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NOZZLE AND SLOT COATER INCLUDING THE SAME

Abstract

A nozzle and a slot coater including the same are disclosed. A nozzle includes: a first body portion and a second body portion that are coupled to each other; a discharge portion between the first body portion and the second body portion and configured to discharge a slurry supplied from an outside onto a substrate; and an area varier inside at least one of the first body portion and the second body portion and configured to change an area of a portion in contact with the slurry discharged through the discharge portion.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to and the benefit of Korean Patent Application No. 10-2024-0022095, filed on Feb. 15, 2024 in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

1. Field

[0002] Aspects of embodiments of the present disclosure relate to a nozzle and a slot coater including the same.

2. Description of the Related Art

[0003] A rechargeable battery may be fabricated into various shapes. Among these, a pouch battery includes an electrode assembly with an insulating separator between positive and negative electrode plates, and a thin flexible pouch with the electrode assembly built in. In this case, the pouch accommodates the electrode assembly in an inner space.

[0004] In the manufacture of the electrode plate, a coating process is performed in which a slurry mixed with an active material, a binder, a conductive material, and a solvent are coated on a current collector. Such a coating method is a generally used method for manufacturing electrode plates due to its ability to produce thin and uniform films at high speed.

[0005] The slurry generated through the mixing process is distributed in a width direction inside the slot coater and applied on the current collector transferred through a nozzle. In this case, the shape of a part of the nozzle closest to the current collector may have a significant impact on thickness planarity of an applied slurry solution.

SUMMARY

[0006] According to an aspect of one or more embodiments of the present disclosure, a nozzle that can change an area of a portion in contact with a slurry, and a slot coater including the same, are provided.

[0007] However, technical aspects and objects of the present disclosure are not limited to the above-mentioned aspects and objects, and other aspects and objects can be clearly understood by a person of an ordinary skill in the art from the description of the invention described below.

[0008] According to one or more embodiments, a nozzle includes: a first body portion and a second body portion that are coupled to each other; a discharge portion between the first body portion and the second body portion and configured to discharge a slurry supplied from an outside onto a substrate; and an area varier inside at least one of the first body portion and the second body portion and configured to change an area of a portion in contact with the slurry discharged through the discharge portion.

[0009] The area varier may include: a moving roller; a first driver configured to move the moving roller; one or more of fixed rollers arranged apart from the moving roller; and a belt member, or belt, that is wound on the moving roller and the fixed roller, and the area of the portion in contact with the slurry changes as the moving roller moves in a direction by the first driver.

[0010] A part of the belt may be exposed to the discharge portion.

[0011] The first driver may be adjacent to the discharge portion.

[0012] The moving roller may perform a straight-line reciprocal motion to be away from the discharge portion or closer to the discharge portion.

[0013] The at least one of the first body portion and the second body portion provided with the area varier may include a first guide portion that guides the moving roller to perform a straight-line reciprocal motion.

[0014] The area varier may include a guide protrusion that is protruded from a side surface of the moving roller and inserted in the first guide portion.

[0015] The first guide portion may be in a portion of one of the first body portion and second body portion, adjacent to the substrate, and parallel with the substrate.

