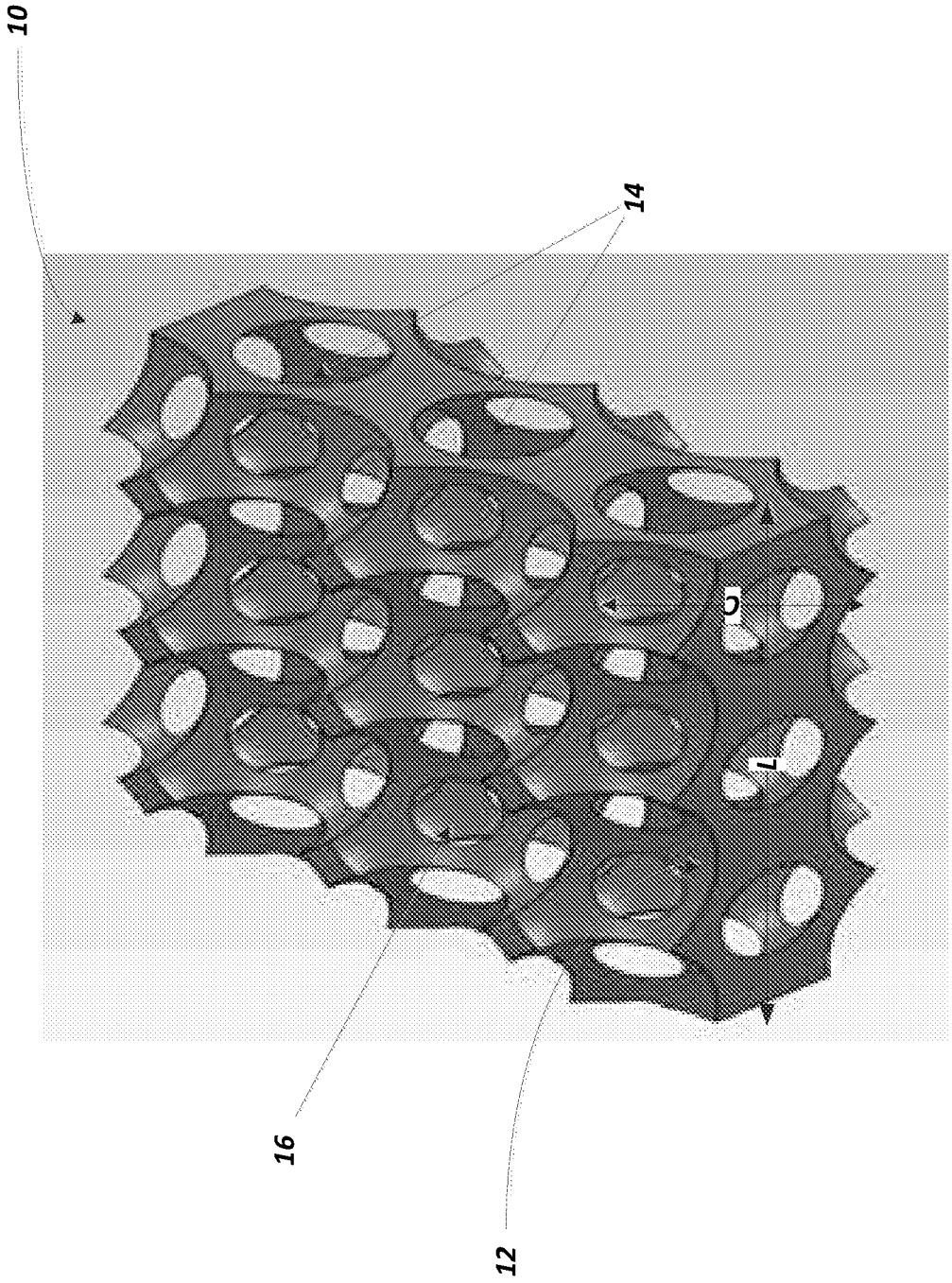

FIG. 1

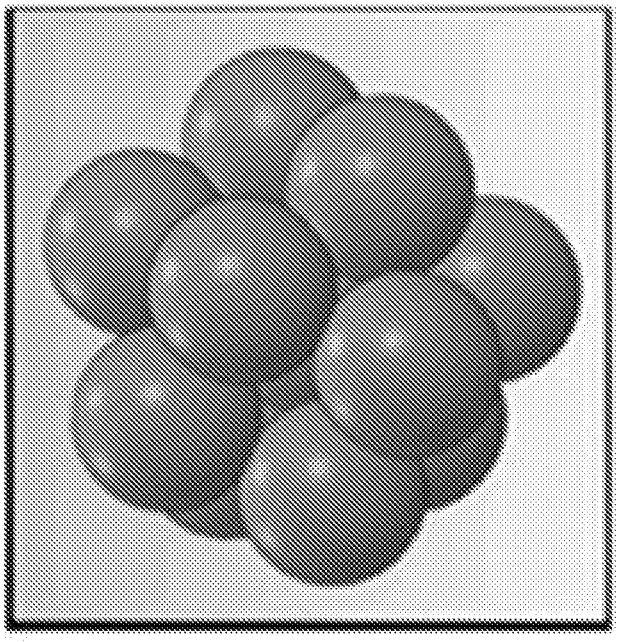

FIG. 1b

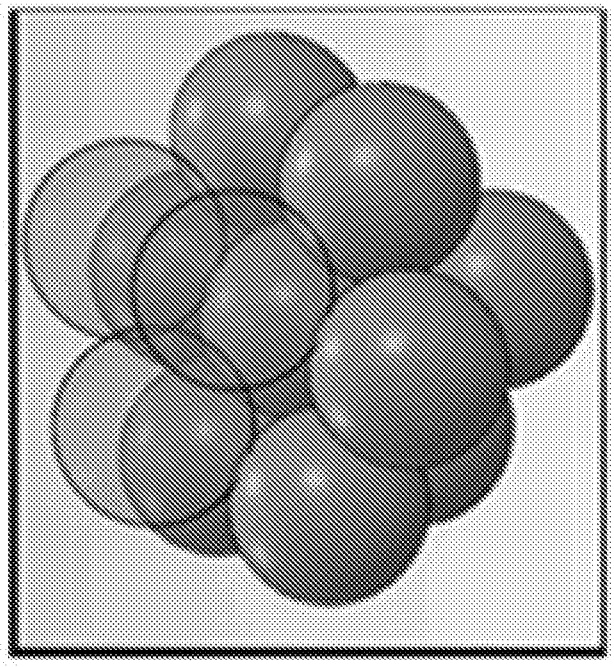

FIG. 1a

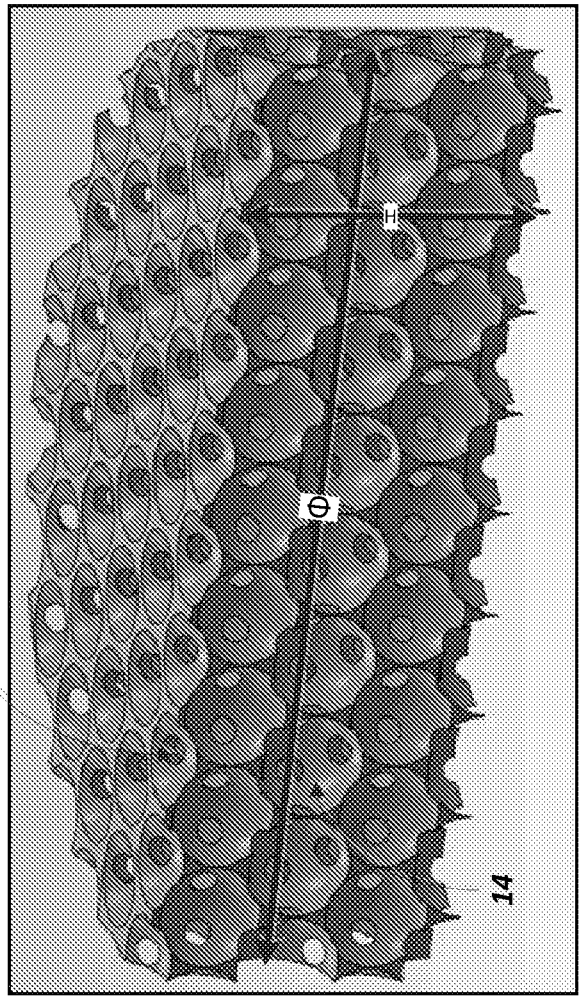

FIG. 1d

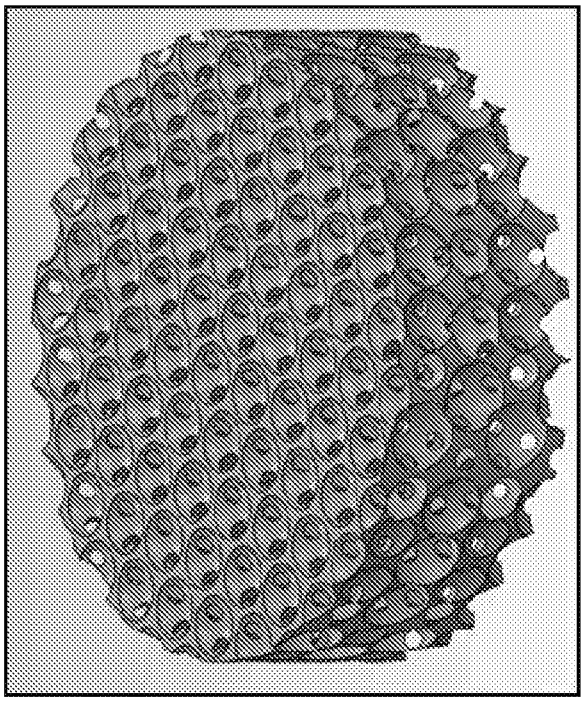

