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.

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 2,2-trifluoroethyl methacrylate (TFEMA), pentafluoropropyl methacrylate, heptafluorobutyl methacrylate, and pentafluorophenyl methacrylate.

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).

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

17. The copolymer of any one of claims 1-16, 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.

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

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

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

21. The thin film composite membrane any one of claims 1-18, wherein the thin film of the polymeric material has a thickness of 1 nm to 1 µm.22. The thin film composite membrane of any one of claims 1-21, wherein the thin film of the polymeric material has an effective pore size of 0.1 nm to 5 nm.

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

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

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

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 1-25.

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 1-25.