[0016] The first guide portion may have a shape of a slot.
[0017] The area varier may further include a support member that has a shape of a plate and arranged in a portion of the belt, adjacent to the discharge portion.
[0018] The support member may be in contact (e.g., close contact) with the belt.
[0019] The nozzle may further include a tension adjuster provided with the area varier among the at least one of the first body portion and the second body portion, is adjacent to the belt, and configured to adjust a tension of the belt by pressing a side of the belt member.
[0020] The tension adjuster may include: a pressure roller that presses a side of the belt; and a second driver configured to move the pressure roller such that the pressure roller presses the belt member or becomes away from the belt member.
[0021] The one or more fixed rollers of the area varier may include a plurality of fixed rollers, and the pressure roller of the tension adjuster may be arranged to press a portion of the belt located between two adjacent fixed rollers among the plurality of fixed rollers.
[0022] Among the first body portion and the second body portion, a portion in which the tension adjuster is provided may include a second guide portion that guides the pressure roller to perform a straight-line reciprocal motion
[0023] The second guide portion may have a shape of a slot.
[0024] The area varier may be provided in each of the first body portion and the second body portion.
[0025] According to one or more embodiments, a slot coater includes: a transferer to transfer a substrate; a nozzle to discharge a slurry to the substrate; and a supplier to supply the slurry to the nozzle.
[0026] According to one or more embodiments, a slot coater including a nozzle can apply a slurry with a target thickness on a substrate by varying the area of a portion in contact with the slurry with the area variable unit. Therefore, even if a design of the electrode plate changes, the coating process can be continuously performed without interruption, which improves productivity and reduces manufacturing costs.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0027] The following drawings attached to the specification illustrate some embodiments of the present disclosure, and are provided to allow the technical spirit of the present disclosure to be better understood together with the detailed description of the present disclosure described below. However, the present disclosure is not be construed as limited to matters described with reference to the drawings.
[0028] FIG. **1** is a perspective view of a slot coater including a nozzle according to an embodiment.
[0029] FIG. **2** is a perspective view of a nozzle according to an embodiment.
[0030] FIG. **3** is a cross-sectional view of the nozzle according to an embodiment.
[0031] FIG. **4** is a cross-sectional view of a state in which an area variable unit of the nozzle in FIG. **3** operates.
[0032] FIG. **5** is a cross-sectional view of a state in which an area variable unit is provided in both of a first body portion and a second body portion, according to an embodiment.
[0033] FIG. **6** is a cross-sectional view of an area variable unit according to an embodiment.
DESCRIPTION OF SYMBOLS
TABLE-US-00001 10: slot coater 20: transfer unit 30: supply unit 100: nozzle 110: first body portion 120: second body portion 131: discharge portion 140: area variable unit 141: first driving member 142: moving roller 143: fixed roller 144: belt member 145: guide protrusion 146: support member 150: tension adjustment unit 151: pressure roller 152: second driving member G1: first

guide portion G2: second guide portion

DETAILED DESCRIPTION

[0034] Herein, some example embodiments of the present disclosure will be described in further detail with reference to the accompanying drawings. However, the terms or words used in this specification and ranges described below should not be construed as being limited to conventional or dictionary meanings, and are to be interpreted as having meaning and concept consistent with the technical idea of the present invention based on the principle that it can be appropriately defined as a concept of a term to describe an inventor's own invention in the best way. Therefore, embodiments described in the present specification and the configurations shown in the drawings are provided as example embodiments of the present invention, and do not necessarily represent all the technical spirit of the present invention, and, therefore, it is to be understood that various equivalents and modifications may be substituted for them at the time of filing the present application.

[0035] In addition, the terms “comprise” or “include” and/or “comprising” or “including” used in the present disclosure may specify the presence of stated shapes, numerals, steps, operations, members, elements, and/or a group thereof, and do not preclude the presence or addition of one or more other shapes, numerals, steps, operations, members, elements, and/or groups thereof.

[0036] Further, the accompanying drawings may not be illustrated to scale, and sizes of some components may be exaggerated to assist in the understanding of the present disclosure. In addition, the same reference numerals may be assigned to the same components in different embodiments.

[0037] It is to be understood that two objects of comparison may be the same or substantially the same when referred to as “the same.” Therefore, “substantially the same” may include a deviation which is considered low in the art, for example, a deviation of 5% or less. In addition, the fact that a parameter is in a predetermined region may indicate that the parameter is uniform from an average perspective.

[0038] Expressions such as “first,” “second,” and the like may be used to indicate various components, and do not limit the corresponding components. These terms are used to distinguish one component and another component from each other, and a first component may also be a second component unless specifically stated to the contrary.

[0039] Throughout the specification, each element may be one element or a plurality of elements unless specifically stated to the contrary.

[0040] It is to be understood that when a component is referred to as being disposed “on the top (or bottom) of” or “above (or below)” another component, the component may be disposed “on the top (or bottom) of” another component, or may have one or more third components interposed between a component and any component disposed above (or below) another component.

[0041] In addition, when a component is described to be disposed “on,” “connected to,” or “coupled to” another component, it is to be understood that a component may be directly coupled or connected to another component, has one or more third components “interposed” therebetween, or is “in contact with,” “coupled to,” or “connected to” another component through the one or more third components.

