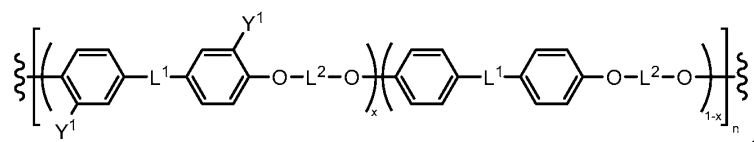
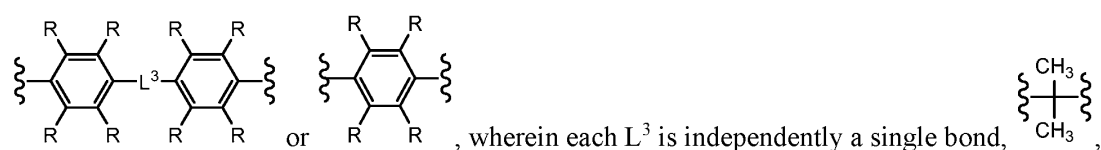


WHAT IS CLAIMED IS:

1. A copolymer comprising the structure:

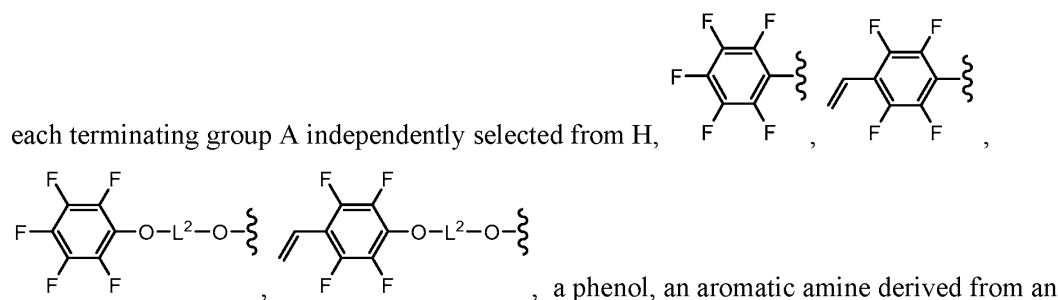


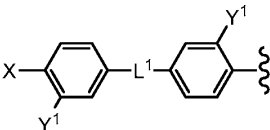
wherein each L^1 is independently  or , wherein each L^2 is independently



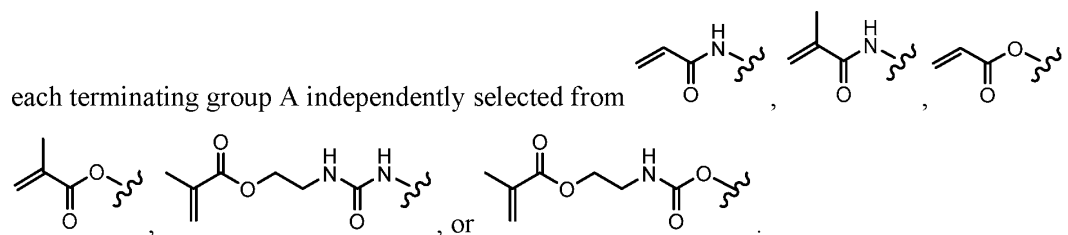
or , wherein one Y^1 is SO_3Z and the other Y^1 is H, wherein Z is a counterion, and wherein each R is independently H, F, or CH_3 .

2. The copolymer of claim 1, further comprising one or more terminating groups A,



aminophenol as an endcapping agent in the copolymerization, or , wherein X is a halogen, one Y^1 is SO_3Z and the other Y^1 is H or both Y^1 are H.

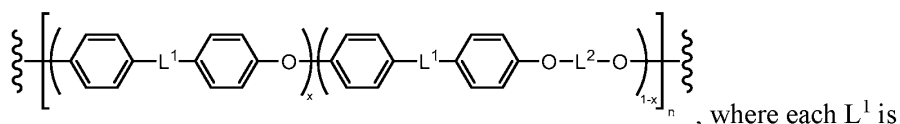
3. The copolymer of claim 1, further comprising one or more terminating groups A,



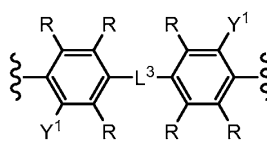
4. A crosslinked network comprising:

the copolymer of claim 2 or claim 3 in crosslinked form; blends of different molecular weights of copolymers of claim 2 or claim 3 in crosslinked form; or blends of a single molecular weight or different molecular weights of copolymers of claim 2 or claim 3 and one or more small molecule polymerizable reagents, in crosslinked form.

