WHAT IS CLAIMED IS

1. A cell-culture device, comprising:

a three-dimensional body comprising multiple two-dimensional surfaces extending inwardly from a periphery of the three-dimensional body towards an interior of the three-dimensional body, wherein the multiple two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional body has a maximum dimension ranging from about 1 mm to about 50 mm.

2. The device of claim 1, wherein the multiple two-dimensional surfaces comprise a plurality of ribs extending from an interior of the three-dimensional body towards the periphery of the three-dimensional body.

3. The device of claim 1, wherein the multiple two-dimensional surfaces comprise a plurality of ribs extending substantially parallel to one another from an interior of the three-dimensional body towards the periphery of the three-dimensional body.

4. The device of any of claims 1-3, wherein the multiple two dimensional surfaces have a curved shape.

5. The device of any of claims 1-4, wherein the multiple two-dimensional surfaces comprise as least one spiral-shaped rib extending from an interior of the three-dimensional body towards the periphery of the three-dimensional body.

6. The device of any of claims 1-3, wherein the multiple two-dimensional surfaces are substantially flat over at least a portion of their surface area.

7. The device of any of claims 1-6, wherein the three-dimensional body comprises at least one of a substantially spherical shape, a substantially ellipsoid shape, and an irregular polyhedral shape.

8. The device of any of claims 1-7, wherein the multiple two-dimensional surfaces comprise a plurality of ribs extending from a central core towards a periphery of the three-dimensional body.

9. The device of claim 1, wherein the three-dimensional body comprises a spherical shape and the multiple two-dimensional surfaces comprise substantially flat surfaces extending from a periphery of the three-dimensional body towards an interior of the three-dimensional body, and wherein the multiple two-dimensional surfaces are spaced from one another at a distance selected to prevent contact of objects adjacent to the three-dimensional body with cells growing on the multiple two-dimensional surfaces.

10. The device of any of claims 1-9, wherein at least some of the multiple two-dimensional surfaces are spaced from one another at a distance sufficient to allow culture medium surrounding the device to contact at least a portion of the multiple two-dimensional surfaces.

11. The device of claim 10, wherein the multiple two-dimensional surfaces are spaced at a distance to prevent contact between cells on adjacent two-dimensional surfaces.

12. The device of any of claims 1-11, wherein the material forming the multiple two-dimensional surfaces comprises a material selected from at least one of metals, glass, borosilicate, carbon fibers, ceramics, collagen, gelatin, hydrogels, and polymers.

13. The device of any of claims 1-11, wherein the material forming the multiple two-dimensional surfaces comprises at least one polymer.

14. The device of claim 13, wherein the polymer is selected from a polyamide, a polycarbonate, a polysulfone, a polyester, a polyacetal, and polyvinyl chloride.

15. The device of claim 13, wherein the polymer is a polyamide.

16. The device of claim 13, wherein the polymer is a polycarbonate.

17. The device of any of claims 1-16, wherein the multiple two-dimensional surfaces comprise a material selected to allow direct attachment and growth of eukaryotic cells.

18. The device of any of claims 1-16, wherein the multiple two-dimensional surfaces further comprise at least one coating selected to facilitate attachment and growth of eukaryotic cells.

19. The device of claim 18, wherein the at least one coating is selected from a protein and polylysine.

20. The device of any of claims 1-19, wherein the multiple two-dimensional surfaces have been subjected to a plasma surface treatment.

21. The device of any of claims 1-20, wherein the multiple two-dimensional surfaces comprise a modulus and curvature selected to facilitate growth of eukaryotic cells.

22. The device of any of claims 1-21, wherein the eukaryotic cells comprise at least one of stem cells, anchorage dependent cells, mesenchymal cells, and stromal cells.

23. The device of any of claims 1-19, wherein the ratio of the surface area of the multiple two-dimensional surfaces to the volume of the three-dimensional body is between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3.