[0042] The term “and/or” used herein includes any one or all combinations of the associated listed items. In addition, the use of “may” when describing the embodiments of the present disclosure relates to “one or more embodiments of the present disclosure.” Expressions such as “one or more” preceding a list of elements may modify the entire list of elements and may not modify individual elements of the list.

[0043] Throughout the specification, when referring to “A and/or B,” A, B, or A and B is indicated, unless specifically stated to the contrary, and when referring to “C to D”, C or more and D or less is indicated, unless specifically stated to the contrary.

[0044] A phrase may refer to any and all suitable combinations when the phrase such as “at least

one of A, B, and C", "at least one of A, B, or C", "at least one selected from the group A, B, and C" or "at least one selected from A, B, and C" is used to specify a list of the elements A, B, and C.
[0045] The term "use" may be considered synonymous with a term "utilize." As used herein, a term "substantially," "about," or a similar term may be used as a term of approximation rather than a term of degree, and used to consider an inherent variation in a measured or calculated value which is to be recognized by those skilled in the art.
[0046] Although the terms "first," "second," "third," or the like may be used herein to describe various elements, components, regions, layers, and/or sections, these elements, components, regions, layers, and/or sections are not to be limited by these terms. These terms may be used to distinguish one element, component, region, layer, or section from another element, component, region, layer, or section. Accordingly, a first element, component, region, layer, or section discussed below may be named a second element, component, region, layer, or section without departing from the teachings of the embodiments.
[0047] For ease of explanation, a spatial relative term such as "beneath," "below," "lower," "above," "upper," or the like may be used herein to describe a relationship between one element or feature and another element(s) or feature(s), as shown in the drawings. A spatial relative location is to be understood to encompass a different direction of a device in use or operation in addition to a direction thereof shown in the drawings. For example, when the device in the drawing is turned over, an element described as "beneath" or "below" another element may be understood to be "on" or "above" another element. Therefore, the term "below" may encompass both upward and downward directions.
[0048] The terms used herein are intended to describe embodiments of the present disclosure and are not intended to limit the present disclosure.
[0049] Herein, referring to the drawings, before describing a nozzle according to an embodiment, a slot coater including the nozzle will be described in further detail.
[0050] FIG. **1** is a perspective view of a slot coater including a nozzle according to an embodiment.
[0051] Referring to FIG. **1**, a slot coater **10** may include a transfer unit **20**, a nozzle **100**, and a supply unit **30**.
[0052] The transfer unit **20** transfers a substrate M. The transfer unit **20** may include a stage **21** and a plurality of rollers **22**. The substrate M may be a current collector used to manufacture, for example, an electrode plate. However, the substrate M may be used to manufacture an active material layer in the form of a film, but is not limited thereto.
[0053] The nozzle **100** discharges a slurry S to the substrate M. The nozzle **100** may be disposed adjacent to the stage **21**. The nozzle **100** may include a buffer portion **132** and a discharge portion **131**. The slurry S supplied from the outside to the nozzle **100** may be filled in the buffer portion **132** and then discharged to the substrate M through the discharge portion **131**.
[0054] The supply unit **30** supplies the slurry S to the nozzle **100**. In an embodiment, the above-described slurry S may be manufactured by mixing an active material, a binder, a conductive material, and a solvent.
[0055] The slurry S supplied to the nozzle **100** by the supply unit **30** is distributed in a width direction inside the nozzle **100** and applied on the current collector transferred through the nozzle **100**. In this case, an area closest to the current collector on a lower side of the nozzle **100** may have an influence (e.g., a significant influence) on a thickness planarity of the slurry S solution applied on the substrate M.
[0056] A lower area of the nozzle **100** according to an embodiment may change based on a direction shown in the drawing, and, thus, the slot coater **10** may apply the slurry S solution on the substrate M to a target thickness T. The nozzle **100** will be described in further detail with reference to the drawing.
[0057] FIG. **2** is a perspective view of a nozzle according to an embodiment; and FIG. **3** is a cross-sectional view of the nozzle according to an embodiment.