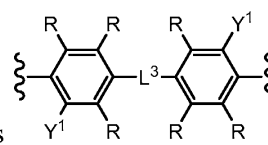
5. A copolymer comprising the structure:



independently  or , wherein each L^2 is

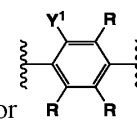
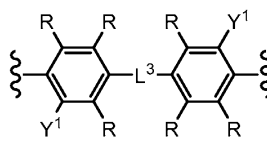
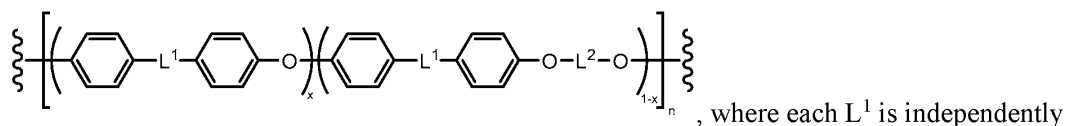


independently a single bond, , or , wherein at least one or both Y^1 is SO_3Z , wherein Z is a counterion, and wherein each R is independently H, F, or CH_3 .

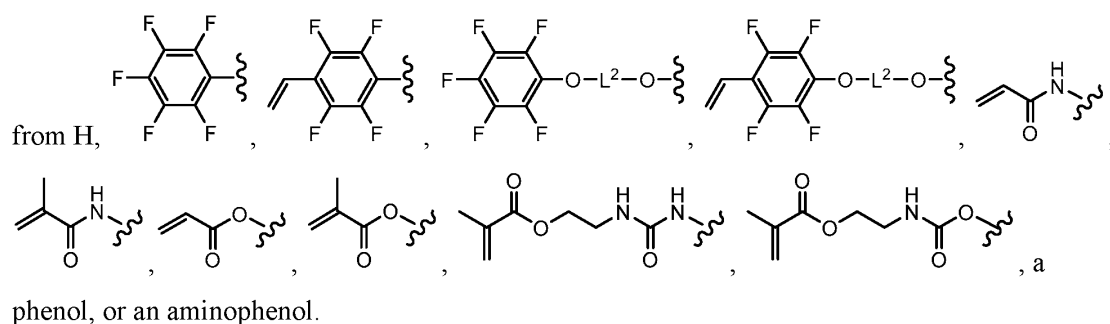


6. The copolymer of claim 5, wherein each L^2 is a single bond, wherein at least one or both Y^1 is SO_3Z , wherein Z is a counterion, and wherein each R is H or CH_3 .