FIG. 1c

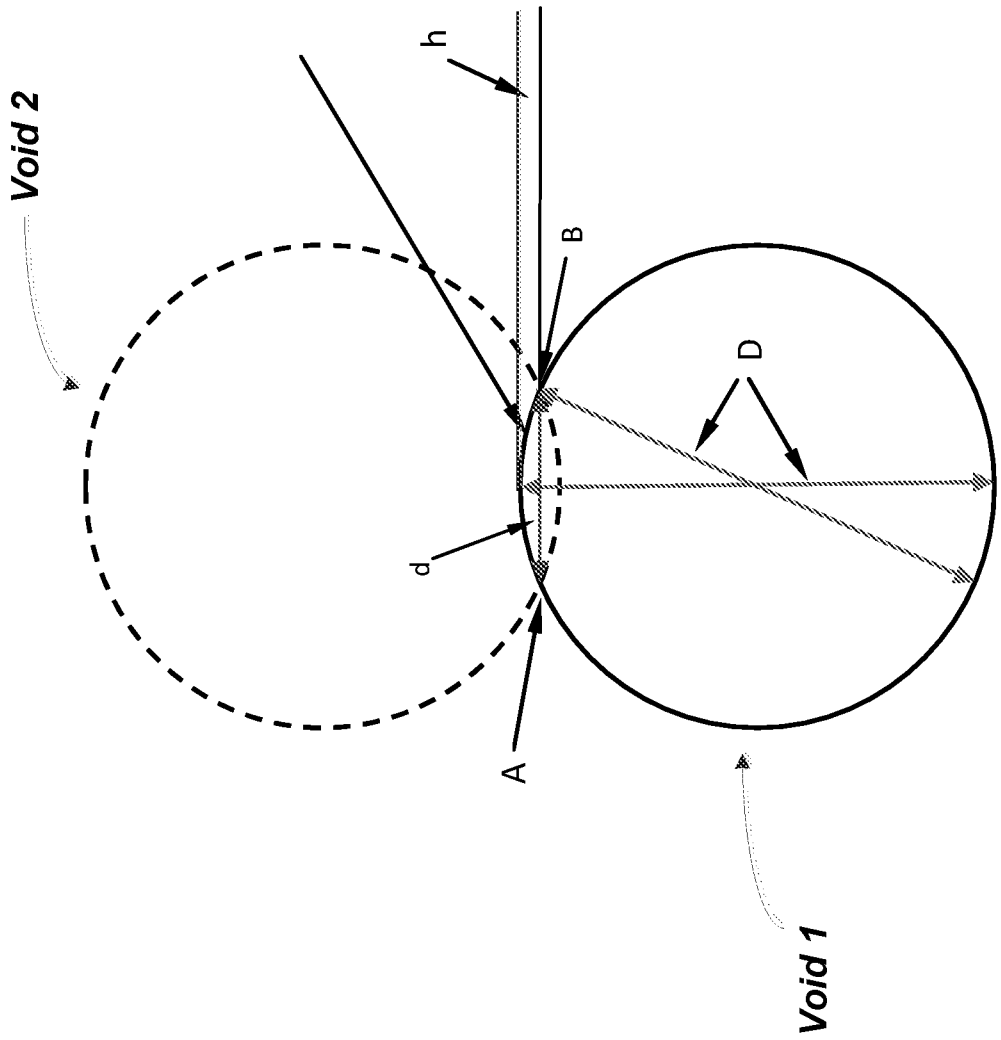

FIG. 1e

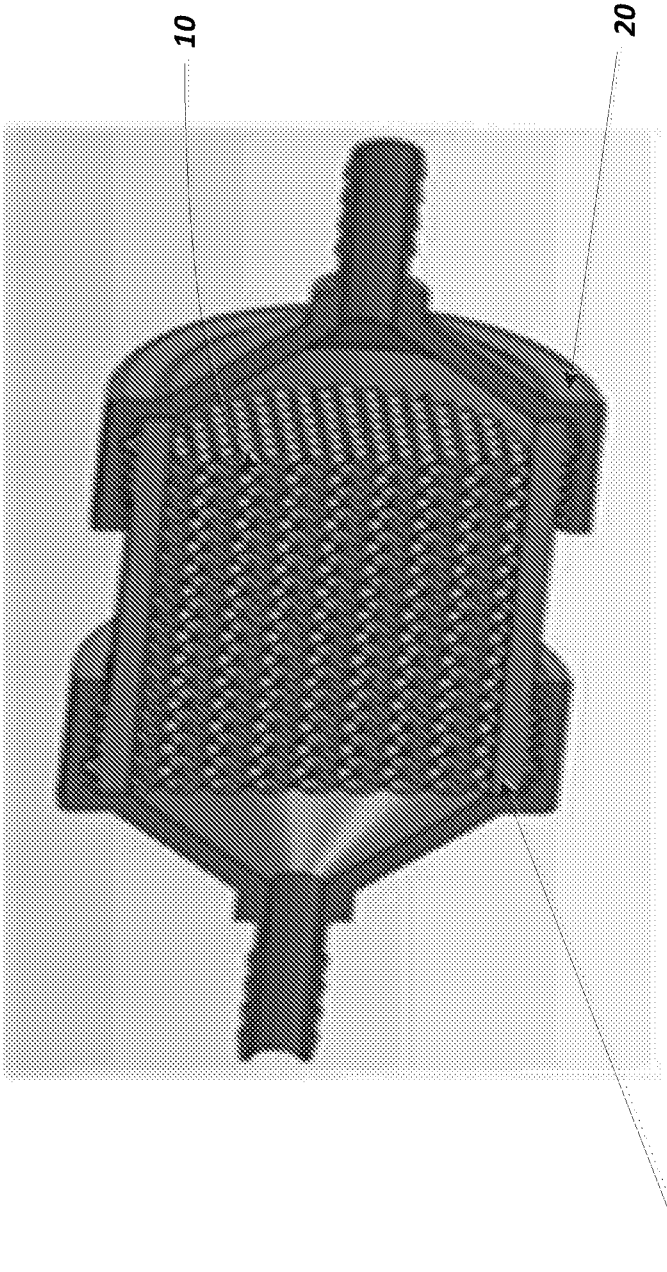

FIG. 2

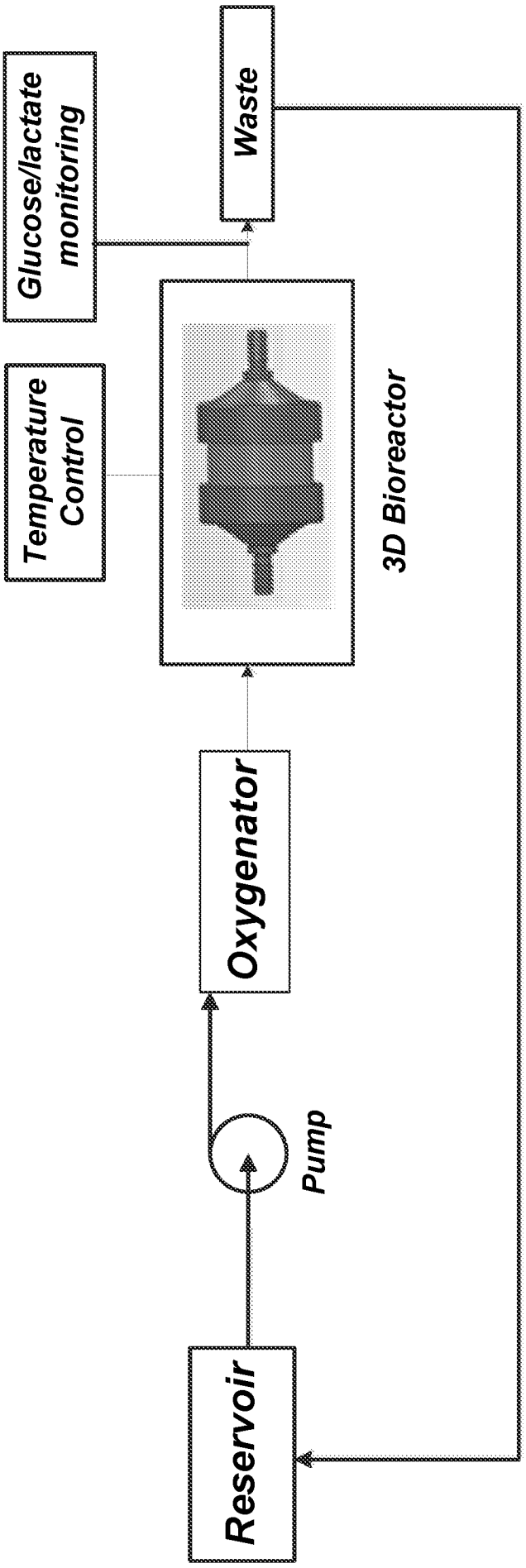
Reservoir
Pump
Oxygenator
3D Bioreactor
Temperature Control
Glucose/lactate monitoring
Waste