[0058] Referring to FIG. **2** and FIG. **3**, the nozzle **100** according to an embodiment includes a first body portion **110**, a second body portion **120**, the discharge portion **131**, and an area variable unit, or area varier, **140**A.
[0059] The first body portion **110** and the second body portion **120** are coupled to each other. In an embodiment, the first body portion **110** and the second body portion **120** may be a body of the nozzle **100**. The buffer portion **132** may be located in either the first body portion **110** or the second body portion **120**. The buffer portion **132** allows the slurry supplied through the supply unit **30** to flow in the width direction of the nozzle **100** and may store a certain amount of the slurry.
[0060] The discharge portion **131** is disposed between the first body portion **110** and the second body portion **120** and discharges slurry supplied from the outside to the substrate. The discharge portion **131** may communicate with the above-described buffer portion **132**.
[0061] The area variable unit **140**A is installed inside one or more of the first body portion **110** and the second body portion **120**, and changes the area of a portion in contact with the slurry discharged through the discharge portion **131**.
[0062] It is illustrated in FIG. **1** that the area variable unit **140**A is installed in the first body portion **110**, but the area variable unit **140**A may be installed in the second body portion **120**. Herein, the description will be made assuming that the area variable unit **140**A is installed in the first body portion **110**.
[0063] The area variable unit **140**A may include, for example, a moving roller **142**, a first driving member, or first driver, **141**, a fixed roller **143**, and a belt member, or belt, **144**.
[0064] The moving roller **142** may press a portion of the belt member **144**, which will be described later. The moving roller **142** may be moved in a straight-line reciprocal movement to be away from the discharge portion **131** or closer to the discharge portion **131**.
[0065] The first driving member **141** moves the moving roller **142**. The first driving member **141** may be disposed adjacent to the discharge portion **131**, but the first driving member **141** is not limited thereto.
[0066] The fixed roller **143** is disposed apart from the moving roller **142**. The fixed roller **143** may be provided as one or more.
[0067] The belt member **144** is wound on the moving roller **142** and the fixed roller **143**. The belt member **144** may not be rotated by the moving roller **142** and the fixed roller **143**, and may remain tightly wound on the moving roller **142** and the fixed roller **143**.
[0068] A region of the belt member **144** in contact with the slurry may change as the moving roller **142** moves in a direction by the first driving member **141**.
[0069] In an embodiment, referring to FIG. **3**, when the moving roller **142** moves to the right by the first driving member **141**, an area L**1** of a region in contact with the slurry may be reduced.
[0070] In an embodiment, referring to FIG. **4**, when the moving roller **142** moves to the left by the first driving member **141**, an area L**2** of the region in contact with the slurry may be increased.
[0071] A portion of the belt member **144** may be installed to be exposed to the discharge portion **131**. With reference to the direction shown in FIG. **3**, the slurry may be moved downward along a portion disposed vertical in the bent member **144**, while being adjacent to the discharge portion **131**.
[0072] As described above, the area variable unit **140**A may vary an area of the portion in contact with the slurry discharged from the discharge portion **131**. Therefore, when repeated experiments are conducted and a shape (e.g., area) of the nozzle **100** optimized or improved for the thickness of the slurry applied to the substrate is confirmed, a user may input a corresponding target area into the slot coater **10**.
[0073] The slot coater **10** controls the area variable unit **140**A, and the area variable unit **140**A may change the area of the portion in contact with the slurry to the input target area.
[0074] Among the first body portion **110** and the second body portion **120**, one in which the area variable unit **140**A is installed may have a first guide portion G**1**. The first guide portion G**1** may

guide movement of the moving roller **142** such that the moving roller **142** performs straight-line reciprocal motion.

[0075] A shape of the first guide portion G**1** for this may be, for example, a slot shape. In an embodiment, the first guide portion G**1** is disposed adjacent to the substrate in one of the first body portion **110** and the second body portion **120** and is disposed parallel to the substrate.

[0076] In an embodiment, the above-described area variable unit **140**A may include a guide protrusion **145**.

[0077] The guide protrusion **145** protrudes from a side surface the moving roller **142** and is inserted into the first guide portion G**1**. As described, since the guide protrusion **145** is inserted into the first guide portion G**1**, the moving roller **142** may reduce the stress generated by the tension of the belt member **144**. In addition, the guide protrusion **145** may ensure that the moving roller **142** moves stably.

[0078] The nozzle **100** according to an embodiment may further include a tension adjustment unit, or tension adjuster, **150**.

