Claims

1. A medical device comprising a support substrate having a modified surface, wherein said support substrate comprises silicone, said modified surface having a thickness of 2-20 µm and comprising two or more layers covering all or part of the device surface, said layers comprising: a first layer comprising a sustained release polymer associated with one or more antimicrobial metal ions or nanoparticles, a second layer contacting the first layer and comprising a sustained release polymer and further comprising a biocompatible uppermost layer comprising an anti-fouling polymer, wherein in said biocompatible layer comprises poly(SBMA-co-AAm), wherein, the modified surface inhibits bacterial adhesion and/or biofilm formation and encrustation of the medical device.

2. The device according to claim 1 wherein the device comprises at least one further layer between the second and uppermost layers comprising a sustained release polymer with one or more antimicrobial metal ions or nanoparticles.

3. The device according to claim 1 or 2 wherein said device surface comprises a plurality of first and second layers to provide a multi-layered device surface.

4. The device according to claim 1 wherein the thickness of said modified surface is 10 µm +/- 10%.

5. The device according to any one of claims 1 to 4 wherein said first and second layers comprise the same sustained release polymer.

6. The device according to any one of claims 1 to 4 wherein the first and second layers comprise a different sustained release polymer.

7. The device according to any one of claims 1 to 5 wherein said sustained release polymer is polydopamine, or its functionally equivalent derivatives.

8. The device according to any one of claims 1 to 7 wherein said ion or nanoparticle comprises an antimicrobial metal selected from the group consisting of: silver, gold or copper.

9. The device according to claim 8 wherein said antimicrobial metal ion[s] or nanoparticle[s] comprise silver.

10. The device according to any one of claims 1 to 9 wherein said antimicrobial metal comprises at least 12 µg metal ion[s]/cm^2.

11. The device according to claim 10 wherein said antimicrobial metal comprises 12-25 µg metal ion[s]/cm^2.

12. The device according to any one of claims 1 to 11 wherein said support substrate comprises a metal.

13. The device according to claim 12 wherein said support substrate comprises a metal selected from the group: stainless steel, cobalt-chrome (Co-Cr) and titanium and its alloys.

14. The device according to any one of claims 1 to 13 wherein said modified surface comprises at least one antimicrobial agent wherein said agent is an antibiotic or antimicrobial peptide.

15. The device according to any one of claims 1 to 14 wherein said medical device is a catheter.

16. The device according to any one of claims 1 to 14 wherein said medical device is a stent.

17. The device according to claim 16 wherein the stent is a ureteral or prostatic stent.

18. The device according to any one of claims 1 to 14 wherein said medical device is a cannula.

19. A method for the fabrication of a substrate surface of a device according to any one of claims 1 to 18 comprising the steps:

i) contacting all or part of the surface of the substrate with a fluid comprising at least one sustained release polymer to coat the substrate with a first polymeric layer;
ii) contacting the first polymeric layer with a fluid comprising at least one antimicrobial metal to coat the first polymeric layer with said antimicrobial metal;
iii) repeating step i) and ii) one or more times;

iv) contacting the bi-layered or multi-layered coated substrate with a fluid comprising at least one sustained release polymer for controlling the antimicrobial metal release and for anchoring the subsequent anti-fouling layer; and

v) contacting the coated substrate with a fluid comprising at least one anti-fouling polymer;

wherein the substrate comprises silicone and a modified surface with a biocompatible uppermost layer having a thickness of 2-20 µm; and

wherein the biocompatible upper layer comprises poly(SBMA-co-AAm).

20. The method according to claim 19 wherein the substrate is immersed in a liquid comprising said sustained release polymer which is subsequently immersed in a liquid comprising said antimicrobial metal.

21. The method according to claim 19 wherein the substrate is contacted with a liquid spray comprising said sustained release polymer which is subsequently contacted with an aerosolized fluid comprising said antimicrobial metal.

22. The method according to any one of claims 19 to 21 wherein said sustained release polymer is polydopamine.

23. The method according to any one of claims 19 to 22 wherein said antimicrobial metal is silver.

24. A device comprising a substrate obtained by the method according to any one of claims 19 to 23, wherein the substrate comprises silicone and a modified surface with a biocompatible uppermost layer having a thickness of 2-20 µm said biocompatible upper layer comprises poly(SBMA-co-AAm); and wherein the modified surface inhibits bacterial adhesion and/or biofilm formation and encrustation of the device.

25. The device according to claim 24 wherein said device is selected from the group consisting of: a catheter, stent, or cannula.

26. The device according to claim 25, wherein the stent is ureteral or prostatic stent.