FIG. 3

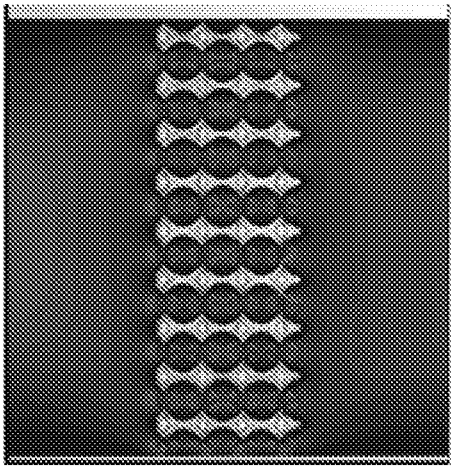

FIG. 4a

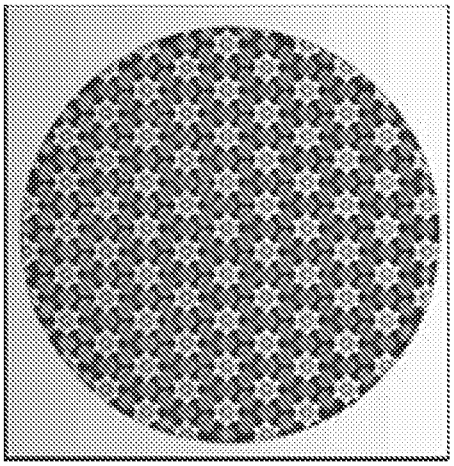

FIG. 4b

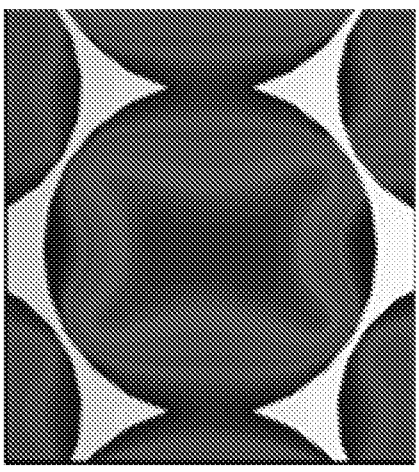

FIG. 4c

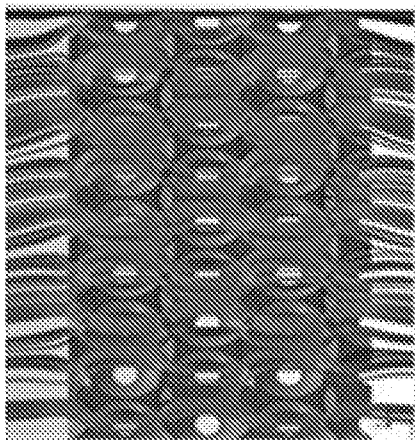

FIG. 4d

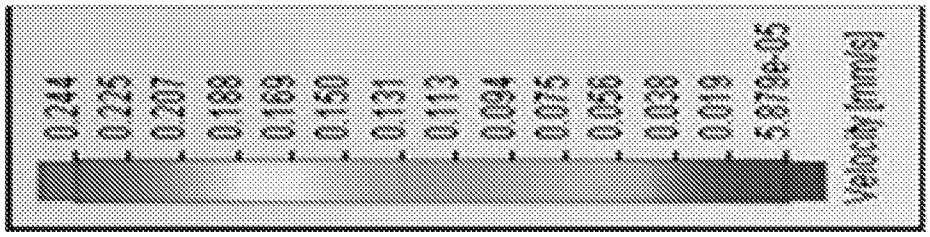

FIG. 4e

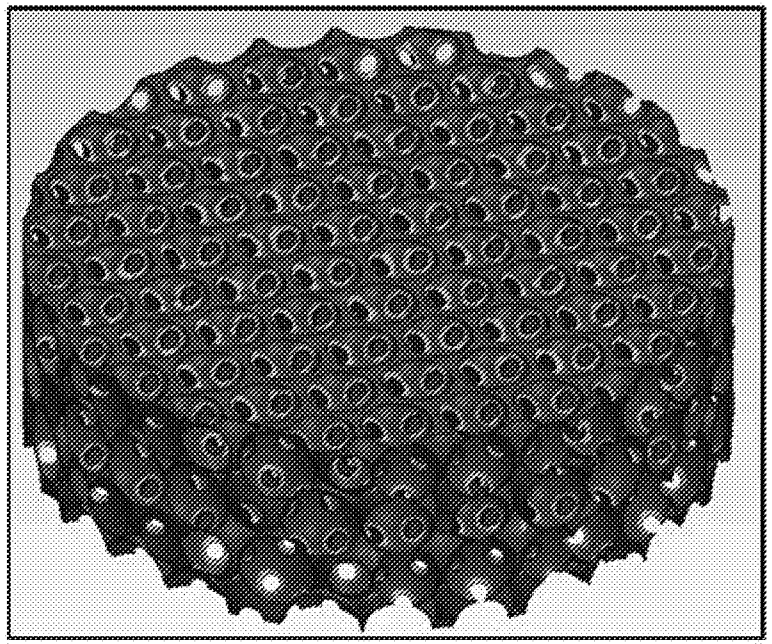

FIG. 5a

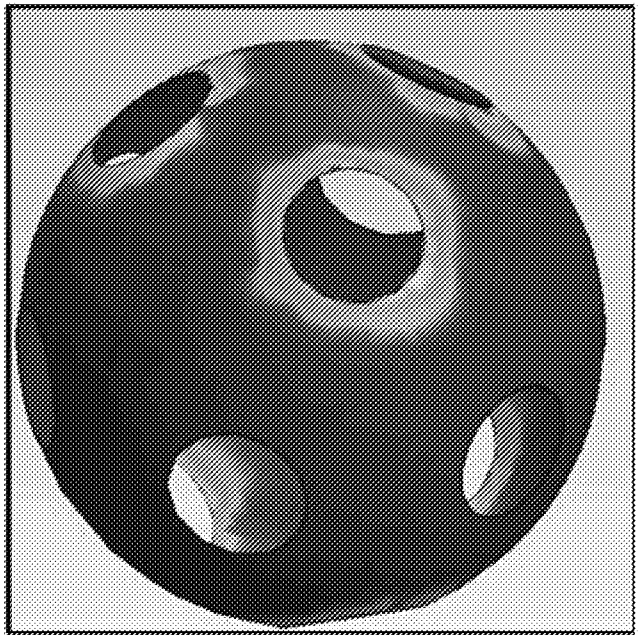

FIG. 5b

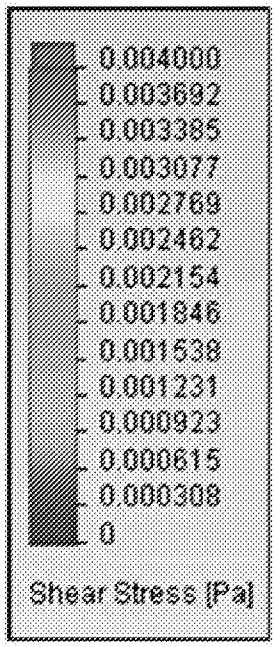

FIG. 5c

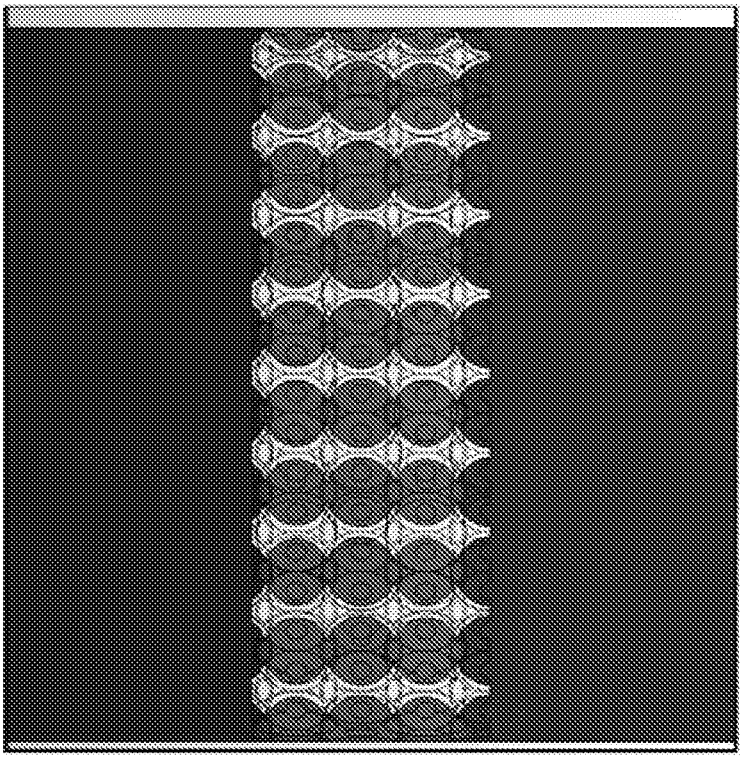

FIG. 6a

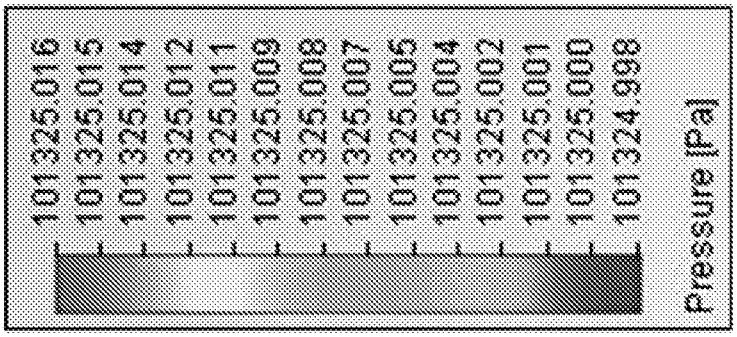
101325.016
101325.015
101325.014
101325.012
101325.011
101325.009
101325.008
101325.007
101325.005
101325.004
101325.002
101325.001
101325.000
101324.998
Pressure [Pa]

