

Claims

1. A porous semi-crystalline polymer membrane, wherein the membrane is a single-layer membrane and wherein the membrane is superwetable without provision of a coating and additives.
- 5 2. The membrane according to claim 1, wherein the membrane comprises multi-level roughness within a surface of the membrane.
3. The membrane according to claim 2, wherein the membrane has a surface
10 roughness of 150-900 nm.
4. The membrane according to claim 2 or 3, wherein the surface of the membrane has a porosity of $\geq 30\%$.
- 15 5. The membrane according to any preceding claim, wherein the membrane has an overall porosity of $\geq 80\%$.
6. The membrane according to any preceding claim, wherein the membrane has a
20 thickness of 50-250 μm .
7. The membrane according to any preceding claim, wherein the membrane has a Young's modulus of ≥ 10 MPa.
8. The membrane according to any preceding claim, wherein the membrane is
25 superhydrophobic.
9. The membrane according to claim 8, wherein the membrane comprises: poly(vinylidene fluoride) (PVDF), poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP), polypropylene (PP), copolymers or homopolymers thereof.
- 30 10. The membrane according to any of claims 1 to 7, wherein the membrane is superhydrophilic.
11. The membrane according to claim 10, wherein the membrane comprises:
35 polyacrylonitrile (PAN), cellulose acetate (CA), copolymers or homopolymers thereof.

12. The membrane according to any preceding claim, wherein the membrane has a liquid entry pressure (LEP) of ≥ 2 bar.

5 13. The membrane according to any preceding claim, wherein the membrane has a water flux of 10-40 kg/m².h.

14. The membrane according to any preceding claim, wherein the membrane is for use in wastewater treatment.

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15. A method of forming a porous semi-crystalline polymer membrane, the method comprising:

- depositing a solution on a substrate surface, wherein the solution comprises a semi-crystalline polymer to form a nascent membrane;
- 15 - spraying a fluid on the nascent membrane; and
- immersing the nascent membrane in a non-solvent to form the semi-crystalline polymer membrane,

wherein the semi-crystalline polymer membrane is a single-layer membrane and superwetttable without provision of a coating and additives.

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16. The method according to claim 15, wherein the depositing comprises: casting, dip coating, spin coating, or a combination thereof.

17. The method according to claim 15 or 16, wherein the semi-crystalline polymer
25 comprises a hydrophobic or hydrophilic polymer.

18. The method according to claim 17, wherein the semi-crystalline polymer comprises a hydrophobic polymer selected from: poly(vinylidene fluoride) (PVDF), poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP), polypropylene (PP),
30 copolymers or homopolymers thereof.

19. The method according claim 17, wherein the semi-crystalline polymer comprises a hydrophilic polymer selected from: polyacrylonitrile (PAN), cellulose acetate (CA), copolymers or homopolymers thereof.

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20. The method according to any of claims 15 to 19, wherein the solution further comprises a solvent and a non-solvent.

21. The method according to any of claims 15 to 20, wherein the depositing
5 comprises depositing the solution at a pre-determined temperature and pre-determined relative humidity.

22. The method according to claim 21, wherein the pre-determined temperature is 20-60°C.

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23. The method according to claim 21 or 22, wherein the pre-determined relative humidity is $\geq 40\%$.

24. The method according to any of claims 15 to 23, wherein the fluid is: compressed
15 air, alcohol, water, salt suspension, or a combination thereof.

25. The method according to claim 24, wherein the alcohol is: ethanol, isopropanol, butanol, or a combination therefore.

26. The method according to any of claims 15 to 25, wherein the spraying comprises
20 spraying the fluid on the nascent membrane at a pre-determined pressure and at a pre-determined flow rate.

27. The method according to claim 26, wherein the pre-determined pressure is 1-3
25 bar.

28. The method according to claim 26 or 27, wherein the pre-determined flow rate is 15-30 L/minute.

29. The method according to any of claims 15 to 28, further comprising drying the
30 membrane following the immersing.