7. A copolymer comprising the structure:

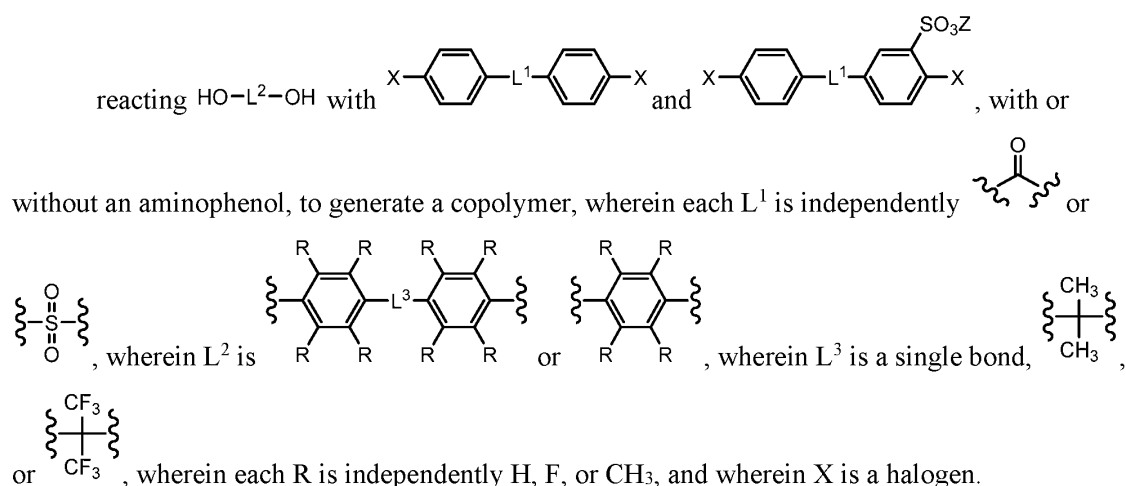


wherein each L^3 is independently a single bond, , or , wherein at least one or all Y^1 is SO_3Z , wherein Z is a counterion, and wherein each R is independently H, F, or CH_3 , further comprising one or more terminating groups A, each terminating group A independently selected

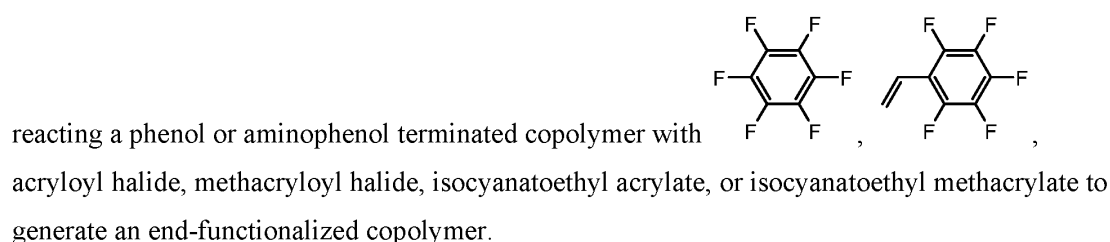


8. A crosslinked network comprising: the copolymer of claim 7 in crosslinked form; blends of different molecular weights of copolymers of claim 7 in crosslinked form; or blends of a single molecular weight or different molecular weights of copolymers of claim 7 and one or more small molecule polymerizable reagents, in crosslinked form.

9. A method comprising:



10. The method of claim 9, further comprising:

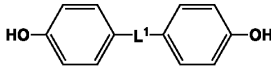
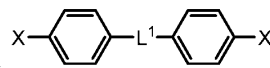


11. The method of claim 9 or 10, further comprising:

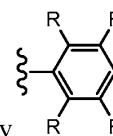
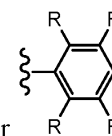
initiating a crosslinking reaction by exposing the end-functionalized copolymer to a crosslinking agent including one or more of heat, light, a free radical initiator, or an epoxy reagent.

12. The method of claim 11, wherein the crosslinking reaction includes: crosslinking a blend of different molecular weights of the end-functionalized copolymer; or crosslinking a single molecular weight or blends of different molecular weights of the end-functionalized copolymer and one or more polymerizable reagents.

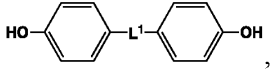
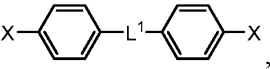
13. A method comprising:

reacting , one or more HO-L²-OH and  to

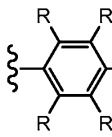
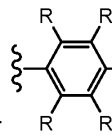
generate a copolymer, wherein each L¹ is independently  or , wherein L² is

independently  and/or , wherein L³ is a single bond, , or , and wherein each R is independently H, F, or CH₃; and sulfonating the copolymer to generate a single SO₃Z substituent on one or every aromatic ring of L², wherein Z is a counterion.