FIG. 6b

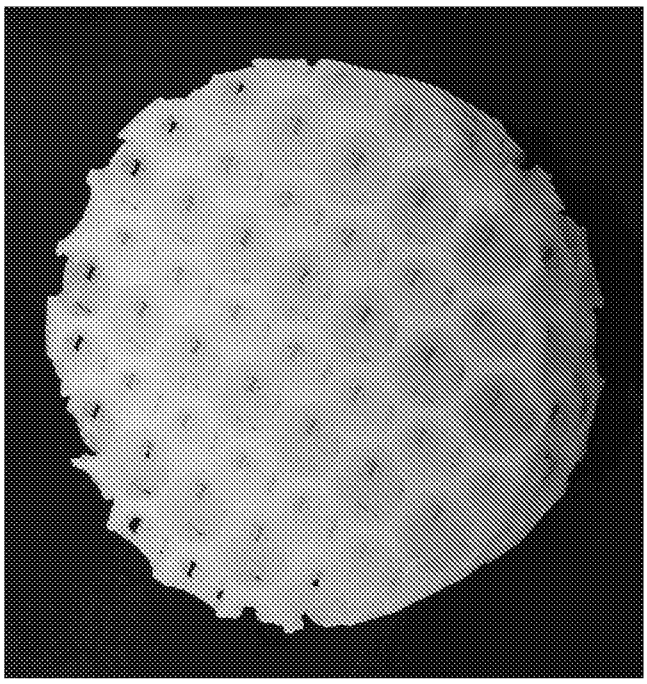

FIG. 7a

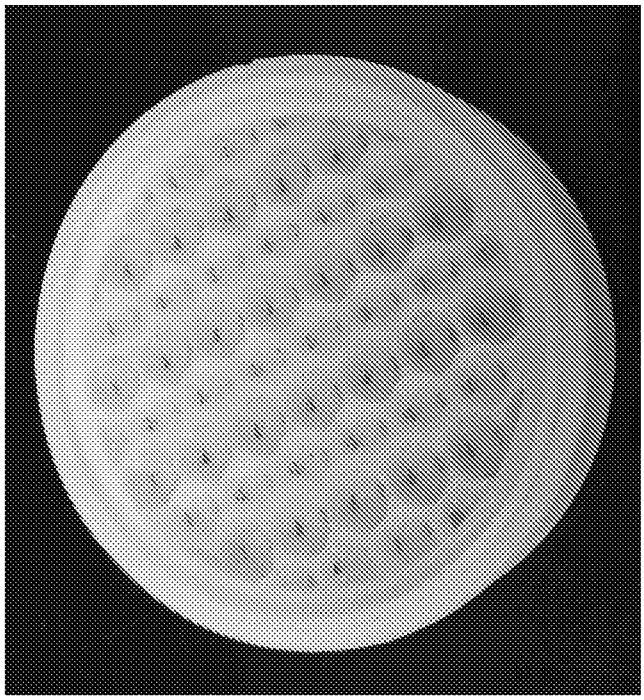

FIG. 7b

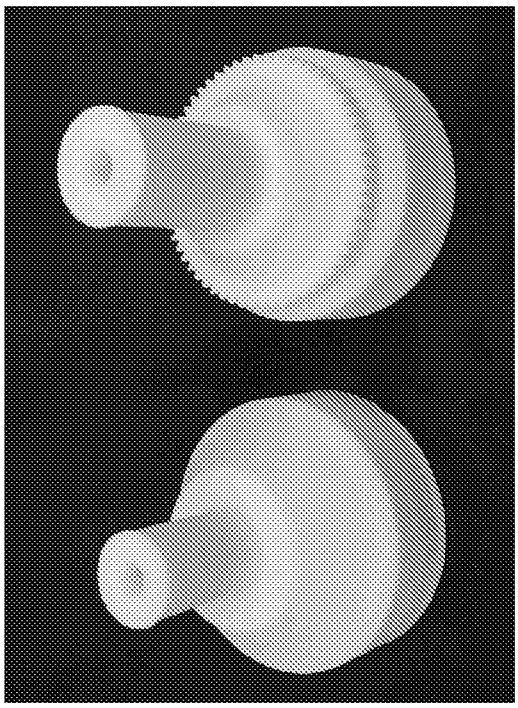

FIG. 7c

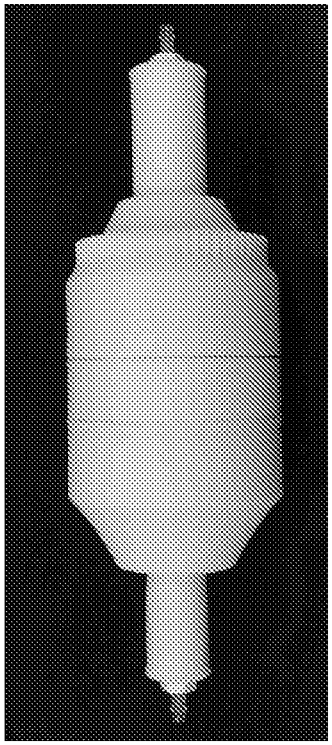

FIG. 7d

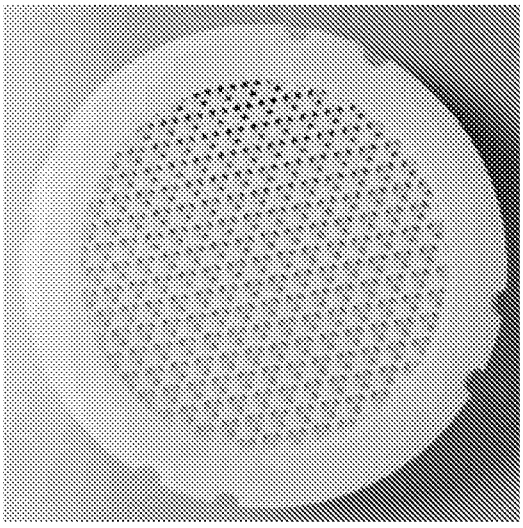

FIG. 7f

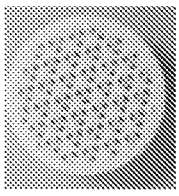

FIG. 7e

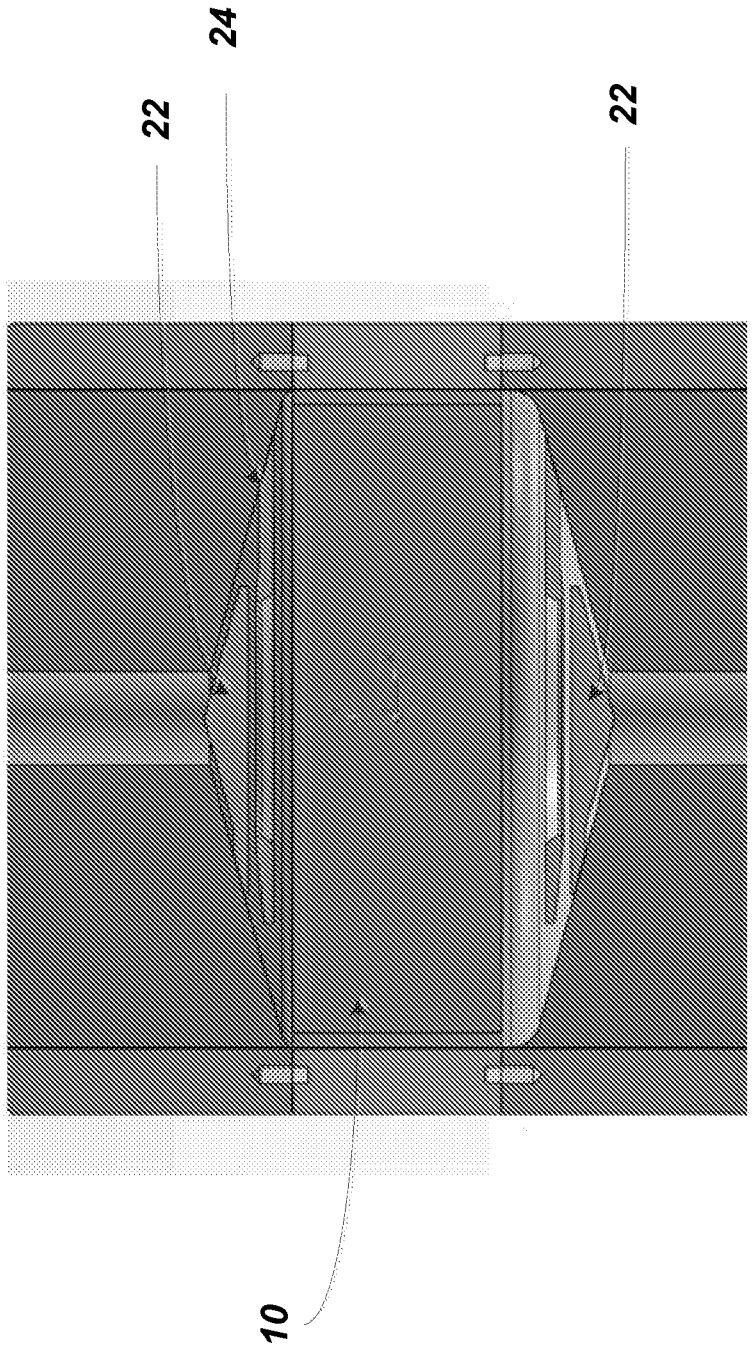

FIG. 8

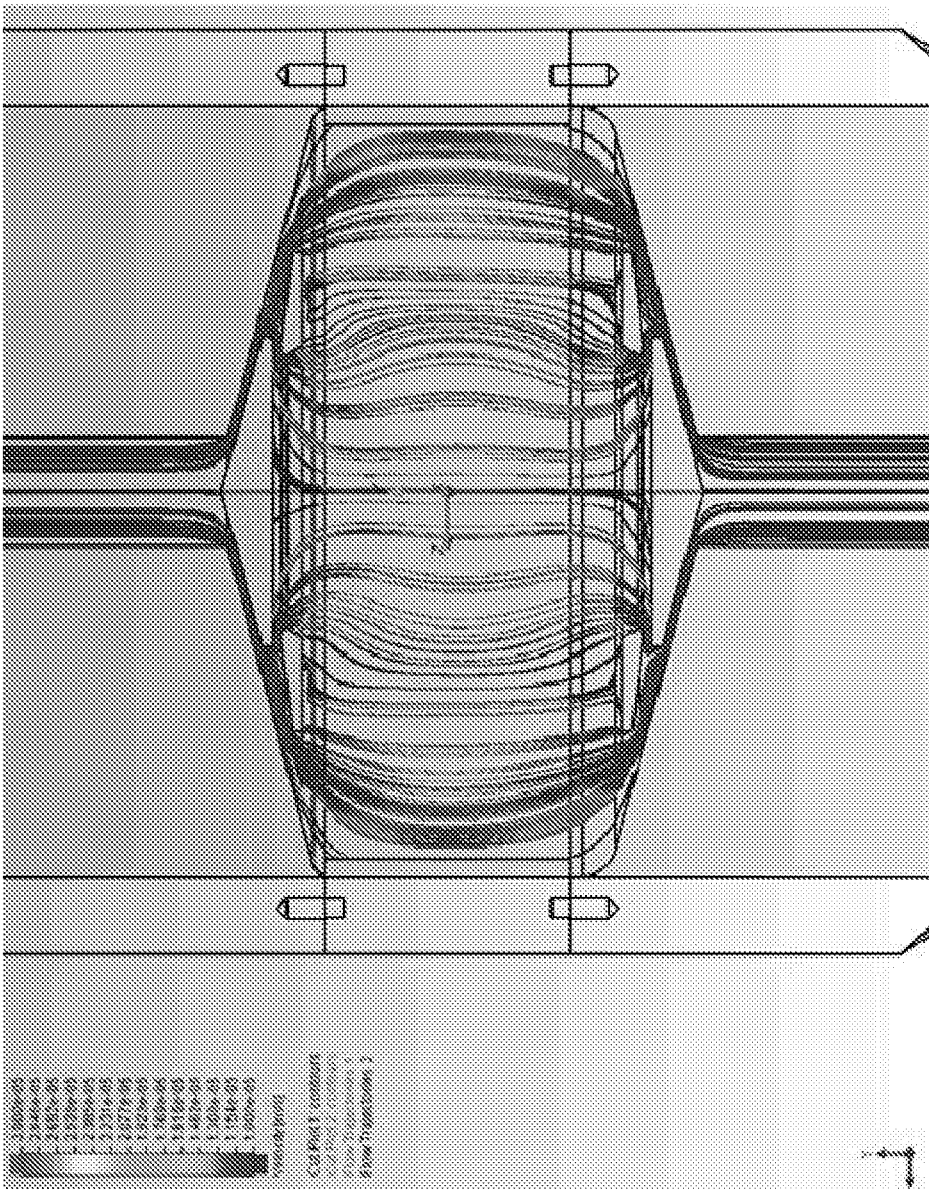