[0079] The tension adjustment unit **150** is installed in one of the first body portion **110** and the second body portion **120** where the area variable unit **140**A is installed, is disposed adjacent to the belt member **144**, and presses a side of the belt member **144** to adjust the tension of belt member **144**.

[0080] The tension adjustment unit **150** may include, for example, a pressure roller **151** and a second driving member **152**.

[0081] The pressure roller **151** presses a side of the belt member **144**. The fixed roller **143** of the area variable unit **140**A may be provided in plural. In an embodiment, the pressure roller **151** of the tension adjustment unit **150** may be disposed to press a portion of the belt member **144** disposed between two adjacent fixed rollers **143**A and **143**B among the plurality of fixed rollers **143**.

[0082] The second driving member **152** moves the pressure roller **151** such that the pressure roller **151** may press the belt member **144** or be away from the belt member **144**.

[0083] In an embodiment, among the first body portion **110** and the second body portion **120**, one where the tension adjustment unit **150** is installed may include a second guide portion G**2**. For example, when the tension adjustment unit **150** is installed in the first body portion **110**, the second guide portion G**2** may also be provided in the first body portion **110**.

[0084] In an embodiment, the second guide portion G**2** guides the pressure roller **151** to perform straight-line reciprocal motion. In an embodiment, the second guide portion G**2** may have a slot shape.

[0085] When the pressure roller **151** is disposed in the first body portion **110**, the second guide portion G**2** may be disposed to cross the upper and lower direction of the first body portion **110**. Accordingly, the pressure roller **151** moves in an up-and-down direction by the second driving member **152** and presses the belt member **144**, and, thus, the belt member **144** may maintain a target tension.

[0086] Here, the target tension of the belt member **144** may be a tension that allows the slurry to be stably discharged through the discharge portion **131**. However, the target tension of the belt member **144** may change depending on a design of the nozzle **100**, and is not limited to a specific value.

[0087] The tension adjustment unit **150** may be connected (e.g., electrically connected) to the area variable unit **140**A and may be operated in conjunction with the area variable unit **140**A. In an embodiment, when the moving roller **142** of the area variable unit **140**A is moved to a position adjacent to the discharge portion **131** and a contact area between the slurry and the belt member **144** is reduced, the tension adjustment unit **150** moves the pressure roller **151** to the belt member **144**. Accordingly, the tension of the belt member **144** may be maintained.

[0088] When the moving roller **142** of the area variable unit **140**A is moved to a position away from the discharge portion **131** and the contact area between the slurry and the belt member **144** is

increased, the tension adjustment unit **150** moves the pressure roller **151** in a direction away from the belt member **144**. Accordingly, the tension of the belt member **144** may be continuously maintained.
[0089] FIG. **5** is a cross-sectional view of an embodiment in which the area variable unit is provided in both of the first body portion and the second body portion.
[0090] Referring to FIG. **5**, the above-described area variable unit **140**A may be installed in each of the first body portion **110** and the second body portion **120**. The area variable unit **140**A is provided in both the first body portion **110** and the second body portion **120**, and contact areas of both the left-hand side and the right-hand side that are in contact with the slurry at the bottom of the nozzle **100** may be varied.
[0091] FIG. **6** is a cross-sectional view of the area variable unit according to an embodiment.
[0092] Referring to FIG. **6**, an area variable unit **140**B according to an embodiment may further include a support member **146**.
[0093] In an embodiment, the support member **146** has a plate shape and is disposed adjacent to the discharge portion **131** in the belt member **144**. The support member **146** may be disposed to be in contact (e.g., close contact) with the belt member **144**.
[0094] The support member **146** may be disposed to be in contact (e.g., close contact) with a portion of the belt member **144**, exposed to the discharge portion **131**. Accordingly, in a process of discharging the slurry through the discharge portion **131**, the exposed portion of the belt member **144** to the discharge portion **131** may be prevented or substantially prevented from bending. Therefore, the area variable unit **140**B according to an embodiment may discharge the slurry stably.
[0095] In a coating process of applying a slurry solution to a substrate using a slot coater using a conventional nozzle, the shape of the nozzle optimized for the thickness of the slurry applied to the substrate needs to be found to manufacture an electrode plate to be mounted on a specific rechargeable battery and the entire slot coater needs to be manufactured to fit the nozzle. Therefore, it takes a lot of cost and time to manufacture a slot coater. In addition, the coating process may be stopped while replacing the existing slot coater with a new slot coater.
[0096] However, referring to FIG. **3** and FIG. **4**, as described above, the slot coater **10** including the nozzle **100** according to an embodiment may apply the slurry with a target thickness on the substrate by varying the area of the portion in contact with the slurry with the area variable unit **140**A.
[0097] Therefore, the slot coater **10** including the nozzle **100** according to an embodiment can continuously carry out the coating process without stopping the coating process even if a design of the electrode plate is changed, thereby improving productivity and reducing manufacturing costs.
[0098] Although some example embodiments of the present disclosure have been described above, the accompanying drawings and detailed description of the present disclosure described above are merely illustrative and provided to explain the present disclosure, and are not intended to limit the meaning or scope of the present disclosure set forth in the claims. Therefore, it is to be understood by those skilled in the art that various modifications and other equivalent embodiments may be derived from the present disclosure. Accordingly, a technical scope of the present disclosure is to be defined by the technical spirit of the claims.

