

CLAIMS**WHAT IS CLAIMED IS:**

1. A tissue culturing device comprising a plurality of trays substantially within the device, wherein each tray is configured to hold at least one cell culturing container, wherein the trays are stacked within the device, and wherein the device is configured to repeatedly tilt such that the angle between the bottom of the stack and the base of the device can repeatedly cycle between about 0 and about 360 degrees.
2. The device of claim 1, wherein the plurality of trays comprises at least one cell culture container that contains a liquid medium and cells.
3. The device of claim 1, wherein the plurality of trays is approximately rectangular on a side.
4. The device of claim 1, wherein the device comprises a pivot and a lifting mechanism configured to tilt the stacked trays by angular raising and lowering.
5. The device of claim 4, wherein the angular raising and lowering creates a wave in a wave in a cell culture medium within said cell culturing container.
6. The device of claim 1, wherein the lifting mechanism comprises a hydraulic mechanism, an electric mechanism, a spring mechanism, a piston, or a combination thereof.
7. The device of claim 1, wherein the device is jacketed.
8. The device of claim 1, wherein the device is temperature controlled.
9. The device of claim 1, wherein the base of the device can comprise a pallet.
10. The device of claim 9, wherein the device can be stacked on a pallet rack.
11. The device of claim 9, wherein the pallet is detachable.
12. The device of claim 9, wherein the pallet is not detachable.
13. The device of claim 9, wherein the pallet comprises a plastic, a metal, or a combination thereof.
14. The device of claim 9, wherein the pallet comprises flats, grids, has an elevated foundation such that air can move underneath, or any combination thereof.
15. The device of claim 1, wherein the base of the device can comprise means for moving said device using a forklift truck.
16. The device of claim 1, wherein a length of the trays is from about 1 cm to about 1000 cm.
17. The device of claim 1, wherein a width of the trays is from about 1 cm to about 1000 cm.
18. The device of claim 1, wherein a height of the trays is from about 1 cm to about 1000 cm.
19. The device of claim 1, wherein a wall thickness of the trays is from about 0.01 cm to about 10 cm.
20. The device of claim 1, wherein a length of the cell culturing container ranges from about 1 cm to about 1000 cm.

21. The device of claim 1, wherein a width of the cell culturing container ranges from about 1 cm to about 1000 cm.
22. The device of claim 1, wherein a height of the cell culturing container ranges from about 1 cm to about 1000 cm.
23. The device of claim 1, wherein a wall thickness of the cell culturing container ranges from about 0.01 cm to about 10 cm.
24. The device of claim 1, wherein at least one of the trays comprises a handle.
25. The device of claim 1, wherein at least one of the trays can slide in and out of the device.
26. The device of claim 1, comprising a monitoring system.
27. The device of claim 26, wherein the monitoring system can alert a user that an action must be taken.
28. The device of claim 26, wherein the monitoring system comprises, a sensor, a camera, or a combination thereof.
29. The device of claim 26, wherein the sensor comprises a thermistor, a thermometer, a pH sensor, a humidity sensor, a pressure sensor, a smoke detector, or any combination thereof.
30. The device of claim 1, wherein the device is jacketed.
31. A system comprising the device of claim 1 and a cell culture medium reservoir.
32. The system of claim 31, wherein the cell culture medium reservoir comprises a monitoring system.
33. The system of claim 32, wherein the monitoring system can alert a user that an action must be taken.
34. The system of claim 32, wherein the monitoring system comprises, a sensor, a camera, or a combination thereof.
35. The system of claim 34, wherein the sensor comprises a thermistor, a thermometer, a pH sensor, a humidity sensor, a pressure sensor, a gas sensor, a CO₂ sensor, an O₂ a smoke detector, or any combination thereof.
36. The system of claim 31, wherein the cell culture medium reservoir is jacketed.
37. The system of claim 31, wherein the cell culture medium reservoir is temperature controlled.
38. The system of claim 31, wherein the cell culture medium reservoir is maintained at a lower temperature than the device.
39. The system of claim 38, wherein the cell culture medium is warmed before entering the device.
40. The system of claim 31, wherein a gas is bubbled into the cell culture medium.
41. The system of claim 40, wherein the gas comprises carbon dioxide, nitrogen, oxygen, or a combination thereof.