FIG. 9

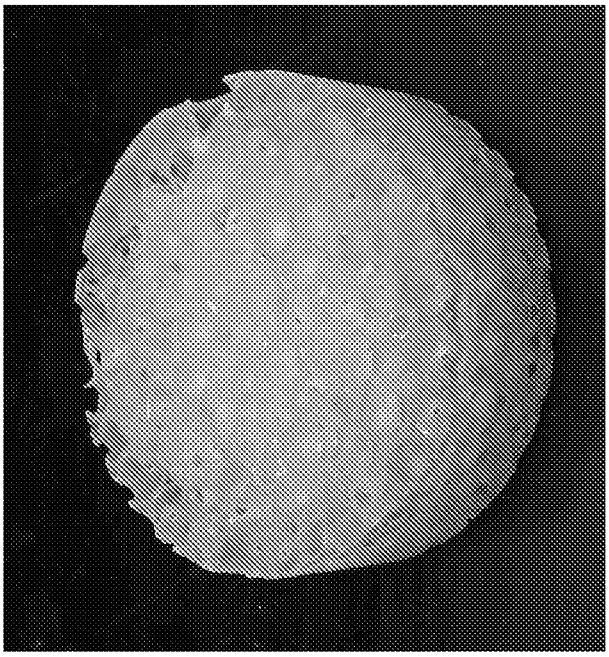

FIG. 10b

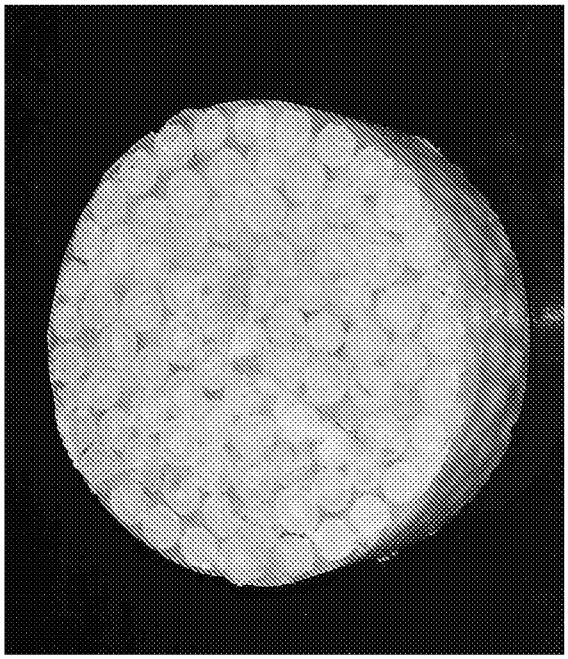

FIG. 10a

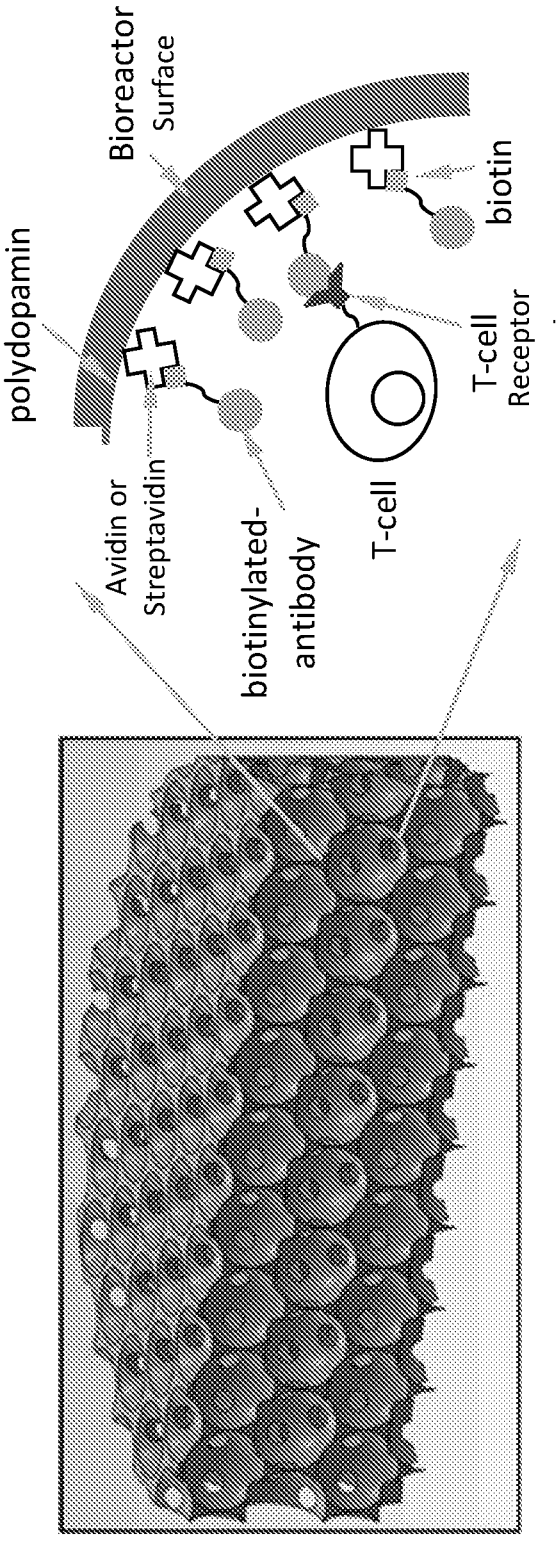
Bioreactor
Surface
polydopamin
biotin
T-cell
Receptor
Avidin or
Streptavidin
biotinylated-
antibody
T-cell

FIG. 11

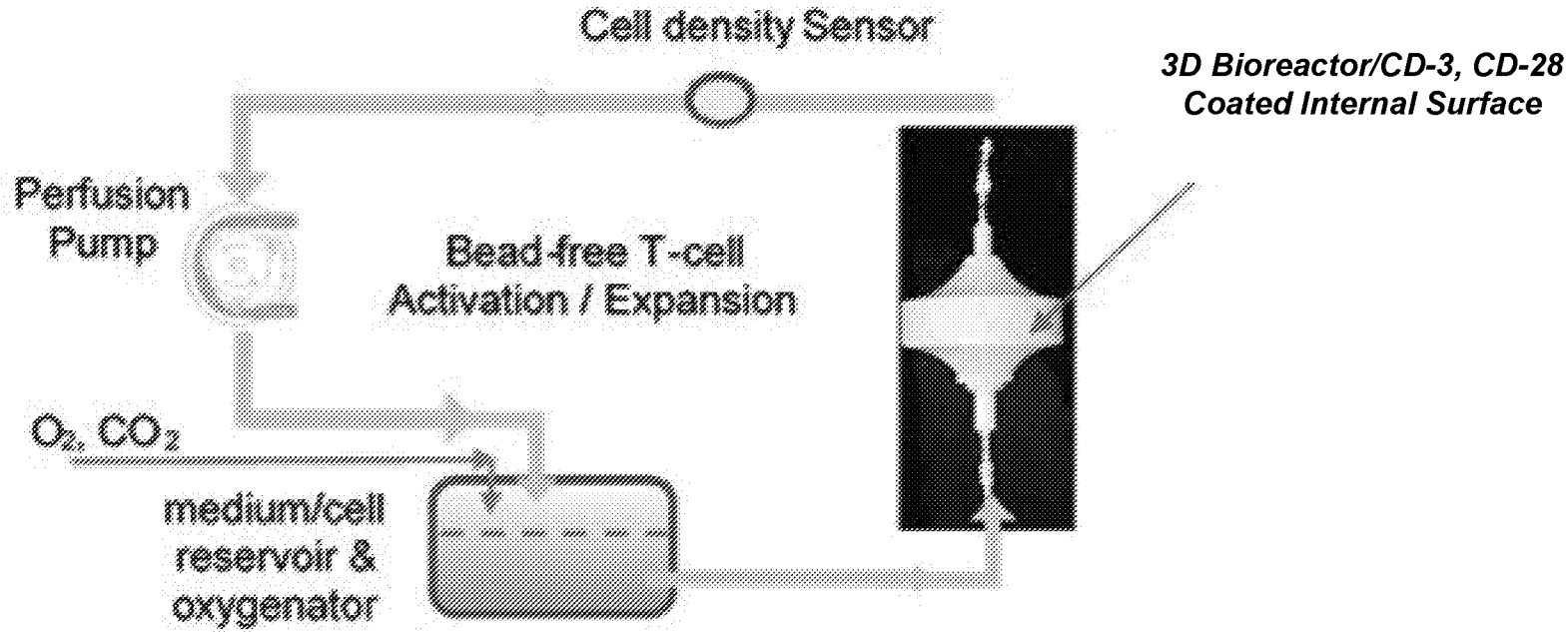
Cell density Sensor
3D Bioreactor/CD-3, CD-28
Coated Internal Surface
