CLAIMS

1. A method of preparing a filtration membrane, the method comprising:

providing a copolymer solution by dissolving a statistical copolymer in a mixture of a co-solvent and a first organic solvent, wherein the co-solvent is an ionic liquid;

coating the copolymer solution onto a porous support layer to form a polymeric layer thereon,

coagulating the polymeric layer on top of the porous support layer to afford a thin film composite membrane, and

immersing the thin film composite membrane into a water bath to obtain a filtration membrane, wherein

the copolymer solution contains the statistical copolymer at 1 to 99 w/v%, the co-solvent at 1 to 99 v/v%, and the first organic solvent at 1 to 99 v/v%;

the statistical copolymer contains zwitterionic repeat units and hydrophobic repeat units, in which the zwitterionic repeat units constitute 15-75% by weight of the statistical copolymer, the hydrophobic repeat units constitute 25-85% by weight of the statistical copolymer, and the hydrophobic repeat units are capable of forming a homopolymer that has a glass transition temperature of 0 ^{o}C or higher; and

the co-solvent is miscible with both water and the first organic solvent.

2. The method of claim 1, wherein the co-solvent is in liquid form at 100 ^{o}C or lower.

3. The method of claim 2, wherein the co-solvent is in liquid form at room temperature or lower.

4. The method of claim 1, wherein the ionic liquid contains one or more cations selected from the group consisting of ammonium, imidazolium, piperidinium, pyridinium, pyrrolidinium, phosphonium, sulfonium, guanidinium, diethanolammonium, alkyl-ammonium, alkyl-imidazolium, alkyl-peperidinium, alkyl-pyridinium, alkyl-pyrrolidinium, alkyl-phosphonium, alkyl-sulfonium, alkyl-guanidinium, and alkyl-diethanolammonium; and one or more anions selected from the group consisting of nitrate, sulfonate, methanesulfonate, alkyl-sulfonate, fluoroalkyl-sulfonate, sulfate, methylsulfate, alkyl-sulfate, fluoroalkyl-sulfate, phosphate, methylphosphate, alkyl-phosphate, fluoroalkyl-phosphate, phosphinate, methylphosphinate, alkyl-phosphinate, fluoroalkyl-phosphinate, halogen, trifluoromethanesulfonate, dihydrogen phosphate, bis(trifluoromethylsulfonyl)imide, alkyl-imide, alkyl-amide**,** tetrafluoroborate,

hexafluoro phosphate, formate, acetate, trifluoroacetate, dicyanamide, decanoate, alkyl-methide, and alkyl-borate.

5. The method of claim 4, wherein the ionic liquid is selected from the group consisting of ethyl ammonium nitrate, 1-ethyl-3-methylimidazolium ethyl sulfate, 1-Ethyl-3-methylimidazolium tetrafluoroborate, 1-butyl-3-methylimidazolium trifluoromethanesulfonate, 1-ethyl-3-methylimidazolium methanesulfonate, 1-butylpyridinium bromide, and 2-hydroxyethyl-dimethylammonium methanesulfonate.

6. The method of claim 1, wherein the co-solvent alters self-assembly of the statistical copolymer in the copolymer solution.

7. The method of claim 1, wherein the copolymer solution contains the statistical copolymer at 1 to 50 w/v%, the co-solvent at 1 to 80 v/v%, and the first organic solvent at 20 to 99 v/v%.

8. The method of claim 7, wherein the copolymer solution contains the statistical copolymer at 3 to 30 w/v%, the co-solvent at 5 to 49 v/v%, and the first organic solvent at 51 to 95 v/v%.

9. The method of claim 1, wherein the zwitterionic repeat units constitute 20-70% by weight of the statistical copolymer, the hydrophobic repeat units constitute 30-80% by weight of the statistical copolymer, and the hydrophobic repeat units are capable of forming a homopolymer that has a glass transition temperature of room temperature or higher.

10. The method of claim 9, wherein the zwitterionic repeat units constitute 30-50% by weight of the statistical copolymer and the hydrophobic repeat units constitute 50-70% by weight of the statistical copolymer.

