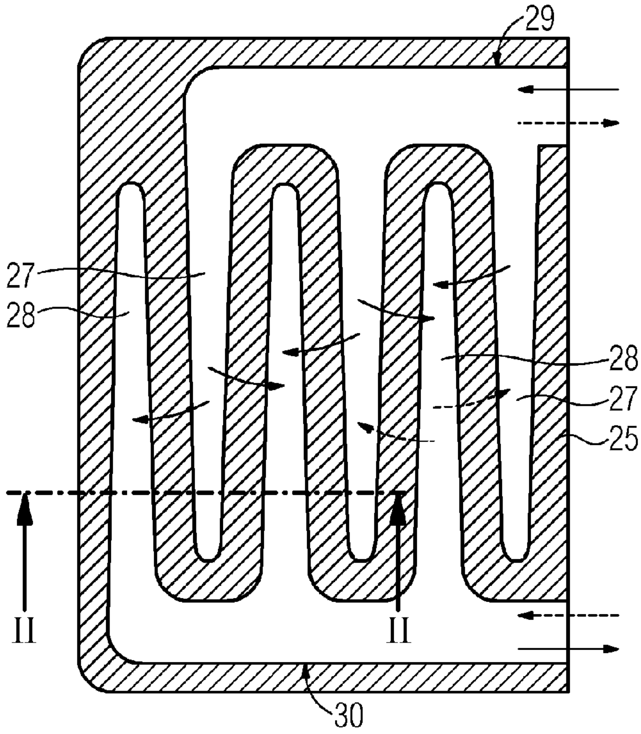


FIG 6