Claims

1. A nozzle comprising: a first body portion and a second body portion that are coupled to each other; a discharge portion between the first body portion and the second body portion and configured to discharge a slurry supplied from an outside onto a substrate; and an area varier inside at least one of the first body portion and the second body portion and configured to change an area of a portion in contact with the slurry discharged through the discharge portion.
2. The nozzle as claimed in claim 1, wherein the area varier comprises: a moving roller; a first

driver configured to move the moving roller; at least one fixed roller arranged apart from the moving roller; and a belt that is wound on the moving roller and the fixed roller, and the area of the portion in contact with the slurry changes as the moving roller moves in a direction by the first driver.

3. The nozzle as claimed in claim 2, wherein a part of the belt is exposed to the discharge portion.

4. The nozzle as claimed in claim 2, wherein the first driver is adjacent to the discharge portion.

5. The nozzle as claimed in claim 2, wherein the moving roller performs a straight-line reciprocal motion to be away from the discharge portion or closer to the discharge portion.

6. The nozzle as claimed in claim 2, wherein, the at least one of the first body portion and the second body portion provided with the area varier comprises a first guide portion that guides the moving roller to perform a straight-line reciprocal motion.

7. The nozzle as claimed in claim 6, wherein the area varier comprises a guide protrusion that is protruded from a side surface of the moving roller and inserted in the first guide portion.

8. The nozzle as claimed in claim 6, wherein the first guide portion is located in a portion of one of the first body portion and the second body portion, adjacent to the substrate, and is parallel with the substrate.

9. The nozzle as claimed in claim 6, wherein the first guide portion has a shape of a slot.

10. The nozzle as claimed in claim 2, wherein the area varier further comprises a support member having a shape of a plate and located in a portion of the belt, adjacent to the discharge portion.

11. The nozzle as claimed in claim 10, wherein the support member is in contact with the belt.

12. The nozzle as claimed in claim 2, further comprising a tension adjuster provided with the area varier among the at least one of the first body portion and the second body portion, located adjacent to the belt member, and configured to adjust a tension of the belt by pressing a side of the belt.

13. The nozzle as claimed in claim 12, wherein the tension adjuster comprises: a pressure roller configured to press a side of the belt; and a second driver configured to move the pressure roller such that the pressure roller presses the belt or becomes away from the belt.

14. The nozzle as claimed in claim 13, wherein the at least one fixed roller of the area varier comprises a plurality of fixed rollers, and the pressure roller of the tension adjuster is arranged to press a portion of the belt located between two adjacent fixed rollers among the plurality of fixed rollers.

15. The nozzle as claimed in claim 13, wherein, among the first body portion and the second body portion, a portion in which the tension adjuster is provided comprises a second guide portion that guides the pressure roller to perform a straight-line reciprocal motion.

16. The nozzle as claimed in claim 15, wherein the second guide portion has a shape of a slot.

17. The nozzle as claimed in claim 1, wherein the area varier is provided in each of the first body portion and the second body portion.

18. A slot coater comprising: a transferer to transfer a substrate; a nozzle to discharge a slurry to the substrate; and a supplier to supply the slurry to the nozzle, wherein the nozzle is the nozzle as claimed in claim 1.