

CLAIM(S):

1. An asymmetric membrane comprising
 - (a) a first exterior porous surface;
 - (b) a second exterior porous surface;
 - (c) a porous bulk between the first exterior porous surface and the second exterior porous surface, the porous bulk having a first porous region and a second porous region, the first porous region contacting the second porous region;
 - (d) a first asymmetric porous zone, the first asymmetric porous zone including the first exterior surface, and extending into, and including, the first porous region of the bulk; and,
 - (e) a second asymmetric porous zone, the second asymmetric porous zone including the second exterior surface, and extending into, and including, the second porous region of the bulk;

wherein the first asymmetric porous zone includes a first porous asymmetry that increases from the first exterior surface through the first porous region of the bulk, and the second asymmetric porous zone includes a second porous asymmetry that increases from the second exterior surface through the second porous region of the bulk, and the first porous surface has a first average pore size and the second porous surface has a second average pore size, wherein the first average pore size is larger than the second average pore size.

2. A membrane comprising:
 - a first, upstream porous zone comprising a first zone upstream porous portion, and a first zone downstream porous portion; and
 - a second, downstream porous zone comprising a second zone upstream porous portion, and a second zone downstream porous portion, wherein
 - the first zone having an average pore size that increases in an upstream to downstream direction,
 - the second zone having an average pore size that increases in a downstream to upstream direction,

the first zone downstream porous portion having an average pore size that is greater than an average pore size of the first zone upstream porous portion, and greater than an average pore size of the second zone upstream porous portion, and
the average pore size of the first zone is greater than the average pore size of the second zone.

3. The membrane of claim 1 or 2, wherein the first zone has a thickness of about 10 μm to about 500 μm .

4. The membrane of any one of claims 1-3, wherein the second zone has a thickness of about 10 μm to about 400 μm .

5. The membrane of any one of claims 1-4, wherein the membrane has a pore size ratio of about 1.1 to about 100.0.

6. The membrane of any one of claims 1-5, wherein the first zone has an average pore size of 0.2 μm to 10.0 μm .

7. The membrane of any one of claims 1-6, wherein the second zone has an average pore size of 0.01 μm to 5.0 μm .

8. The membrane of any one of claims 1-7, comprising a pleated membrane.

9. A method of processing a fluid, comprising passing the fluid into the membrane of any one of claims 1-8, in a direction from the first zone toward the second zone.

10. The method of claim 9, comprising passing the fluid through the membrane.

11. A method of making the membrane of any one of claims 1-8 comprising:
preparing a first solution comprising at least one polymer, at least one solvent, and at least one nonsolvent;
preparing a second solution comprising at least one polymer, at least one solvent, and at least one nonsolvent;

casting the first solution on a belt to form a first layer;
casting the second solution onto the first layer to form a second layer, wherein the second layer is exposed to air;
removing the solvent(s) to form the membrane.

12. The method of claim 11, wherein at least one solution comprises a polysulfone.

13. The method of claim 11 or 12, wherein at least one solution comprises PVDF.

14. The method of any one of claims 11-13, wherein the first solution further comprises at least one initiator.

15. The method of any one of claims 11-14, wherein the second solution further comprises at least one initiator.

CLAIMS:

1. An asymmetric membrane comprising
 - (a) a first exterior porous surface;
 - (b) a second exterior porous surface;
 - (c) a porous bulk between the first exterior porous surface and the second exterior porous surface, the porous bulk having a first porous region and a second porous region, the first porous region contacting the second porous region;
 - (d) a first asymmetric porous zone, the first asymmetric porous zone including the first exterior porous surface, and extending into, and including, the first porous region of the bulk; and,
 - (e) a second asymmetric porous zone, the second asymmetric porous zone including the second exterior porous surface, and extending into, and including, the second porous region of the bulk;

wherein the first asymmetric porous zone includes a first porous asymmetry that increases from the first exterior porous surface through the first porous region of the bulk, and the second asymmetric porous zone includes a second porous asymmetry that increases from the second exterior porous surface through the second porous region of the bulk, and the first exterior porous surface has a first average pore size and the second exterior porous surface has a second average pore size, wherein the first average pore size is larger than the second average pore size.

2. The membrane of claim 1, wherein the first asymmetric porous zone has a thickness of 10 μm to 500 μm .

3. The membrane of claim 1 or 2, wherein the second asymmetric porous zone has a thickness of 10 μm to 400 μm .

4. The membrane of any one of claims 1-3, wherein the membrane has a pore size ratio of 1.1 to 100.0.
5. The membrane of any one of claims 1-4, wherein the first asymmetric porous zone has an average pore size of 0.2 μm to 10.0 μm .
6. The membrane of any one of claims 1-5, wherein the second asymmetric porous zone has an average pore size of 0.01 μm to 5.0 μm .
7. The membrane of any one of claims 1-6, comprising a pleated membrane.