CLAIMS

1. A thin film composite membrane comprising a porous support and a thin film of a polymeric material, wherein:
the pore size of the porous support is larger than the pore size of the thin film of the polymeric material; and
the polymeric material comprises a copolymer comprising a plurality of zwitterionic monomeric units, a plurality of charged/ionizable monomeric units, and a plurality of hydrophobic monomeric units; further wherein:
the copolymer is linear;
the copolymer is random;
the copolymer is statistical; and
each of the hydrophobic monomeric units is formed from a monomer selected from the group consisting of styrene, methyl methacrylate, acrylonitrile, a fluoroalkyl acrylate, a fluoroaryl acrylate, a fluoroalkyl methacrylate, a fluoroaryl methacrylate, a fluoroalkyl acrylamide, and a fluoroaryl acrylamide.~~A copolymer, comprising a plurality of zwitterionic monomeric units, a plurality of charged/ionizable monomeric units, and a plurality of hydrophobic monomeric units.~~

2. The copolymer of claim 1, wherein the molecular weight of the copolymer is 20,000 g/mol to 1,000,000 g/mol.

3. The copolymer of claim 1, wherein the molecular weight of the copolymer is 40,000 g/mol to 1,000,000 g/mol.

4. The copolymer of claim 1, wherein the molecular weight of the copolymer is 100,000 g/mol to 1,000,000 g/mol.

5. The copolymer of any one of claims 1-4, wherein the zwitterionic monomeric units constitute 1-40 wt% of the copolymer.

6. The copolymer of any one of claims 1-5, wherein the charged/ionizable monomeric units constitute 1-40 wt% of the copolymer.

7. The copolymer of any one of claims 1-6, wherein the hydrophobic monomeric units constitute 30-80 wt% of the copolymer.

8. The copolymer of any one of claims 1-7, wherein each of the zwitterionic monomeric units is formed from a monomer comprising sulfobetaine, carboxybetaine, or phosphorylcholine moieties.

9. The copolymer of any one of claims 1-7, wherein each of the zwitterionic monomeric unit is formed from a monomer selected from the group consisting of sulfobetaine methacrylate (SBMA), methacryloxy phosphoryl choline (MPC), carboxybetaine methacrylate (CBMA), sulfobetaine-2-vinylpyridine, sulfobetaine-4-vinylpyridine, and sulfobetaine-vinyl imidazole.

10. The copolymer of any one of claims 1-7, wherein each of the zwitterionic monomeric units is formed from sulfobetaine methacrylate (SBMA).

11. The copolymer of any one of claims 1-10, wherein each of the charged/ionizable monomeric units is formed from a monomer selected from the group consisting of a methacrylate, an acrylate, an acrylamide or a styrene derivative comprising carboxylic acid, sulfonate, phosphate, or amine moieties.

12. The copolymer of any one of claims 1-10, wherein each of the charged/ionizable monomeric units is formed from a monomer selected from the group consisting of methacrylic acid (MAA), acrylic acid, 2-carboxyethyl acrylate, 2-carboxyethyl methacrylate, styrene sulfonate, 3-sulfopropyl acrylate, 3-sulfopropyl methacrylate, 2-acrylamido-2-methyl-1-propanesulfonic acid, 2-(dimethylamino)ethyl methacrylate, 2-(diethylamino)ethyl methacrylate, 2-aminoethyl methacrylate, [2-(methacryloyloxy)ethyl]trimethylammonium chloride, [2-(acryloyloxy)ethyl]trimethylammonium chloride, 2-(diethylamino)ethyl acrylate, 2-(dimethylamino)ethyl acrylate, 3-(dimethylamino)propyl acrylate, N-acryloyl-L-valine, (3-acrylamidopropyl)trimethylammonium chloride, N-[3-(dimethylamino)propyl]methacrylamide,

2-isopropenylaniline, 4-[N-(methylaminoethyl)aminomethyl]styrene, and (vinylbenzyl)trimethylammonium chloride.

13. The copolymer of any one of claims 1-10, wherein each of the charged/ionizable monomeric units is formed from methacrylic acid (MAA).

