Claims

1. A flat-plate membrane filter element, comprising:

a membrane support member (21);

a nonwoven fabric membrane (22); and

an outlet pipe (25),

wherein the membrane support member (21) has a flat-plate shape; a flow channel (24) is formed on a surface of the membrane support member (21); an opening of the flow channel (24) is formed on a side of the membrane support member (21);

the nonwoven fabric membrane (22) is placed on a surface of the membrane support member (21) and provided with chemically modified coating layer (223); edges of the nonwoven fabric membrane (22) are bonded to the membrane support member (21) in such a way that the flow channel (24) on the membrane support member (21) is covered under the nonwoven fabric membrane (22); and

the outlet pipe (25) is communicated with the opening of the flow channel (24),

wherein a protruded structure (23) is disposed at an area on a surface of the membrane support member (21), the surface being covered by the nonwoven fabric membrane (22), and

the flat-plate membrane filter element (2) further comprises a supporting net (26) which is disposed between the membrane support member (21) and the nonwoven fabric membrane (22).

2. The flat-plate membrane filter element according to claim 1, wherein the chemically modified coating layer (223) is a layer made of acrylic acid and derivatives thereof.

3. The flat-plate membrane filter element according to claim 1, wherein a thickness of the nonwoven fabric membrane (22) is within 0.01

mm to 5 mm, and an average pore size of the nonwoven fabric is within 0.05 μm to 500 μm.

4. The flat-plate membrane filter element according to claim 1, wherein the flow channels (24) are respectively disposed on an upper surface and a lower surface of the membrane support member (21).

5. The flat-plate membrane filter element according to claim 1, wherein the nonwoven fabric membrane (22) and the membrane support member (21) are chemically or physically connected with each other to be coactive, so as to provide necessary mechanical strength to the nonwoven fabric membrane.

6. The flat-plate membrane filter element according to any one of claims 1 to 5, wherein the nonwoven fabric membrane (22) has a stacked structure; and the stacked structure comprises: a substrate layer (221), a nonwoven fabric filter layer (222) stacked on the substrate layer (221), and the chemically modified coating layer (223) formed on the nonwoven fabric filter layer (222).

7. The flat-plate membrane filter element according to claim 6, wherein the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by glycerol polymerization.

8. The flat-plate membrane filter element according to claim 6, wherein the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by the implantation of modified hybrid fibers.

9. The flat-plate membrane filter element according to claim 6, wherein an average pore size of the nonwoven fabric filter layer (222) is 0.05μm to 500 μm, and an average pore size of the substrate layer (221) is greater than the average pore size of the nonwoven fabric filter layer (222).

10. The flat-plate membrane filter element according to claim 6, wherein both the substrate layer (221) and the nonwoven fabric filter layer (222) are made of polymer material.

11. A flat-plate membrane filter module, comprising:

a plurality of the flat-plate membrane filter elements (2) according to any one of claims 1 to 8,

wherein the flat-plate membrane filter elements (2) are mounted in a frame by stacking, and are arranged in parallel; and a certain distance is reserved between the adjacent flat-plate membrane filter elements (2).

12. A membrane bioreactor, comprising:

an inlet portion (41);

a reaction portion (42); and

an outlet portion (43),

wherein the reaction portion (42) comprises the flat-plate membrane filter module according to claim 11.

13. A method for manufacturing the flat-plate membrane filter element according to claim 1, comprising:

providing the membrane support member (21) and the nonwoven fabric membrane (22);

manufacturing the membrane support member (21) into a flat-plate shape, and disposing the flow channel (24) on the surface of the membrane support member (21) in such a way that the opening of the flow channel (24) is formed on the side of the membrane support member (21); and

disposing the nonwoven fabric membrane (22) on the surface of the membrane support member (21), disposing the chemically modified coating layer (223) on the surface of the nonwoven fabric membrane (22), and bonding the edges of the nonwoven fabric membranes (22) to the membrane support member (21) in such a way that the flow channel (24)

on the membrane support member (21) is covered under the nonwoven fabric membrane (22);

disposing a protruded structure (23) at an area on a surface of the membrane support member (21), the surface being covered by the nonwoven fabric membrane (22), and

disposing a supporting net (26) between the membrane support member (21) and the nonwoven fabric membrane (22).

14. The manufacturing method according to claim 13, wherein

the nonwoven fabric membrane (22) is provided with a stacked structure;

the stacked structure comprises: a substrate layer (221), a nonwoven fabric filter layer (222) stacked on the substrate layer (221), and the chemically modified coating layer (223) formed on the nonwoven fabric filter layer (222); and

the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by glycerol polymerization.

15. The manufacturing method according to claim 13, wherein

the nonwoven fabric membrane (22) is provided with a stacked structure;

the stacked structure comprises: a substrate layer (221), a nonwoven fabric filter layer (222) stacked on the substrate layer (221), and the chemically modified coating layer (223) formed on the nonwoven fabric filter layer (222); and

the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by the implantation of modified hybrid fibers.

