Claims

1. A method, comprising:

(a) modifying a surface energy of at least a portion of a surface of a base comprising a cyclic olefin copolymer (COC);

(b) forming a hydrogel layer on the surface of the base overlying the portion of the surface having the modified surface energy, the hydrogel layer being susceptible to cross-linking by exposure to light, the hydrogel layer having a surface facing away from the base, wherein the modification of the surface energy of the portion of the surface of the base promotes adhesion of the hydrogel layer to the surface of the base; and

(c) exposing at least a portion of the hydrogel layer to light in a preselected pattern, thereby optically micropatterning the surface of the hydrogel layer.

2. The method of claim 1, wherein the surface energy of at least the portion of the surface of the base is modified by plasma treatment.

3. The method of claim 1, wherein the preselected pattern is an anisotropic pattern.

4. The method of claim 1, wherein the preselected pattern is a geometric shape.

5. The method of claim 4, wherein geometric shape is a square saw-tooth, a rectangle, a square, a circle, or a triangle.

6. The method of claim 1, wherein the pre-selected pattern includes a plurality of lines or a plurality of line segments with a peak-to-peak line separation in a range of 1 μm to 100 μm.

7. The method of claim 1, wherein a peak-to-trough height of the resulting micropattern in the surface of the hydrogel layer falls in a range of 0.5 μm to 10 μm.

8. The method of claim 1, wherein a laser is used to expose the portion of the hydrogel layer to light in the preselected pattern.

9. The method of claim 8, wherein exposing the portion of the hydrogel layer to light in the preselected pattern comprises serially writing the preselected pattern into the hydrogel layer using the laser.

10. The method of claim 1, wherein the wavelength of the light is 315 nm to 380 nm.

11. The method of claim 10, wherein the wavelength of the light is 355 nm.

12. The method of claim 1, wherein forming the hydrogel layer on the surface of the base overlying the portion of the surface having the modified surface energy comprises depositing an aqueous solution comprising a hydrogel on the surface of the base.

13. The method of claim 12, wherein the aqueous solution further comprises transglutaminase.

14. The method of claim 12, wherein forming the hydrogel layer on the surface of the base overlying the portion of the surface having the modified surface energy further comprises curing the deposited aqueous solution resulting in a cured layer.

15. The method of claim 14, wherein forming the hydrogel layer on the surface of the base overlying the portion of the surface having the modified surface energy further comprises treating the cured layer with a second solution that makes the cured layer susceptible to cross-linking by exposure to light.

16. The method of claim 15, wherein the second solution comprises riboflavin-5' phosphate, Rose Bengal, or SU-8 Photoresist.

17. The method of claim 16, wherein the second solution comprises riboflavin-5' phosphate.

18. The method of claim 17, wherein the second solution comprises 0.01% w/v to 0.3% w/v riboflavin-5' phosphate.

19. The method of claim 18, wherein the second solution comprises 0.05% w/v riboflavin-5' phosphate.

20. The method of claim 18, wherein the second solution comprises 0.1% w/v riboflavin-5' phosphate.

21. The method of claim 15, wherein cured layer is hydrated in the aqueous solution prior to treating the cured layer with the second solution.

22. The method of claim 21, wherein the method further comprises:

masking a portion of the surface of the base using an adhesive mask prior to step (a), wherein the surface energy of the masked portion of the surface of the base is not modified during the modification of the surface energy of at least a portion of the surface of the base; and

removing the adhesive mask from the surface of the base after hydration of the cured layer.

23. The method of claim 1, further comprising drying the formed hydrogel layer prior to exposing at least the portion of the hydrogel layer to the light in the preselected pattern.

24. The method of claim 1, further comprising cutting through a full thickness of the hydrogel layer using a laser after the surface of the hydrogel layer has been micropatterned.

25. The method of claim 1, further comprising ablating a portion of the hydrogel layer using a laser after the surface of the hydrogel layer has been micropatterned.

26. The method of claim 1, further comprising modifying a surface energy of a portion of the surface of the base surrounding the micropatterned hydrogel layer to inhibit cell adhesion to the surface of the base.

27. The method of claim 1, further comprising seeding the micropatterned surface of the hydrogel layer with cells.

28. A fluidic device comprising a base and a gelatin layer having a micropatterned surface prepared according to claim 1, wherein the micropatterned surface is configured to support growth of a functional muscle tissue.

29. The fluidic device of claim 28, further comprising a functional muscle tissue disposed on the gelatin layer.

30. The fluidic device of claim 29, wherein the functional muscle tissue comprises cells selected from the group consisting of cardiac muscle cells, ventricular cardiac muscle cells, atrial cardiac muscle cells, striated muscle cells, smooth muscle cells, and vascular smooth muscle cells and combinations thereof.

31. A method, comprising:

(a) modifying a surface energy of at least a portion of a surface of a base;

(b) depositing an aqueous solution comprising a hydrogel on the surface of the base, wherein said solution comprises transglutaminase;

(c) curing the deposited aqueous solution resulting in a cured layer;

(d) treating the cured layer with a second solution that makes the cured layer susceptible to cross-linking by exposure to light; and

(e) exposing at least a portion of the hydrogel layer to light in a preselected pattern, thereby optically micropatterning the surface of the hydrogel layer.

32. The method of claim 31, wherein the surface energy of at least the portion of the surface of the base is modified by plasma treatment.

33. The method of claim 31, wherein the hydrogel layer has a surface facing away from the base.

34. The method of claim 31, wherein the modification of the surface energy of the portion of the surface of the base promotes adhesion of the hydrogel layer to the surface of the base.

35. The method of claim 31, wherein the second solution comprises riboflavin-5' phosphate, Rose Bengal, or SU-8 Photoresist.

36. The method of claim 31, wherein the second solution comprises riboflavin-5' phosphate.

37. The method of claim 31, wherein the base comprising a cyclic olefin copolymer (COC).