~~14. The copolymer of any one of claims 1-13, wherein each of the hydrophobic monomeric units is formed from a monomer selected from the group consisting of styrene, methyl methacrylate, acrylonitrile, a fluoroalkyl acrylate, a fluoroaryl acrylate, a fluoroalkyl methacrylate, a fluoroaryl methacrylate, a fluoroalkyl acrylamide, and a fluoroaryl acrylamide.~~

~~15~~14. The copolymer of any one of claims 1-13, wherein each of the hydrophobic monomeric units is formed from a monomer selected from the group consisting of 2,2-trifluoroethyl methacrylate (TFEMA), pentafluoropropyl methacrylate, heptafluorobutyl methacrylate, and pentafluorophenyl methacrylate.

~~16~~15. The copolymer of any one of claims 1-13, wherein each of the hydrophobic monomeric units is formed from 2,2-trifluoroethyl methacrylate (TFEMA).

~~17~~16. The copolymer of any one of claims 1-~~16~~15, wherein the hydrophobic monomeric units are characterized in that a homopolymer formed thereof has a glass transition temperature above room temperature.

~~18~~17. The copolymer of any one of claims 1-~~17~~16, wherein the copolymer is a linear copolymer; the copolymer is a statistical copolymer; the copolymer is a random copolymer; or the copolymer is a linear, statistical, random copolymer.

~~19~~18. The copolymer of any one of claims 1-~~18~~17, wherein the copolymer is poly((sulfobetaine methacrylate)-random-(methacrylic acid)-random-(2,2-trifluoroethyl methacrylate)).

~~20. A polymeric material, comprising a copolymer of any one of claims 1-19.~~

~~21. The polymeric material of claim 20, wherein the polymeric material is in the form of a thin film.~~

~~22. A thin film composite membrane, comprising a porous support, and a thin film of the polymeric material of claim 21; wherein the pore size of the porous support is larger than the pore size of the thin film of the polymer material.~~

~~23~~19. The thin film composite membrane any one of claims 1-18~~of claim 22~~, wherein the thin film of the polymeric material has a thickness of 1 nm to 10 µm.

~~24~~20. The thin film composite membrane any one of claims 1-18~~of claim 22~~, wherein the thin film of the polymeric material has a thickness of 1 nm to 3 µm.

~~25~~21. The thin film composite membrane any one of claims 1-18~~of claim 22~~, wherein the thin film of the polymeric material has a thickness of 1 nm to 1 µm.

~~26~~22. The thin film composite membrane of any one of claims 1-21~~any one of claims 22-25~~, wherein the thin film of the polymeric material has an effective pore size of 0.1 nm to 5 nm.

~~27~~23. The thin film composite membrane of any one of claims ~~22~~1-~~25~~21, wherein the thin film of the polymeric material has an effective pore size of 0.6 nm to 3 nm.

~~28~~24. The thin film composite membrane of any one of claims ~~22~~1-~~25~~21, wherein the thin film of the polymeric material has an effective pore size of 0.6 nm to 2 nm.

~~29. The thin film composite membrane of any one of claims 22-28, wherein the thin film composite membrane exhibits resistance to fouling by an oil emulsion.~~

~~30. The thin film composite membrane of any one of claims 22-29, wherein the thin film composite membrane is stable upon exposure to chlorine bleach (e.g., at pH 4).~~

~~31. The thin film composite membrane of any one of claims 22-30, wherein the thin film~~

~~composite membrane undergoes a one-time, irreversible change in pore size upon exposure to buffers with high pH.~~

~~32. The thin film composite membrane of any one of claims 22-31, wherein the thin film composite membrane exhibits size-based selectivity between uncharged organic molecules.~~

~~33~~25. The thin film composite membrane of any one of claims ~~22~~1-~~32~~24, wherein the thin film composite membrane rejects charged solutes and salts.

~~34~~26. A method of size-based selection or exclusion, comprising contacting a solution comprising a plurality of uncharged organic molecules of different sizes with a thin film composite membrane of any one of claims ~~22~~1-~~33~~25.

~~35~~27. A method of charge-based selection or exclusion, comprising contacting a solution comprising a plurality of salts with a thin film composite membrane of any one of claims ~~22~~1-~~33~~25.