WHAT IS CLAIMED IS:

1. A method of preparing a polymer, the method comprising:

mixing in an aqueous solution comprising water and a water-soluble alcohol:

a vinyl-based monomer having a sulfonic acid functional group,

a bifunctional vinyl-based cross-linking agent, and

a polymerization initiator,

to form a reaction solution, wherein the monomer and the cross-linking agent are soluble in the reaction solution; and

polymerizing the monomer and cross-linking agent to form the polymer.

2. The method according to claim 1, wherein:

the monomer and cross-linking agents are mixed in a molar ratio ranging from 0.5:1 to 2.0:1 (monomer : cross-linking agent);

the polymerization initiator is added in a molar ratio ranging from 0.0025:1 to 0.02:1 (mols of polymerization initiator : total mols of monomer and cross-linking agent); and

the aqueous solution comprises water and the water-soluble alcohol in a weight ratio ranging from 1.0:1 to 3.0:1 (water : water-soluble alcohol).

3. The method according to claim 2, wherein the reaction solution comprises:

the monomer and cross-linking agent total between 50 and 80 wt% of the reaction solution; and

the aqueous solution makes up the remaining wt% of the reaction solution.

4. The method according to claim 1, wherein the monomer is 2-acrylamidopropyl methane sulfonic acid (AMPS), the cross-linking agent is glycerol dimethacrylate (GDMA), and the water-soluble alcohol is 1-propanol.

5. The method according to claim 1, further comprising mixing the reaction solution under vacuum.

6. The method according to claim 1, further comprising:

placing the polymer on a backing cloth to form a polymer sheet;

drying the polymer sheet; and

converting the sulfonic acid groups to sulfonate functional groups to form a sheet of cation exchange membrane.

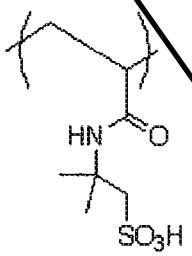
7. The method according to claim 6, wherein the polymer sheet is cured at a temperature between 60°C and 90°C for between 30 and 120 minutes.

8. The method according to claim 6, wherein a saturated solution of sodium bicarbonate is used to convert the sulfonic acid groups to sulfonate functional groups.

9. The method according to claim 6, wherein the backing cloth is selected from the group consisting of acrylic, prolyene and polyester cloth.

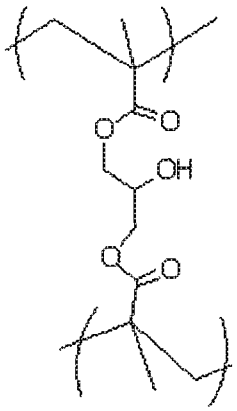
10. A polymer comprising:
a polymer backbone comprising sulfonic acid functional groups; and
crosslinks comprising alcohol functional groups.

11. The polymer according to claim 10, wherein the polymer backbone comprises a monomeric building block according to Formula I:



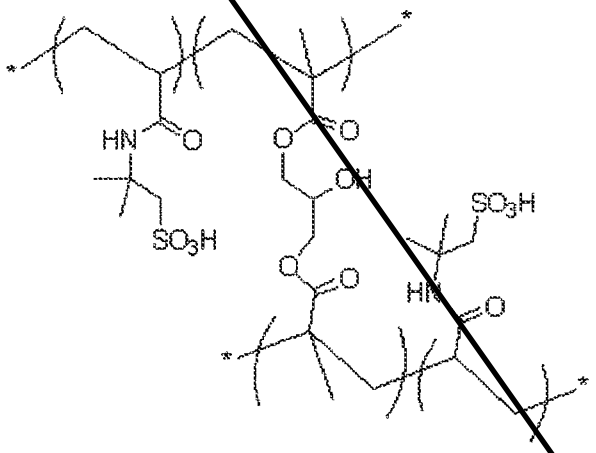
Formula I.

12. The polymer according to claim 10, wherein the crosslinks comprises a cross-linker according to Formula II:



Formula II.

13. The polymer according to claim 10, wherein the polymer is according to Formula III:



Formula III.

WHAT IS CLAIMED IS:

1. A method of preparing a cation exchange membrane, the method comprising:
mixing in an aqueous solution comprising water and a water-soluble alcohol:

a vinyl-based monomer having a sulfonic acid functional group,

a divinyl cross-linking agent which is selected from the group consisting of glycerol dimethacrylate, ethyleneglycol dimethacrylate and poly(ethylene glycol) dimethacrylate, and

a thermally initializable polymerization initiator,

to form a reaction solution, wherein the monomer and the cross-linking agent are soluble in the reaction solution;

wherein the monomer and the cross-linking agent are mixed in a molar ratio ranging from 0.5:1 to 2.0:1 (monomer:cross-linking agent);

the polymerization initiator is added in a molar ratio ranging from 0.0025:1 to 0.02:1 (mols of polymerization initiator:total mols of monomer and cross-linking agent); and

the aqueous solution comprises water and the water-soluble alcohol in a weight ratio ranging from 1.0:1 to 3.0:1 (water:water-soluble alcohol);

placing the reaction solution on a backing cloth;

polymerizing the monomer and cross-linking agent to form a polymer sheet; and

converting the sulfonic acid group to a sulfonate functional group for forming the cation exchange membrane.

2. The method according to claim **1**, wherein the reaction solution comprises:
the vinyl based monomer having a sulfonic acid functional group and the cross-linking agent total between 50 and 80 wt % of the reaction solution; and

the aqueous solution and the thermally initializable polymerization initiator makes up the remaining wt % of the reaction solution.

3. The method according to claim **1**, wherein the vinyl-based monomer having a sulfonic acid functional group is 2-acrylamido-2-methylpropane sulfonic acid (AMPS), the cross-linking agent is glycerol dimethacrylate (GDMA), and the water-soluble alcohol is 1-propanol.

4. The method according to claim **1**, further comprising mixing the reaction solution under vacuum.

5. The method according to claim **1**, wherein the step of polymerizing occurs at a temperature between 60° C. and 90° C. for between 30 and 120 minutes.

6. The method according to claim **1**, wherein a saturated solution of sodium bicarbonate is used to convert the sulfonic acid groups to sulfonate functional groups.

7. The method according to claim **1**, wherein the backing cloth is selected from the group consisting of acrylic, polypropylene and polyester cloth.

8. The method according to claim **1** wherein the crosslinking agent is glycerol dimethacrylate (GDMA).

9. The method according to claim **1**, wherein the vinyl based monomer having a sulfonic acid functional group is 2-acrylamido-2-2-methylpropane sulfonic acid (AMPS), and the cross-linking agent is glycerol dimethacrylate (GDMA).