42. The system of claim 31, wherein the cell culture medium reservoir is connected to an inlet in the device.
43. The system of claim 42, wherein the inlet comprises an inlet manifold.
44. The system of claim 31, wherein the device comprises an outlet for waste cell culture medium.
45. The system of claim 44, wherein the outlet comprises an outlet manifold.
46. The system of claim 31, wherein the system comprises racks.
47. The system of claim 46, wherein the racks are stackable vertically.
48. The system of claim 47, wherein the racks are from about 1m high to about 200m high.
49. The system of claim 48, wherein the racks can be arranged from approximately floor to ceiling in a warehouse.
50. The system of claim 31, wherein the system comprises a pallet retrieval system.
51. A system for growing an animal cell culture, comprising:
 - (a) at least two containers, wherein the at least two containers are configured for stacking, and wherein the animal cell culture directly contacts a portion of a surface of the at least two containers; and
 - (b) a motion control system that, when activated, is configured to rock or tilt the at least two containers at an angle of greater than 0 degrees to about 360 degrees, and wherein the at least two stackable containers are configured to reversibly attach to the motion control system.
52. The system of claim 51, wherein a length of the at least two containers ranges from about 1 cm to about 1000 cm.
53. The system of claim 51, wherein the width of the at least two containers ranges from about 1 cm to about 1000 cm.
54. The system of claim 51, wherein the height of the at least two containers ranges from about 1 cm to about 1000 cm.
55. The system of claim 51, wherein the wall thickness of the at least two containers ranges from about 0.01 cm to about 10 cm.
56. The system of any one of claims 1-55, wherein at least one of the at least two containers comprise a port operatively coupled to at least one of the at least two containers, wherein the port comprises a diameter of from about 0.1 cm to about 1000 cm.
57. The system of any one of claims 1-56, wherein at least one of the at least two containers comprise a lid.
58. The system of claim 57, wherein the lid is gas permeable.
59. The system of claim 57, wherein the lid is gas impermeable.

60. The system of any one of claims 1-59, further comprising a rack comprising a frame and a shelf; wherein the rack is configured to reversibly attach to the motion control system, and wherein at least one of the at least two containers are configured to reversibly attach to the shelf.
61. The system of claim 60, wherein the rack, the frame, or the shelf are independently constructed from a material selected from the group consisting of: polypropylene, polypropylene co-polymers, polyethylene, polyester, polystyrene, polycarbonate, polysulfone, polyolefin, polyetherimide, fluorinated ethylene propylene, polyphenylsulfone, polyetheretherketone, perfluoroalkoxy, ethylene tetrafluoroethylene, ethylene chlorotrifluoroethylene, polychlorotrifluoroethylene, polytetrafluoroethylene, polyphenyl sulfide, silicone, silicone co-polymers, stainless steel, steel alloys, aluminum, aluminum alloys, titanium, titanium alloys, glass, ceramic, and any combination thereof.
62. The system of any one of claims 1-61, wherein the system is configured to fit on a North American 40" x 48" pallet.
63. The system of any one of claims 1-62, wherein the system is configured to fit on a conveyer system.
64. The system of any one of claims 1-63, wherein at least one of the at least two containers comprise a tube operatively connected thereto.
65. The system of any one of claims 1-64, further comprising a temperature control system configured to heat or cool at least a portion of the system to a temperature of from about -200 degrees Celsius to about 200 degrees Celsius.
66. The system of claim 65, further comprising an intermediate bulk container heating jacket operatively coupled to the temperature control system, wherein the intermediate bulk container heating jacket is configured to heat the portion of the system.
67. The system of claim 65 or 66, further comprising an intermediate bulk container cooling jacket operatively coupled to the temperature control system, wherein the intermediate bulk container cooling jacket is configured to cool the portion of the system.
68. The system of any one of claims 1-67, further comprising a cell growth substrate.
69. The system of claim 68, wherein the cell growth substrate comprises a synthetic polymer, a natural polymer, a plant-derived material, a microbial-derived material, an animal-derived material, a metal, a ceramic, a glass, a mineral, a rock, a gem, a clay, or any combination thereof.
70. The system of claim 68, wherein the cell growth substrate comprises polystyrene, polyester, polyethylene terephthalate, poly(glycolic acid), poly(lactic acid), poly(lactic-co-glycolic acid), poly(ethylene glycol), polyurethane, poly(glycerol sebacate), polycarbonate, polyetherimide,

stainless steel, silver, gold, platinum, palladium, iridium, titanium, tantalum, noble metal, collagen, fibrin, silk, wool, wood, hemp, linen, cotton, cellulose, grass, leaves, straw, lignin, diamond, sapphire, amethyst, ruby, emerald, opal, topaz, quartz, marble, slate, lava rock, coral, sponge, diatom, sand dollar, sea shell, starfish, seaweed, kelp, algae, or any combination thereof.