24. The device of claim 23, wherein the ratio of the surface area of the multiple two-dimensional surfaces to the volume of the three-dimensional body is between about 10 cm^2/cm^3 and about 15 cm^2/cm^3.

25. The device of any of claims 1-24, wherein the three-dimensional body has a maximum dimension between 1 mm and 50 mm.

26. The device of claim 25, wherein the three-dimensional body has a maximum dimension between about 2 mm and 10 mm.

27. The device of any of claims 25-26, wherein the device is substantially spherical, and the maximum dimension is a diameter.

28. A cell-culture system, comprising:

a container; and

a group of three-dimensional bodies, each three dimensional body comprising:

multiple two-dimensional surfaces extending inwardly from a periphery of the three-dimensional body towards an interior of each three-dimensional body, wherein the multiple two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional body each have a maximum dimension ranging from about 1 mm to about 50 mm.

29. The system of claim 28, wherein the multiple two-dimensional surfaces comprise a plurality of ribs extending from an interior of the three-dimensional body towards the periphery of the three-dimensional body.

30. The system of claim 28, wherein the multiple two-dimensional surfaces comprise a plurality of ribs extending substantially parallel to one another from an interior of the three-dimensional body towards the periphery of the three-dimensional body.

31. The system of any of claims 28-30, wherein the multiple two dimensional surfaces have a curved shape.

32. The system of any of claims 28-31, wherein the multiple two-dimensional surfaces comprise as least one spiral-shaped rib extending from an interior of the three-dimensional body towards the periphery of the three-dimensional body.

33. The system of any of claims 28-30, wherein the multiple two-dimensional surfaces are substantially flat over at least a portion of their surface area.

34. The system of any of claims 28-33, wherein the three-dimensional bodies comprise at least one of a substantially spherical shape, a substantially ellipsoid shape, and an irregular polyhedral shape.

35. The system of any of claims 28-34, wherein the multiple two-dimensional surfaces are configured to prevent contact of objects adjacent to the three-dimensional body with cells growing on the multiple two-dimensional surfaces.

36. The system of claim 28, wherein the three-dimensional bodies comprises a spherical shape and the multiple two-dimensional surfaces comprise substantially flat surfaces extending from a periphery of each three-dimensional body towards an interior of each three-dimensional body, and wherein the multiple two-dimensional surfaces are spaced from one another at a distance selected to prevent contact of objects adjacent to the three-dimensional bodies with cells growing on the multiple two-dimensional surfaces.

37. The system of any of claims 28-36, wherein at least some of the multiple two-dimensional surfaces are spaced from one another at a distance sufficient to allow culture medium surrounding the device to contact at least a portion of the multiple two-dimensional surfaces.

38. The system of any of claims 28-37, wherein the multiple two-dimensional surfaces are spaced at a distance to prevent contact between cells on adjacent two-dimensional surfaces.

39. The system of any of claims 28-38, wherein the material forming the multiple two-dimensional surfaces comprises a material selected from at least one of metals, glass, borosilicate, carbon fibers, ceramics, collagen, gelatin, hydrogels, and polymers.

40. The system of any of claims 28-39, wherein the material forming the multiple two-dimensional surfaces comprises at least one polymer.

41. The system of claim 40, wherein the polymer is selected from a polyamide, a polycarbonate, a polysulfone, a polyester, a polyacetal, and polyvinyl chloride.

42. The system of claim 40, wherein the polymer is a polyamide.

43. The system of claim 40, wherein the polymer is a polycarbonate.

44. The system of any of claims 28-43, wherein the multiple two-dimensional surfaces comprise a material selected to allow direct attachment and growth of eukaryotic cells.

45. The system of any of claims 28-44, wherein the multiple two-dimensional surfaces further comprise at least one coating selected to facilitate attachment and growth of eukaryotic cells.

46. The system of claim 45, wherein the at least one coating is selected from a protein and polylysine.

47. The system of any of claims 28-46, wherein the multiple two-dimensional surfaces have been subjected to a plasma surface treatment.

