CLAIMS

What is claimed is:

1. A porous membrane comprising ionizable nitrogen functional groups at least at the surface of the membrane, wherein at least a portion of the ionizable nitrogen functional groups are associated with a hydroxide anion.

2. The membrane of claim 1, wherein the membrane is capable of removing anionic contaminants from a polar solvent composition.

3. The membrane of claim 2, wherein the anionic contaminants are chosen from chloride, fluoride, bromide, nitrate, nitrite, sulfate, and phosphate ions.

4. The membrane of claim 1, wherein the ionizable nitrogen functional groups are grafted to the membrane.

5. The membrane of claim 1, having a coating and wherein the ionizable nitrogen functional groups are at least at the surface of the coating on the membrane.

6. The membrane of claim 5, wherein the coating is a polymeric material formed from the free radical reaction of ethylenically-unsaturated monomers, wherein at least a portion of the ethylenically-unsaturated monomers are ethylenically-unsaturated monomers having ionizable nitrogen functional groups.

7. The membrane of claim 6, wherein the ethylenically-unsaturated monomers having ionizable nitrogen functional groups are chosen from 2-(dimethylamino)ethyl acrylate, [2-(acryloyloxy)ethyl]trimethylammonium, 2-aminoethyl methacrylate, N-(3-aminopropyl) methacrylate, 2-(dimethylamino)ethyl methacrylate, [3-(methacryloylamino)propyl] trimethylammonium, [2-(methacryloyloxy)ethyl]trimethylammonium, acrylamidopropyl trimethylammonium, 2-aminoethyl methacrylamide, N-(2-aminoethyl) methacrylamide, N-(3-aminopropyl)-methacrylamide, diallyldimethylammonium, allylamine, vinyl imidazolium, vinyl pyridinium, and vinyl benzyl trimethyl ammonium, or a hydroxide, or a halide or hydrohalide salt thereof.

8. The membrane of claim 6, wherein the ethylenically-unsaturated monomer having ionizable nitrogen functional groups comprises acrylamido propyl trimethylammonium chloride.

9. The membrane of claim 6, wherein the ethylenically-unsaturated monomers are further chosen from monomers which are uncharged, negatively-charged, or zwitterionic.

10. The membrane of claim 6, wherein the ethylenically-unsaturated monomers having ionizable nitrogen functional groups is a quaternary ammonium group associated with a hydroxyl anion.

11. The membrane of claim 5, wherein the coating is a polyallylamine or a polyvinylamine.

12. The membrane of claim 1, wherein the membrane has been treated with an alkyl or aryl phosphonium hydroxide, ammonium hydroxide, or an organic ammonium hydroxide.

13. The membrane of claim 12, wherein the hydroxide compound is chosen from ammonium hydroxide, tetramethylammonium hydroxide, tetraethylammonium hydroxide, tetrapropylammonium hydroxide, tetrabutylammonium hydroxide, tributylmethylammonium hydroxide, benzyltrimethylammonium hydroxide, choline hydroxide, tetrabutylphosphonium hydroxide, tetramethylphosphonium hydroxide, tetraethylphosphonium hydroxide, tetrapropylphosphonium hydroxide, benzyltriphenylphosphonium hydroxide, methyl triphenylphosphonium hydroxide, ethyl triphenylphosphonium hydroxide, N-propyl triphenylphosphonium hydroxide.

14. The membrane of claim 1, wherein the underlying polymeric membrane is at least partially coated with a free-radical polymerized polymer, wherein the polymer is prepared from monomers comprising about 3 to about 10 weight percent of acrylamido propyl trimethylammonium chloride, and wherein the ethylenically-unsaturated monomers further comprise dimethylacrylamide and methylene bis acrylamide.

15. A method for removing anionic contaminants from a polar solvent composition, the method comprising passing the polar solvent composition through the membrane of claim 1.

16. The method of claim 15, wherein the polar solvent composition is comprised of a solvent chosen from at least one of water, C_1-C_6 alcohols, glycols, and glycol ethers.

17. The method of claim 15, wherein the polar solvent composition is comprised of a solvent chosen from at least one of methanol, ethanol, isopropanol, butanol, C_2-C_4 diols, C_2-C_4 triols, tetrahydrofurfuryl alcohol, 3-chloro-1,2-propanediol, 3-chloro-1-propanethiol, 1-chloro-2-propanol, 2-chloro-1-propanol, 3-chloro-1-propanol, 3-bromo-1,2-propanediol, 1-bromo-2-propanol, 3-bromo-1-propanol, 3-iodo-1-propanol, 4-chloro-1-butanol, 2-chloroethanol), dichloromethane, chloroform, acetic acid, propionic acid, trifluoroacetic acid, tetrahydrofuran, N-methylpyrrolidinone, cyclohexylpyrrolidinone, N-octylpyrrolidinone, N-phenylpyrrolidinone, methyldiethanolamine, methyl formate, N, N-dimethyl formamide, dimethylsulfoxide, tetramethylene sulfone, diethyl ether, phenoxy-2-propanol, propriophenone, ethyl lactate, ethyl acetate, ethyl benzoate, acetonitrile, acetone, ethylene glycol, propylene glycol, 1,3-propanediol, dioxane, butyryl lactone, butylene carbonate, ethylene carbonate, propylene carbonate, dipropylene glycol, diethylene glycol monomethyl ether, triethylene glycol monomethyl ether, diethylene glycol monoethyl ether, triethylene glycol monoethyl ether, ethylene glycol monopropyl ether, ethylene glycol monobutyl ether, diethylene glycol monobutyl ether, triethylene glycol monobutyl ether, ethylene glycol monohexyl ether, diethylene glycol monohexyl ether, ethylene glycol phenyl ether, propylene glycol methyl ether, dipropylene glycol methyl ether, tripropylene glycol methyl ether, dipropylene glycol dimethyl ether, dipropylene glycol ethyl ether, propylene glycol n-propyl ether, dipropylene glycol n-propyl ether, tripropylene glycol n-propyl ether, propylene glycol n-butyl ether, dipropylene glycol n-butyl ether, tripropylene glycol n-butyl ether, propylene glycol phenyl ether, ethylene glycol monophenyl ether, diethylene glycol monophenyl ether hexaethylene glycol monophenylether, dipropylene glycol methyl ether acetate, tetraethylene glycol dimethyl ether, dibasic ester, glycerine carbonate, N-formyl morpholine, triethyl phosphate, and combinations thereof.

18. The method of claim 16, wherein the C_1-C_6 alcohol is isopropanol.

19. The method of claim 15, wherein the anionic contaminant is chosen from one or more of halides, phosphates, nitrates, nitrites, sulfites, and sulfates.

20. The method of claim 15, wherein the anionic contaminant is chosen from fluoride, chloride, and phosphate ions.

21. A composite membrane comprising:

a first membrane; and

a second membrane,

wherein an output facing surface of the first membrane in contact with an input facing surface of the second membrane,

wherein the first membrane or the second membrane comprises a porous membrane having ionizable nitrogen functional groups at least at the surface of the membrane, wherein at least a portion of the ionizable nitrogen functional groups are associated with a hydroxide anion, and

wherein the second membrane is different from the first membrane.

22. The composite membrane of claim 21, wherein the membrane is capable of removing anionic contaminants from a polar solvent composition.

23. A filter comprising the membrane of claim 1.

24. A filter comprising the membrane of claim 21.