71. The system of any one of claims 68-70, wherein the cell growth substrate is positioned inside at least one of the at least two containers.
72. The system of claim 71, wherein the cell growth substrate is positioned using a magnet or a fastener.
73. The system of any one of claims 1-72, wherein the at least two containers are independently rectangular, cylindrical, spherical, or triangular.
74. The system of any one of claims 1-73, wherein the at least two containers are independently constructed from a material that is substantially rigid, semi-rigid, or flexible.
75. The system of any one of claims 1-74, wherein the motion control system is an intermediate bulk container tilter.
76. The system of any one of claims 1-75, wherein at least one of the at least two containers is an intermediate bulk container.
77. The system of claim 76, wherein the intermediate bulk container comprises a volume of at least 275 gallons.
78. The system of any one of claims 1-77, wherein at least one of the at least two containers is a single use bioprocessing container.
79. The system of any one of claims 1-77, wherein at least one of the at least two containers is a storage tank.
80. The system of any one of claims 1-77, wherein at least one of the at least two containers is a pressure vessel.
81. The system of any one of claims 1-77, wherein at least one of the at least two containers is a drum.
82. The system of any one of claims 1-81, wherein the system is configured to be heated in an incubator.
83. The system of any one of claims 1-82, wherein the system is configured to be heated in a heated space.
84. The system of any one of claims 1-83, wherein the system is configured to be cooled using refrigeration or freezing technology.
85. The system of any one of claims 1-84, wherein at least a portion of at least one of the at least two containers is gas permeable.

86. The system of any one of claims 1-84, wherein at least a portion of at least one of the at least two containers is gas impermeable.
87. The system of any one of claims 1-86, wherein at least a portion of an interior of at least one of the at least two containers is shaped or textured to influence fluid motion.
88. The system of any one of claims 1-87, wherein at least a portion of an interior of at least one of the at least two containers is shaped or textured to influence cell or tissue attachment.
89. The system of any one of claims 1-88, wherein at least one of the at least two containers is sterile.
90. The system of any one of claims 1-88, wherein at least one of the at least two containers is non-sterile.
91. A method of growing an animal cell culture comprising culturing the cell culture in the system of any one of claims 1-90.
92. The method of claim 91, wherein the culturing produces a cell-based tissue.
93. The method of claim 92, wherein the cell-based tissue is tanned, retanned, dyed, or fatliquored.
94. The method of claim 91, wherein the animal cell culture comprises a transgene, a heterologous RNA, or an epigenetically-modified base.
95. A cell-based tissue produced by the method of any one of claims 91-93.
96. The cell-based tissue of claim 95, wherein the cell-based tissue is treated for the purpose of making leather.
97. A composition that comprises:
 (a) an acrylated chitosan; and
 (b) an acrylate polymer, wherein the acrylate polymer comprises a phosphine oxide or a salt thereof.
98. The composition of claim 97, wherein the acrylated chitosan is a methacrylated chitosan or salt thereof.
99. The composition of claim 97, wherein the acrylated polymer comprises polyethylene glycol.
100. The composition of claim 99, wherein the acrylated polymer is poly(ethylene glycol) dimethacrylate or a salt thereof.
101. The composition of claim 97, wherein the phosphine oxide or salt thereof is 2,4,6-trimethylbenzoyl-diphenylphosphine oxide or a salt thereof.
102. The composition of claim 101, wherein the phosphine oxide comprises the salt of the 2,4,6-trimethylbenzoyl-diphenylphosphine oxide.
103. The composition of claim 102, wherein the salt is a lithium salt.
104. The composition of claim 102, wherein the salt is a sodium salt.

- 105.** The composition of claim 97, that further comprises an organic dye or a salt thereof.
- 106.** The composition of claim 105, wherein the organic dye or salt thereof is Martius yellow or a salt thereof.
- 107.** The composition of claim 106 that comprises the salt of Martius yellow, wherein the salt is sodium.
- 108.** A method comprising contacting an acrylated chitosan with an acrylate polymer, wherein the acrylate polymer comprises a phosphine oxide or a salt thereof.
- 109.** The method of claim 108, wherein the acrylated chitosan is a methacrylated chitosan or salt thereof.
- 110.** The method of claim 108, wherein the acrylated polymer comprises polyethylene glycol.
- 111.** The method of claim 110, wherein the acrylated polymer is poly(ethylene glycol) dimethacrylate or a salt thereof.
- 112.** The method of claim 108, wherein the phosphine oxide or salt thereof is 2,4,6-trimethylbenzoyl-diphenylphosphine oxide or a salt thereof.
- 113.** The method of claim 112, wherein the phosphine oxide is the salt of the 2,4,6-trimethylbenzoyl-diphenylphosphine oxide.
- 114.** The method of claim 113, wherein the salt is a lithium salt.
- 115.** The method of claim 113, wherein the salt is a sodium salt.
- 116.** The method of claim 108, further comprising contacting the acrylated chitosan and acrylate polymer with an organic dye or a salt thereof.
- 117.** The method of claim 116, wherein the organic dye or salt thereof is Martius yellow or a salt thereof.
- 118.** The method of claim 117, wherein the organic dye is the salt of Martius yellow, wherein the salt is sodium.
- 119.** The method of claim 108, wherein the acrylated chitosan is dissolved in an organic acid prior to contacting with the acrylate polymer.
- 120.** The method of claim 108, further comprising printing a scaffold comprising the acrylated chitosan and acrylate polymer.