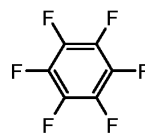
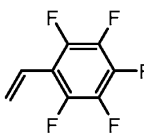
14. A method comprising:

reacting , one or more HO-L²-OH and , with or without an aminophenol, to generate a copolymer with phenol or aminophenol endgroups,

wherein each L¹ is independently  or , wherein L² is independently

 and/or , wherein L³ is a single bond, , or ; and

sulfonating the copolymer to generate a single SO₃Z substituent on one or every aromatic ring of L², wherein Z is a counterion; and

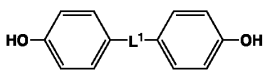
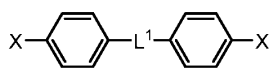
conducting an end-functionalization reaction with , , acryloyl halide, methacryloyl halide, isocyanatoethyl acrylate, or isocyanatoethyl methacrylate to generate a post-sulfonated, end-functionalized copolymer.

15. The method of claim 14, wherein the end-functionalization reaction is with the copolymer or a post-sulfonated copolymer, or wherein the sulfonation reaction is with the copolymer or the end-functionalized copolymer.

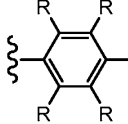
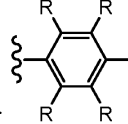
16. The method of any one of claims 13-15, further comprising:
initiating a crosslinking reaction by subjecting the end-functionalized copolymer to a crosslinking agent including one or more of heat, light, a free radical initiator, or an epoxy reagent.

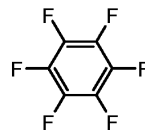
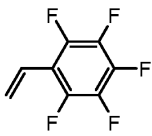
17. The method of claim 16, wherein the crosslinking reaction includes: crosslinking a blend of different molecular weights of the end-functionalized copolymer; or crosslinking a single molecular weight or blends of different molecular weights of the end-functionalized copolymer and one or more polymerizable reagents.

18. A method comprising:

reacting , one or more HO-L²-OH and , with or without an aminophenol, to generate a copolymer with phenol or aminophenol endgroups,

wherein each L¹ is independently  or , wherein L² is independently

 and/or , wherein L³ is a single bond, , or ; and

conducting an end-functionalization reaction with , , acryloyl halide, methacryloyl halide, isocyanatoethyl acrylate, or isocyanatoethyl methacrylate to generate a post-sulfonated, end-functionalized copolymer;

initiating a crosslinking reaction by subjecting the end-functionalized copolymer to a crosslinking agent including one or more of heat, light, a free radical initiator, or an epoxy reagent.
wherein the crosslinking reaction includes: crosslinking a blend of different molecular weights of the end-functionalized copolymer; or crosslinking a single molecular weight or blends of different molecular weights of the end-functionalized copolymer and one or more polymerizable reagents;
and

sulfonating the crosslinked copolymer to generate a single SO₃Z substituent on some, one, or every aromatic ring of L², wherein Z is a counterion.

19. A water desalination membrane comprising the copolymer of any one of claims 1-3 or 5-7.
20. The water desalination membrane of claim 19 exhibiting a rejection of aqueous monovalent ions of over 95% in the presence of polyvalent cations.
21. A water desalination membrane comprising the crosslinked network of claim 4.
22. The water desalination membrane of claim 21 exhibiting a rejection of aqueous monovalent ions of over 95% in the presence of polyvalent cations.
23. A water desalination membrane comprising the crosslinked network of claim 8.
24. The water desalination membrane of claim 23 exhibiting a rejection of aqueous monovalent ions of over 95% in the presence of polyvalent cations.
25. A method comprising:
exposing a first side of a water desalination membrane to an aqueous salt solution, the aqueous salt solution comprising a mixture of monovalent cations and polyvalent cations, wherein the water desalination membrane comprises the water desalination membrane of claim 19; and
pressurizing the aqueous salt solution to drive a reverse osmosis process wherein water from the aqueous salt solution passes from the first side of the water desalination membrane through to a second side of the water desalination membrane and wherein at least 95% of the monovalent ions are rejected from passing through the water desalination membrane in the presence of the polyvalent cations.
26. The method of claim 25, wherein the water desalination membrane comprises the water desalination membrane of any one of claims 20-24.
27. The method of claim 25 or claim 26, wherein a concentration of the polyvalent cations is at least 100 parts per million, wherein a concentration of the monovalent cations is at least 100 parts per million.
28. The method of claim 25 and 26, wherein the aqueous salt solution includes a chlorine-based sterilization agent and wherein the water desalination membrane remains substantially unoxidized by the chlorine-based sterilization agent.