What is claimed is:

1. A medical article formed from a polyurethane-based resin, which is a random copolymer of a reaction product of the following ingredients:

a diisocyanate;

a diol chain extender;

a polyglycol; and

a cationic modifier having one or more quaternary ammonium functional moiety, the cationic modifier incorporated into a backbone, or into both of the backbone and a side chain of the random copolymer of the reaction product formed by the diisocyanate, the polyglycol, and the diol chain extender;

the polyurethane-based resin having a hard segment content in a range of from 60% to 75% by weight and a soft segment content of the resin is in a range of from 25% to less than 40% by weight.

2. The medical article of claim 1, which is effective to reduce thrombus formation and/or bacterial biofilm formation.

3. The medical article of claim 2, which is effective to reduce thrombus formation and/or bacterial biofilm formation due to inhibition of microbial growth by cationic quaternary ammonium and ionic repulsion of blood components.

4. The medical article of claim 1, wherein the cationic modifier comprises: bis(2-hydroxyethyl)dimethylammonium chloride (BHDAC).

5. The medical article of claim 1, wherein the cationic modifier is present in an amount of greater than or equal to 0.01 weight percent of the overall composition of the polyurethane-based resin.

6. The medical article of claim 1, wherein the cationic modifier is present in an amount of less than or equal to 10 weight percent of the overall composition of the polyurethane-based resin.

7. The medical article of claim 1, wherein the diisocyanate is selected from the group consisting of: an aliphatic diisocyanate, alicyclic diisocyanate and an aromatic diisocyanate.

8. The medical article of claim 1, wherein the diisocyanate is selected from the group consisting of: 4,4’-diphenylmethane diisocyanate (MDI), toluene diisocyanate (TDI), isophorone diisocyanate (IPDI), methylene-bis(4-cyclohexylisocyanate) (HMDI), and combinations thereof.

9. The medical article of claim 1, wherein the diol chain extender is selected from the group consisting of: ethylene glycol, 1,3-propylene glycol, 1,4-butanediol, neopentyl glycol, and alicyclic glycols having up to 10 carbon atoms.

10. The medical article of claim 1, wherein the polyglycol is selected from the group consisting of: polyalkylene glycol, polyester glycol, polycarbonate glycol, and combinations thereof.

11. The medical article of claim 1, wherein the polyglycol comprises the polyalkylene glycol.

12. The medical article of claim 11, wherein the polyalkylene glycol comprises a polytetramethylene ether glycol.

13. The medical article of claim 1, wherein the ingredients of the reaction product consist essentially of:

4,4’-diphenylmethane diisocyanate (MDI) as the diisocyanate;

1,4-butanediol as the diol chain extender;

a polytetramethylene ether glycol as the polyglycol; and

bis(2-hydroxyethyl)dimethylammonium chloride (BHDAC) as the cationic modifier.

14. The medical article of claim 1, wherein the polyurethane-based resin is bound to an anionic agent through ionic bonding.

15. The medical article of claim 14, wherein the ionic bonding is achieved by a technique comprising a solution imbibing technique or a bulk mixing technique.

16. The medical article of claim 15, wherein the bulk mixing technique comprises a thermal compounding technique and a solvent mixing technique.

17. The medical article of claim 14, wherein the anionic agent comprises one or more of: an antimicrobial agent, a lubricating agent, and an antithrombotic agent.

18. The medical article of claim 17 comprising the antimicrobial agent, antithrombotic agent, or a combination thereof, which is effective to provide antimicrobial and/or anti-fouling activity.

19. The medical article of claim 18, which is effective to actively provide enhanced surface properties including antimicrobial and/or anti-fouling activity.

20. The medical article of claim 17, wherein the anionic agent comprises one or more of: cloxacillin salt, cefoxitin salt, cefazolin salt, penicillin salt, heparin salt, or derivatives thereof.

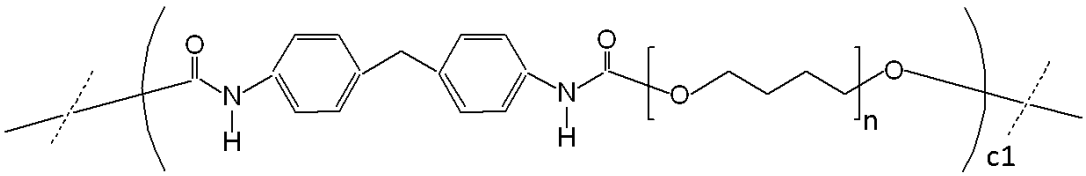
21. The medical article of claim 1, wherein the ingredients of the reaction product further comprise: a low-surface energy modifying oligomer incorporated into a backbone, as a side chain, or both of the polyurethane-based resin formed by the diisocyanate, the polyglycol, the cationic modifier, and the diol chain extender.

22. The medical article of claim 21, wherein the modifying oligomer has an alcohol (C-OH) moiety and a functional moiety.

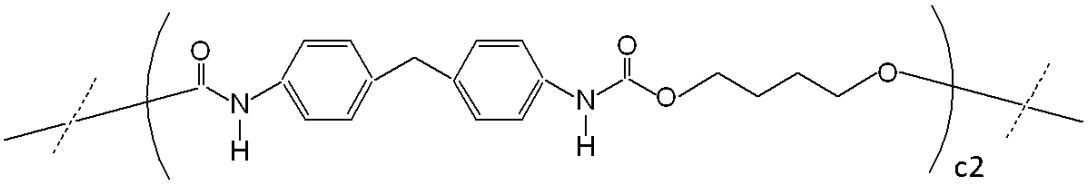
23. The medical article of claim 22, wherein the functional moiety comprises a fluoroether, a silicone, or a combination thereof.

24. The medical article of claim 21, wherein the low-surface energy modifying oligomer is present in an amount ranging from about 0.1 to about 10 weight percent of the overall composition of the polyurethane-based resin.

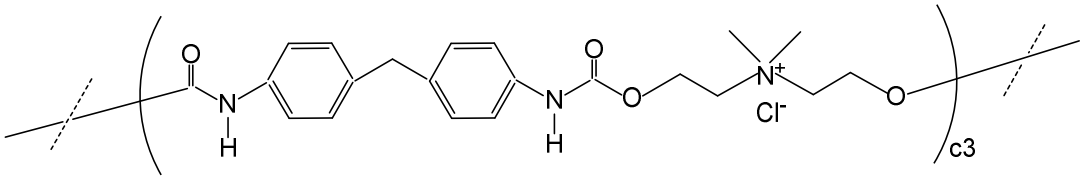
25. A medical article comprising a polyurethane-based resin that is a random copolymer comprising chain segments of (A), (B), and (C) as follows:



(A) wherein n is in the range of 3 to 40;



(B)



(C)

wherein a hard segment content is in the range of from 25% to 75% by weight and a soft segment content of the resin is in the range of from 75% to 25% by weight; the polyurethane-based resin has an overall ion exchange capacity of 0.01 to 1 mmol/g.