Claims

1. A flat-plate membrane filter element, comprising:

a membrane support member (21);

a nonwoven fabric membrane (22); and

an outlet pipe (25),

wherein the membrane support member (21) has a flat-plate shape; a flow channel (24) is formed on a surface of the membrane support member (21); an opening of the flow channel (24) is formed on a side of the membrane support member (21);

the nonwoven fabric membrane (22) is placed on a surface of the membrane support member (21) and provided with chemically modified coating layer (223); edges of the nonwoven fabric membrane (22) are bonded to the membrane support member (21) in such a way that the flow channel (24) on the membrane support member (21) is covered under the nonwoven fabric membrane (22); and

the outlet pipe (25) is communicated with the opening of the flow channel (24),

wherein a protruded structure (23) is disposed at an area on a surface of the membrane support member (21), the surface being covered by the nonwoven fabric membrane (22), and

the flat-plate membrane filter element (2) further comprises a supporting net (26) which is disposed between the membrane support member (21) and the nonwoven fabric membrane (22).

2. The flat-plate membrane filter element according to claim 1, wherein the chemically modified coating layer (223) is a layer made of acrylic acid and derivatives thereof.

~~3. The flat-plate membrane filter element according to claim 1, wherein a protruded structure (23) is disposed at an area on a surface of~~

~~the membrane support member (21), the surface being covered by the nonwoven fabric membrane (22).~~

43. The flat-plate membrane filter element according to claim 1, wherein a thickness of the nonwoven fabric membrane (22) is within 0.01 mm to 5 mm, and an average pore size of the nonwoven fabric is within 0.05 μm to 500 μm.

54. The flat-plate membrane filter element according to claim 1, wherein the flow channels (24) are respectively disposed on an upper surface and a lower surface of the membrane support member (21).

65. The flat-plate membrane filter element according to claim 1, wherein the nonwoven fabric membrane (22) and the membrane support member (21) are chemically or physically connected with each other to be coactive, so as to provide necessary mechanical strength to the nonwoven fabric membrane.

~~7. The flat-plate membrane filter element according to any one of claims 1 to 6, wherein the flat-plate membrane filter element (2) further comprises a supporting net (26) which is disposed between the membrane support member (21) and the nonwoven fabric membrane (22).~~

86. The flat-plate membrane filter element according to any one of claims 1 to 65, wherein the nonwoven fabric membrane (22) has a stacked structure; and the stacked structure comprises: a substrate layer (221), a nonwoven fabric filter layer (222) stacked on the substrate layer (221), and the chemically modified coating layer (223) formed on the nonwoven fabric filter layer (222).

97. The flat-plate membrane filter element according to claim 86, wherein the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by glycerol polymerization.

~~10~~8. The flat-plate membrane filter element according to claim ~~8~~6, wherein the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by the implantation of modified hybrid fibers.

~~11~~9. The flat-plate membrane filter element according to claim ~~8~~6, wherein an average pore size of the nonwoven fabric filter layer (222) is 0.05μm to 500 μm, and an average pore size of the substrate layer (221) is greater than the average pore size of the nonwoven fabric filter layer (222).

~~12~~10. The flat-plate membrane filter element according to claim ~~8~~6, wherein both the substrate layer (221) and the nonwoven fabric filter layer (222) are made of polymer material.

~~13~~11. A flat-plate membrane filter module, comprising:

a plurality of the flat-plate membrane filter elements (2) according to any one of claims 1 to ~~10~~8,

wherein the flat-plate membrane filter elements (2) are mounted in a frame by stacking, and are arranged in parallel; and a certain distance is reserved between the adjacent flat-plate membrane filter elements (2).

~~14~~12. A membrane bioreactor, comprising:

an inlet portion (41);

a reaction portion (42); and

an outlet portion (43),

wherein the reaction portion (42) comprises the flat-plate membrane filter module according to claim ~~13~~11.

~~15~~13. A method for manufacturing the flat-plate membrane filter element according to claim 1, comprising:

providing the membrane support member (21) and the nonwoven fabric membrane (22);

manufacturing the membrane support member (21) into a

flat-plate shape, and disposing the flow channel (24) on the surface of the membrane support member (21) in such a way that the opening of the flow channel (24) is formed on the side of the membrane support member (21); and

disposing the nonwoven fabric membrane (22) on the surface of the membrane support member (21), disposing the chemically modified coating layer (223) on the surface of the nonwoven fabric membrane (22)~~the membrane support member (21)~~, and bonding the edges of the nonwoven fabric membranes (22) to the membrane support member (21) in such a way that the flow channel (24) on the membrane support member (21) is covered under the nonwoven fabric membrane (22);

disposing a protruded structure (23) at an area on a surface of the membrane support member (21), the surface being covered by the nonwoven fabric membrane (22), and

disposing a supporting net (26) between the membrane support member (21) and the nonwoven fabric membrane (22).

~~16~~14. The manufacturing method according to claim ~~15~~13, wherein

the nonwoven fabric membrane (22) is provided with a stacked structure;

the stacked structure comprises: a substrate layer (221), a nonwoven fabric filter layer (222) stacked on the substrate layer (221), and the chemically modified coating layer (223) formed on the nonwoven fabric filter layer (222); and

the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by glycerol polymerization.

~~17~~15. The manufacturing method according to claim ~~15~~13, wherein

the nonwoven fabric membrane (22) is provided with a stacked structure;

the stacked structure comprises: a substrate layer (221), a nonwoven fabric filter layer (222) stacked on the substrate layer (221), and the chemically modified coating layer (223) formed on the nonwoven fabric filter layer (222); and

the chemically modified coating layer (223) is formed on a surface of the nonwoven fabric filter layer (222) by the implantation of modified hybrid fibers.