11. The method of claim 1, wherein the zwitterionic repeat units each contain, independently, sulfobetaine, carboxybetaine, phosphorylcholine, or pyridinium alkyl sulfonate; and the hydrophobic repeat units each are formed, independently, from styrene, fluorinated styrene, methyl methacrylate, acrylonitrile, or trifluoroethyl methacrylate.

12. The method of claim 11, wherein the zwitterionic repeat units each are formed, independently, from sulfobetaine acrylate, sulfobetaine acrylamide, phosphorylcholine acrylate,

phosphorylcholine acrylamide, phosphorylcholine methacrylate, carboxybetaine acrylate, carboxybetaine methacrylate, carboxybetaine acrylamide, 3-(2-vinylpyridinium-1-yl)propane-1-sulfonate, 3-(2-vinylpyridinium-1-yl)butane-1-sulfonate, 3-(4-vinylpyridinium-1-yl)propane-1-sulfonate, or sulfobetaine methacrylate; and the hydrophobic repeat units each are formed, independently, from methyl methacrylate, acrylonitrile, or trifluoroethyl methacrylate.

13. The method of claim 12, wherein the statistical copolymer is poly((trifluoroethyl methacrylate)-*r*-(sulfobetaine methacrylate)), poly((methyl methacrylate)-*r*-(sulfobetaine methacrylate)), poly((trifluoroethyl methacrylate)-*r*-(3-(2-vinylpyridinium-1-yl)propane-1-sulfonate)), poly((trifluoroethyl methacrylate)-*r*-(phosphorylcholine methacrylate), or poly((trifluoroethyl methacrylate)-*r*-(3-(2-vinylpyridinium-1-yl)butane-1-sulfonate)).

14. The method of claim 1, wherein the first organic solvent is selected from the group consisting of trifluoroethanol, dimethyl sulfoxide, formamide, dimethyl formamide, hexafluoro isopropanol, N-methyl-2-pyrrolidone, pyridine, dioxane, toluene, chloroform, benzene, carbon tetrachloride, chlorobenzene, 1,1,2-trichloroethane, dichloromethane, ethylene dichloride, xylene, tetrahydrofuran, methanol, and ethanol.

15. The method of claim 1, wherein the zwitterionic repeat units constitute 30-50% by weight of the statistical copolymer, the hydrophobic repeat units constitute 50-70% by weight of the statistical copolymer, the statistical copolymer is poly((trifluoroethyl methacrylate)-*r*-(sulfobetaine methacrylate)), the co-solvent is ethyl ammonium nitrate, and the first organic solvent is trifluoroethanol.

16. The method of claim 1, wherein the coagulating step is performed via air drying the polymeric layer for 60 minutes or less or immersing the polymeric layer together with the porous support layer into a non-solvent bath for 60 minutes or less.

17. The method of claim 16, wherein the coagulating step is performed via air drying the polymeric layer for 60 minutes or less.

18. The method of claim 16, wherein the coagulating step is performed via immersing the polymeric layer together with the porous support layer into a non-solvent bath for 60 minutes or less.

19. The method of claim 18, wherein the non-solvent is methanol, ethanol, isopropanol, butanol, acetone, water, or a combination thereof.

20. The method of claim 1, wherein the porous support layer has an effective pore size larger than that of the polymeric layer and is formed of polyethersulfone, polyphenylenesulfone, polyphenylenesulfidesulfone, polyacrylonitrile, cellulose ester, polyphenyleneoxide, polypropylene, polyvinyledenefluoride, polyvinylchloride, polyarylsulfone, polyphenylene sulfone, polyetheretherketone, polysulfone, polyamide, polyimide, or a combination thereof.

21. The method of claim 20, wherein the porous support layer is a flat sheet membrane or a hollow fiber membrane.

22. The method of claim 1, further comprising an annealing step after the immersing step, wherein the filtration membrane thus obtained is annealed in a water bath at 50 ^{o}C or higher.

23. A filtration membrane prepared by the method of claim 1, wherein the membrane has an effective pore size of 0.5 to 5 nm and a water permeance of 10 $Lm^{-2}h^{-1}bar^{-1}$ or higher.

24. A process of filtering a liquid, the process comprising:

providing a filtration membrane of claim 23 that has a support layer and a polymeric selective layer;

directing a liquid through the filtration membrane, first through the polymeric selective layer and then through the support layer; and

collecting the liquid that permeates through the filtration membrane.