48. The system of any of claims 28-47, wherein the multiple two-dimensional surfaces comprise a modulus and curvature selected to facilitate growth of eukaryotic cells.

49. The system of any of claims 28-48, wherein the eukaryotic cells comprise at least one of stem cells, anchorage dependent cells, mesenchymal cells, and stromal cells.

50. The system of any of claims 28-49, wherein the ratio of the surface area of the multiple two-dimensional surfaces to the volume of the three-dimensional body is between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3.

51. The system of any of claims 50, wherein the ratio of the surface area of the multiple two-dimensional surfaces to the volume of the three-dimensional body is between about 10 cm^2/cm^3 and about 15 cm^2/cm^3.

52. The system of any of claims 28-51, wherein the three-dimensional body has a maximum dimension between 1 mm and 20 mm.

53. The system of claim 52, wherein the three-dimensional body has a maximum dimension between about 2 mm and 10 mm.

54. The system of any of claims 52-53, wherein the device is substantially spherical, and the maximum dimension is a diameter.

55. A method of culturing cells, comprising:

selecting a group of eukaryotic cells; and

contacting the eukaryotic cells with at least one three-dimensional body having multiple two-dimensional surfaces extending inwardly from a periphery of the three-dimensional body towards an interior of the at least one three-dimensional body, wherein the multiple two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional body has a maximum dimension ranging from about 1 mm to about 50 mm.

56. The method of claim 55, wherein contacting the eukaryotic cells with the at least one three-dimensional body comprises placing the cells and at least one three-dimensional body in a container.

57. The method of either of claims 55-56, further comprising supplying culture media to the cells.

58. The method of any of claims 55-57, further comprising causing movement of the at least one three-dimensional body.

59. The method of claim 58, wherein causing movement comprises rotating or shaking a container in which the at least one three-dimensional body is contained.

60. The method of claim 58, wherein causing movement of the at least one three-dimensional body comprises providing a flow of media into a container in which the at least one three-dimensional body is contained.

61. A cell-culture device, comprising:

a three-dimensional body comprising multiple two-dimensional surfaces extending inwardly from a periphery of the three-dimensional body towards an interior of the three-dimensional body, wherein the multiple two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional body has a surface area to volume ratio between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3.

62. The device of claim 61, wherein the three-dimensional body has a surface area to volume ratio between about 10 cm^2/cm^3 and about 15 cm^2/cm^3.

63. A cell-culture device, comprising:

a three-dimensional body comprising a sheet of material formed into a substantially spiral configuration, the sheet of material comprising at least two two-dimensional surfaces, wherein the two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional body has a surface area to volume ratio between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3.

64. The device of claim 63, wherein the three-dimensional body has a surface area to volume ratio between about 10 cm^2/cm^3 and about 15 cm^2/cm^3.

65. The device of either of claims 63-64, wherein the device has a maximum dimension of 50 mm or less.

CLAIMS

1. A cell-culture device, comprising:

a three-dimensional body comprising multiple two-dimensional surfaces extending inwardly from a periphery of the three-dimensional body towards an interior of the three-dimensional body, wherein the multiple two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional body has:

(a) a maximum dimension ranging from about 1 mm to about 50 mm; or

(b) a surface area to volume ratio between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3.

2. A cell-culture system, comprising:

a container; and

a group of three-dimensional bodies, each three dimensional body comprising:

multiple two-dimensional surfaces extending inwardly from a periphery of the three-dimensional body towards an interior of each three-dimensional body, wherein the multiple two-dimensional surfaces are configured to support monolayer growth of eukaryotic cells over at least a majority of or all of the surface area of the multiple two-dimensional surfaces, and wherein the three-dimensional bodies each have:

(a) a maximum dimension ranging from about 1 mm to about 50 mm; or

(b) a surface area to volume ratio between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3.

