Claims

1. A separation membrane for water treatment in a portable liquid container, wherein the separation membrane only has:

a support membrane over which the following layers are layered:
a first polycationic layer;
a second polyzwitterionic layer; and
a third polyanionic layer.

2. The separation membrane according to claim 1, wherein the support membrane comprises hydrolysed polyacrylonitrile (H-PAN).

3. The separation membrane according to claim 1 or 2, wherein the support membrane contains inorganic composite additives selected from a group comprising titanium (IV) dioxide (TiO_2), zinc oxide (ZnO) and carbon nanofiber (CNF).

4. The separation membrane according to any one of claims 1 to 3, wherein the first cationic layer comprises one of the following: polyethylenimine (PEI) or chitosan.

5. The separation membrane according to any one of claims 1 to 4, wherein the second polyzwitterionic layer comprises polyether(sulfobetaine methacrylate) (PSBMA).

6. The separation membrane according to any one of claims 1 to 5, wherein the third polyanionic layer comprises polystyrene sodium sulfonate (PSS).

7. The separation membrane according to any one of claims 1 to 6, wherein
the support membrane comprises hydrolysed polyacrylonitrile (H-PAN)
the first polycationic layer comprises polyethylenimine (PEI)
the second polyzwitterionic layer comprises polyether(sulfobetaine methacrylate) (PSBMA); and
the third polyanionic layer comprises polystyrene sodium sulfonate (PSS).

8. The separation membrane according to any one of claims 1 to 7, wherein
the first polycationic layer is layered over the support membrane;
the second polyzwitterionic layer is layered over the first polycationic layer; and
the third polyanionic layer is layered over the second polyzwitterionic layer.

9. A method of manufacturing a separation membrane for water treatment, wherein the separation membrane comprises:
a support membrane over which the following layers are layered:
a first polycationic layer;
a second polyzwitterionic layer; and
a third polyanionic layer, the method comprising:

(a) dissolving a polymer in a solvent, wherein the solvent comprises dimethylformamide (DMF);

(b) forming the support membrane from the polymer solution by electrospinning technique or dry-wet spinning technique;

(c) hydrolyzing the support membrane;

(d) crosslinking the support membrane with additional selective surface charged polymers to produce the triple layer configuration, wherein the triple layer configuration comprises:

the first polycationic layer;
the second polyzwitterionic layer; and
the third polyanionic layer; and

(e) cross-linking with glutaraldehyde (GA) to produce the separation membrane.

10. The method according to claim 9, wherein the first polycationic layer, second polyzwitterionic layer and third polyanionic layer are coated over the support membrane using successive ionic layer adsorption and reaction (SILAR).

11. The method according to claim 9 or 10, wherein the support membrane comprises hydrolysed polyacrylonitrile (H-PAN).

12. The method according to any one of claims 9 to 11, wherein the method comprising:
adding to the support membrane inorganic composite additives selected from a group comprising titanium (IV) dioxide (TiO_2), zinc oxide (ZnO) and carbon nanofiber (CNF).

13. The method according to any one of claims 9 to 12, wherein
the first polycationic layer comprises polyethylenimine (PEI);
the second polyzwitterionic layer comprises polyether(sulfobetaine methacrylate) (PSBMA); and
the third polyanionic layer comprises polystyrene sodium sulfonate (PSS).

14. The method according to any one of claims 9 to 13, wherein the method comprises:
layering the first polycationic layer over the support membrane;
layering the second polyzwitterionic layer over the first polycationic layer; and
layering the third polyanionic layer over the second polyzwitterionic layer.

15. A portable liquid container comprising a filter, wherein the filter comprises the separation membrane according to any one of claims 1 to 8.

16. The portable liquid container according to claim 15, wherein the portable liquid container or a portion of the portable liquid container is attachable to a pump assembly to pump liquid through the filter, wherein the portion of the portable liquid container comprises the filter.

17. The portable liquid container according to claim 16, wherein the pump assembly is part of the portable liquid container and is detachably connectable to the portable liquid container.

18. The portable liquid container according to any one of claims 15 to 17, wherein the filter is detachably connectable to the portable liquid container.

19. The portable liquid container according to any one of claims 15 to 18, wherein the portable liquid container is a portable drinking bottle.

20. The portable liquid container according to claim 19, wherein the portable drinking bottle comprises:
a top portion comprising the filter; and
a bottom portion detachably attached to the top portion,
wherein the top portion comprises a liquid outlet on which a bottle cap can be disposed.

21. The portable liquid container according to claim 19, wherein the portable drinking bottle comprises a bottle cap comprising the filter, wherein the bottle cap is detachably attached to a liquid outlet of the portable drinking bottle.

22. The portable liquid container according to claim 21, wherein the bottle cap comprises a mouthpiece for drinking.

23. The portable liquid container according to any one of claims 15 to 22, wherein the separation membrane is in the form of a flat sheet membrane, or both flat sheet membrane and hollow fibre.

24. The portable liquid container according to any one of claims 15 to ~~23~~22, wherein the separation membrane is in the form of a hollow fibre.