Perfusion
Pump
Bead-free T-cell
Activation / Expansion
O_2, CO_2
medium/cell
reservoir &
oxygenator

FIG. 12

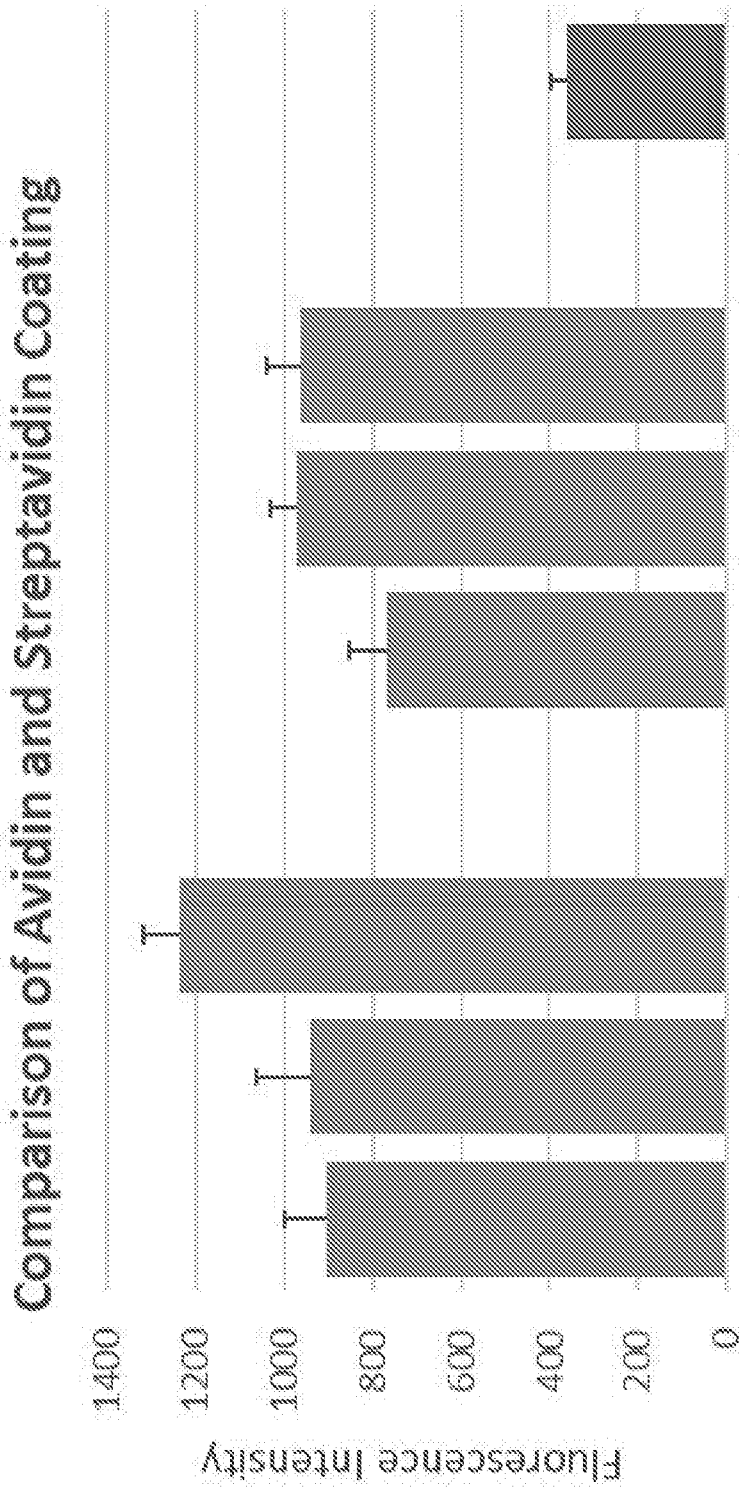
Comparison of Avidin and Streptavidin Coating
Fluorescence Intensity
1400
1200
1000
800
600
400
200
0
Avidin 10 ug/mL
Avidin 30 ug/mL
Avidin 100 ug/mL
Streptavidin 10 ug/mL
Streptavidin 30 ug/mL
Streptavidin 100 ug/mL
Control