3. The device of claim 1 or the system of claim 2, wherein the multiple two-dimensional surfaces:

(a) comprise a plurality of ribs extending from an interior of the three-dimensional body towards the periphery of the three-dimensional body;

(b) comprise a plurality of ribs extending substantially parallel to one another from an interior of the three-dimensional body towards the periphery of the three-dimensional body;

(c)

(i) have a curved shape and/or comprise at least one spiral-shaped rib extending from an interior of the three-dimensional body towards the periphery of the three-dimensional body; or

(ii) are substantially flat over at least a portion of their surface area; and/or

(d) comprise a plurality of ribs extending from a central core towards a periphery of the three-dimensional body.

4. The device of claims 1 or 3 or the system of claims 2 or 3, wherein the three-dimensional body comprises at least one of a substantially spherical shape, a substantially ellipsoid shape, and an irregular polyhedral shape.

5. The device of any one of claims 1, 3-4 or the system of any one of claims 2-4, wherein the material forming the multiple two-dimensional surfaces comprises a material selected from at least one of metals, glass, borosilicate, carbon fibers, ceramics, collagen, gelatin, hydrogels, and polymers.

6. The device of any one of claims 1, 3-5 or the system of any one of claims 2-5, wherein the material forming the multiple two-dimensional surfaces comprises at least one polymer, optionally wherein the polymer is:

(a) selected from a polyamide, a polycarbonate, a polysulfone, a polyester, a polyacetal, and polyvinyl chloride;

(b) a polyamide, or

(c) a polycarbonate.

7. The device of any one of claims 1, 3-6 or the system of claims 2-6, wherein the multiple two-dimensional surfaces further comprise at least one coating selected to facilitate attachment and growth of eukaryotic cells, optionally wherein the at least one coating is selected from a protein and polylysine.

8. The device of any one of claims 1, 3-7 or the system of any one of claims 2-7, wherein the multiple two-dimensional surfaces have been subjected to a plasma surface treatment.

9. The device of any one of claims 1, 3-8 or the system of any one of claims 2-8, wherein the multiple two-dimensional surfaces comprise a modulus and curvature selected to facilitate growth of eukaryotic cells.

10. The device of any one of claims 1, 3-9 or the system of any one of claims 2-9, wherein the eukaryotic cells comprise at least one of stem cells, anchorage dependent cells, mesenchymal cells, and stromal cells.

11. The device of any one of claims 1, 3-10 or the system of any one of claims 2-10, wherein the ratio of the surface area of the multiple two-dimensional surfaces to the volume of the three-dimensional body is between about 3 cm^2/cm^3 and about 1,000 cm^2/cm^3, optionally wherein the ratio of the surface area of the multiple two-dimensional surfaces to the volume of the three-dimensional body is between about 10 cm^2/cm^3 and about 15 cm^2/cm^3.

12. The system of any of claims 2-11, wherein the three-dimensional body has a maximum dimension between 1 mm and 20 mm.

13. The device of any one of claims 1,3-11 or the system of any one of claims 2-12, wherein the three-dimensional body has a maximum dimension between about 2 mm and 10 mm, optionally wherein the device is substantially spherical, and the maximum dimension is a diameter.

14. A method of culturing cells, comprising:

selecting a group of eukaryotic cells; and

contacting the eukaryotic cells with the at least one three-dimensional body as defined in any one of claims 1,3-11 and 13.

15. The method of claim 14, wherein contacting the eukaryotic cells with the at least one three-dimensional body comprises:

(a) placing the cells and at least one three-dimensional body in a container;

(b) further comprising supplying culture media to the cells; and/or

(c) further comprising causing movement of the at least one three-dimensional body, optionally wherein causing movement comprises:

(i) rotating or shaking a container in which the at least one three-dimensional body is contained; or

(ii) providing a flow of media into a container in which the at least one three-dimensional body is contained.

16. The method of claim 14, wherein said at least one three dimensional body is immersed within culture medium inside a suitable container which is configured to resist cellular adhesion.