Claims:

1. A microporous membrane composite comprising:

a microporous membrane support; and

a hydrophilic, crosslinked fluorinated ionomer coating on a surface of the microporous membrane support, the crosslinked fluorinated ionomer comprising:

fluorinated polymer backbone, and

hydrophilic groups attached to the fluorinated backbone, wherein the hydrophilic groups comprise groups selected from $-SO_3H$, -COOH, and PO_3H,

wherein the crosslinked coating does not contain heat-activated radical initiator.

2. The microporous membrane composite of claim 1, wherein the crosslinked coating contains UV-activated radical initiator.

3. The microporous membrane composite of claim 1, wherein the microporous membrane support comprises polymer selected from ultra-high molecular weight polyethylene, polyvinylidene fluoride, and polyphenylsulfone.

4. The microporous membrane composite of claim 1, wherein the hydrophilic groups are present on the crosslinked fluorinated ionomer at an equivalent weight in a range from 380 to 620 grams per equivalent, hydrophilic groups.

5. The microporous membrane composite of claim 1 having a dye-binding capacity of at least 5 micrograms/cm^2.

6. The microporous membrane composite of claim 1 having a (CH_3/H_2O mixture) wettability of less than 92 weight percent CH_3.

7. The microporous membrane composite of claim 1 having an isopropyl alcohol flow time of less than 4092 seconds at 14.2 psi /500 ml/17.35 cm^2 at room temperature.

8. The microporous membrane composite of claim 1 having a flow loss of 80 percent or less compared to the uncoated microporous membrane support when measured using 500 milliliters of isopropyl alcohol at a pressure of 14.2 psi.

9. The microporous membrane composite of claim 1 having a surface energy of at least 25 dynes per cm.

10 The microporous membrane composite of any preceding claim, wherein the microporous membrane comprises polymer selected from the group consisting of fluoropolymer, polysulfone, nylon, polyacrylonitrile, polyethylene, ultra-high molecular weight polyethylene, polyvinylidene fluoride, and polyphenylsulfone.

11. A filter comprising the microporous membrane composite of any preceding claim.

12. A method of preparing a microporous membrane composite that comprises a microporous membrane support and a crosslinked fluorinated ionomer coating on a surface of the microporous membrane support, the method comprising:

a) coating a microporous membrane with a liquid coating composition comprising fluorinated solvent and fluorinated ionomer dissolved or dispersed therein, the fluorinated ionomer derived from copolymerizing reactive units that comprise:

i) fluorinated monomer comprising a fluorinated group and ethylenic unsaturation;

ii) fluorinated monomer comprising ethylenic unsaturation and a functional group that is transformable into a hydrophilic group;

iii) fluorinated bis-olefin monomer, and

iv) fluorinated bromo-alkyl or iodo-alkyl chain transfer agent, and

b) exposing the coated fluorinated ionomer to electromagnetic radiation to cause the reactive units to react to form a crosslinked fluorinated ionomer.

13. The method of claim 12, wherein the fluorinated ionomer further comprises one or more of iodine and bromine atoms at a terminal position,

wherein at least 90% by weight of the fluorinated ionomer has a particle size below 200 nanometers, and

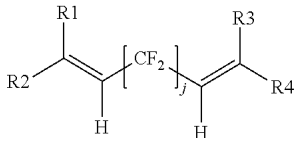
wherein the fluorinated ionomer is derived from copolymerizing reactive units that comprise:

i) fluorinated monomer comprising a fluorinated group and ethylenic unsaturation;

ii) fluorinated monomer comprising ethylenic unsaturation and a functional group that is transformable into a hydrophilic group;

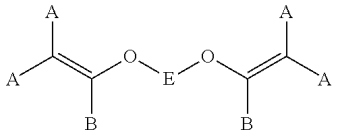
iii) bis-olefin monomers selected from formulae (OF-1), (OF-2), (OF-3) where: (OF-1) has the formula

(OF-1)



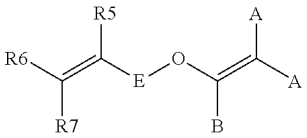
wherein j is an integer between 2 and 10, preferably between 4 and 8, and R1, R2, R3, R4, equal or different from each other, are H, F or C1 to C5 alkyl or (per)fluoroalkyl group; (OF-2) has the formula

(OF-2)



wherein each A is independently selected from F, Cl, and H; each B is independently selected from F, Cl, H and ORB, wherein RB is a branched or straight chain alkyl radical which can be partially, substantially, or completely fluorinated or chlorinated; E is a divalent group having 2 to 10 carbon atoms, optionally fluorinated, which may include ether linkages; (OF-3) has the formula:

(OF-3)



wherein E, A, and B have the same meaning as above defined; R5, R6, R7 is each independently H, F, or C1-5 alkyl or (per)fluoroalkyl group; and

iv) fluorinated chain transfer agent of the formula $R_f(I)_x(Br)_y$, wherein R_f is a fluoroalkyl or (per)fluoroalkyl or a (per)fluorochloroalkyl group having from 1 to 10 carbon atoms, and wherein x and y are integers from 0 to 2, with $1 \leq x+y \leq 2$.

14. The method of claim 12, wherein the microporous membrane comprises polymer selected from the group consisting of fluoropolymer, polysulfone, nylon, polyacrylonitrile,

polyethylene, ultra-high molecular weight polyethylene, polyvinylidene fluoride, and polyphenylsulfone.

15. The method of claim 12, wherein the fluorinated monomer comprising a fluorinated group and ethylenic unsaturation comprises tetrafluoroethylene.

16. The method of claim 12, wherein the functional group that is transformable into a hydrophilic group is selected from the group consisting of: $-SO_2F$, -COOR, -COF, and combinations of these, wherein R is a C1 to C20 alkyl radical or a C6 to C20 aryl radical.

17. The method of claim 12, further comprising:

continuously applying the liquid coating composition to a moving microporous membrane support, and

continuously curing the liquid coating composition applied to the microporous membrane support by passing the moving microporous membrane support and the applied liquid coating composition through electromagnetic radiation.

18. The method of claim 12, wherein the liquid coating composition does not contain thermally-activated radical initiator.

19. The method of claim 12, wherein the liquid coating composition does not contain a radical initiator.

20. The method of claim 12, wherein the liquid coating composition contains a radiation-activated radical initiator

21. The method of claim 12, further comprising, after exposing the coated fluorinated ionomer to electromagnetic radiation to cause the reactive units to react to form a crosslinked fluorinated ionomer, contacting the membrane with solvent to remove un-reacted reactive units from the crosslinked fluorinated ionomer.

22. The method of claim 12, further comprising converting $-SO_2F$, -COOR, or -COF groups to hydrophilic groups by contacting the crosslinked fluorinated ionomer sequentially with base and then acid.

23. A microporous membrane composite prepared according to any of claims 12 through 22.