FIG. 13

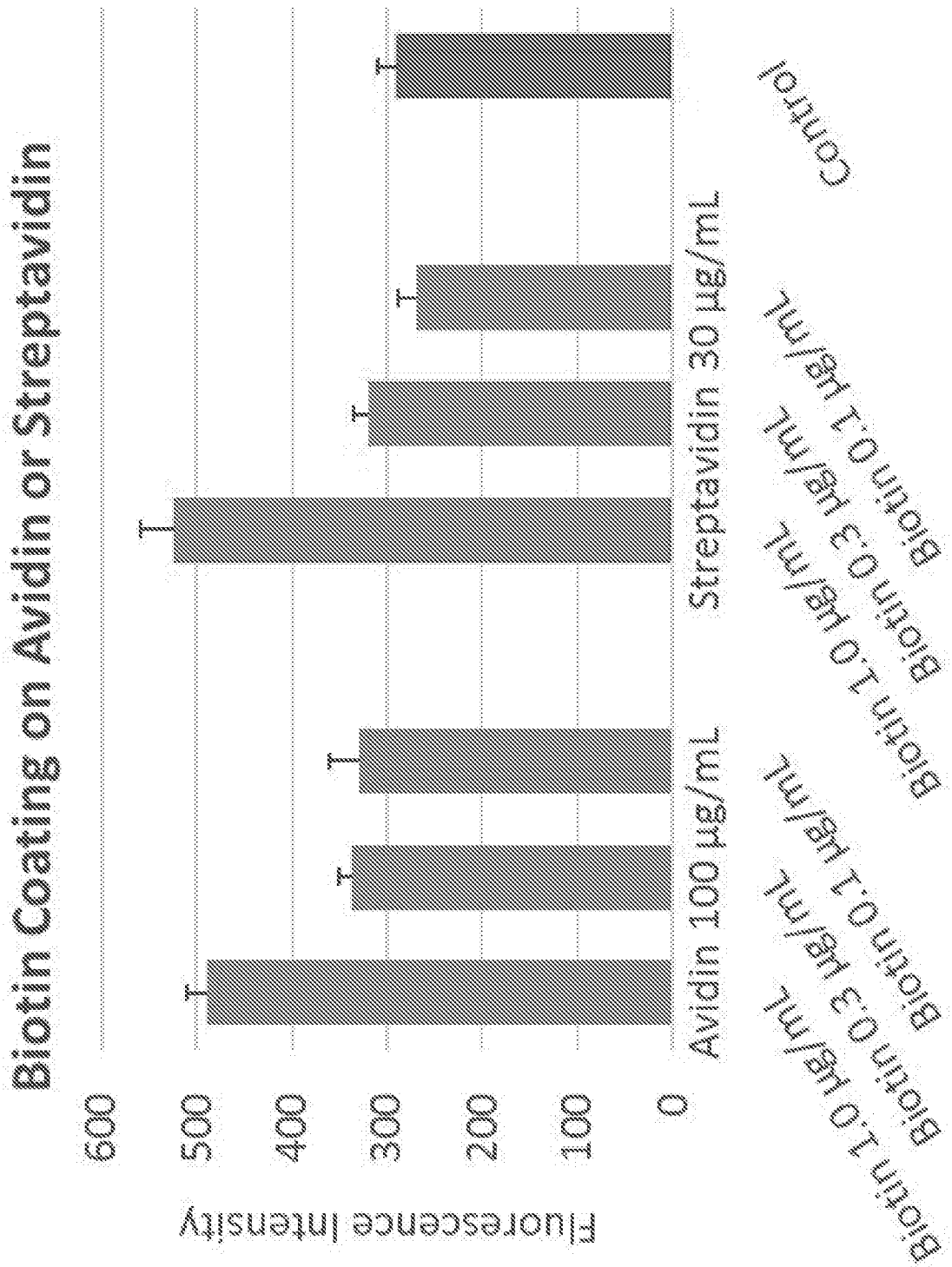
Biotin Coating on Avidin or Streptavidin
Fluorescence Intensity
600
500
400
300
200
100
0
Avidin 100 µg/mL
Streptavidin 30 µg/mL
Biotin 1.0 µg/mL
Biotin 0.3 µg/mL
Biotin 0.1 µg/mL
Control

FIG. 14

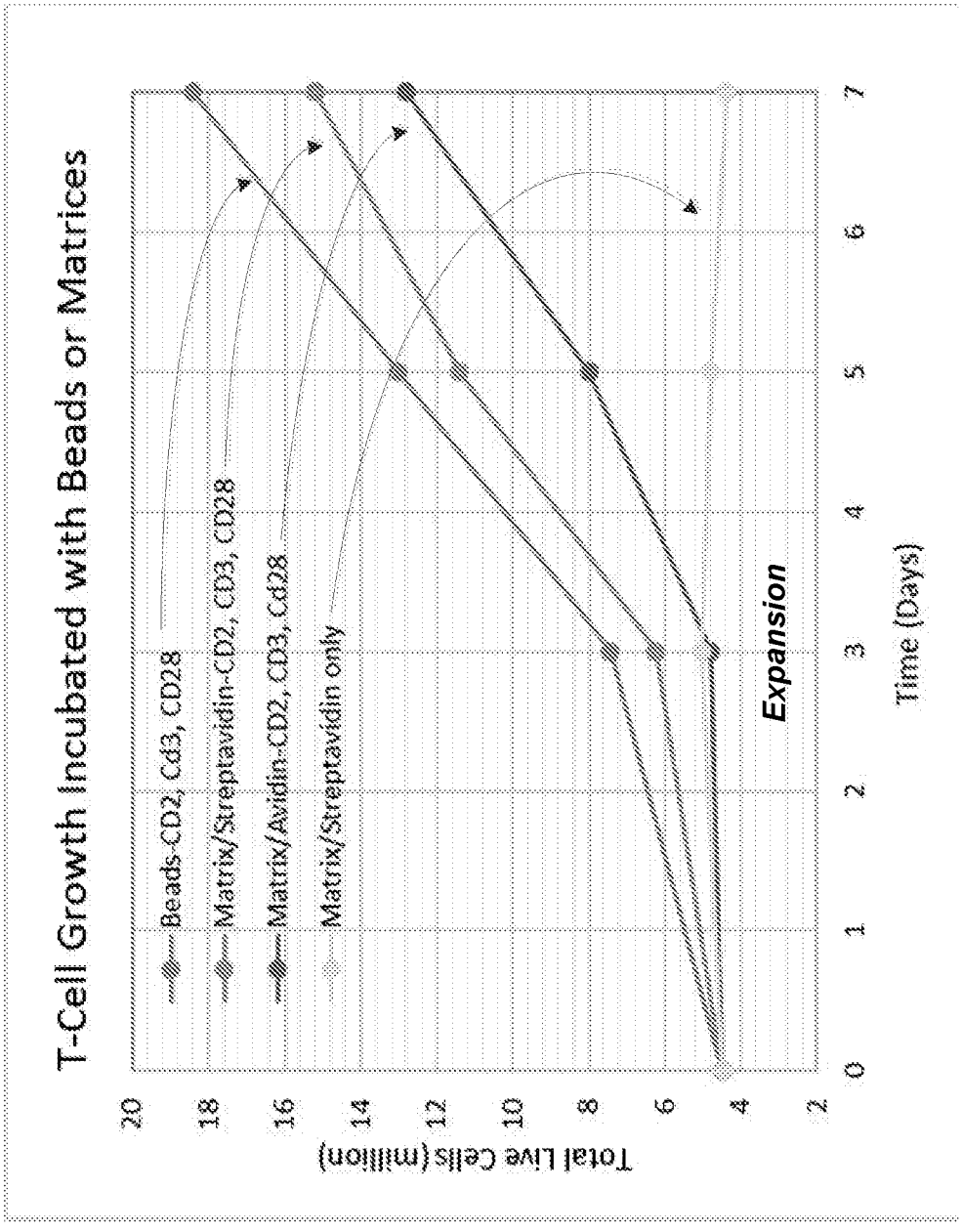
T-Cell Growth Incubated with Beads or Matrices
Beads-CD2, Cd3, CD28
Matrix/Streptavidin-CD2, CD3, CD28
Matrix/Avidin-CD2, CD3, Cd28
Matrix/Streptavidin only
Total Live Cells (million)
Time (Days)
Expansion
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7

FIG. 15

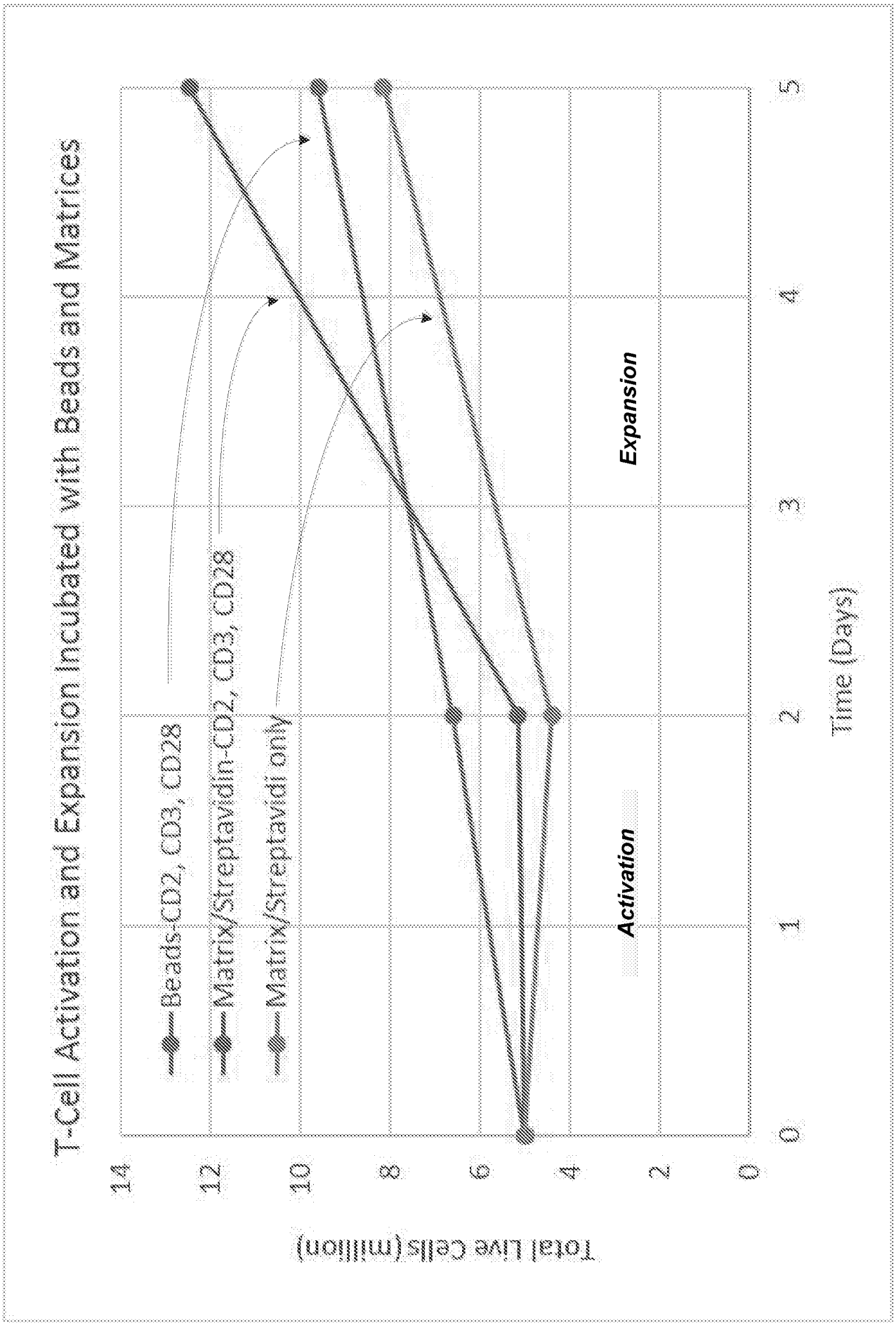
T-Cell Activation and Expansion Incubated with Beads and Matrices
Beads-CD2, CD3, CD28
Matrix/Streptavidin-CD2, CD3, CD28
Matrix/Streptavidi only
Activation
Expansion
Total Live cells (million)
Time (Days)
0
2
4
6
8
10
12
14
0
1
2
3
4
5

FIG. 16

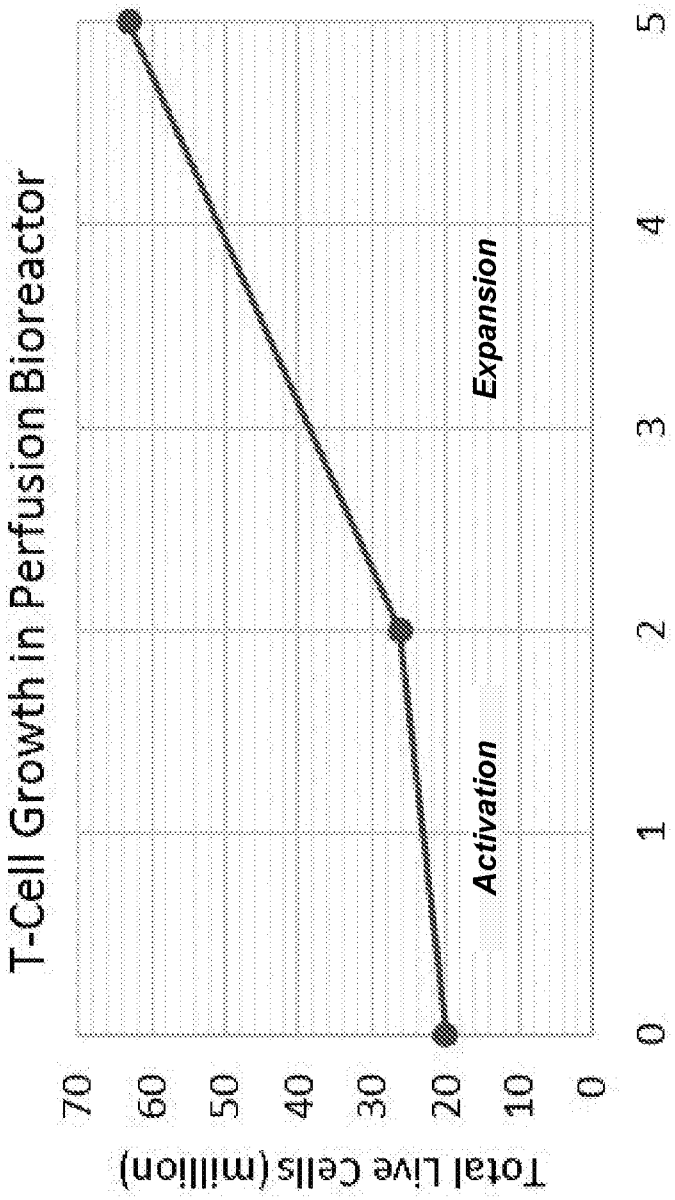
T-Cell Growth in Perfusion Bioreactor
Total Live Cells (million)
70
60
50
40
30
20
10
0
0
1
2
3
4
5
Time (Days)
Activation
Expansion

FIG. 17

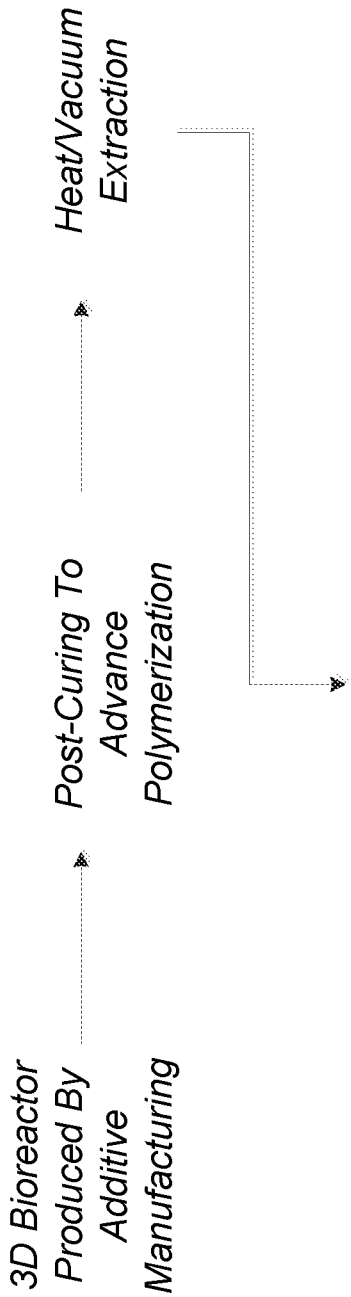
3D Bioreactor Produced By Additive Manufacturing
Post-Curing To Advance Polymerization
Heat/Vacuum Extraction
Parylene Coating

FIG. 18

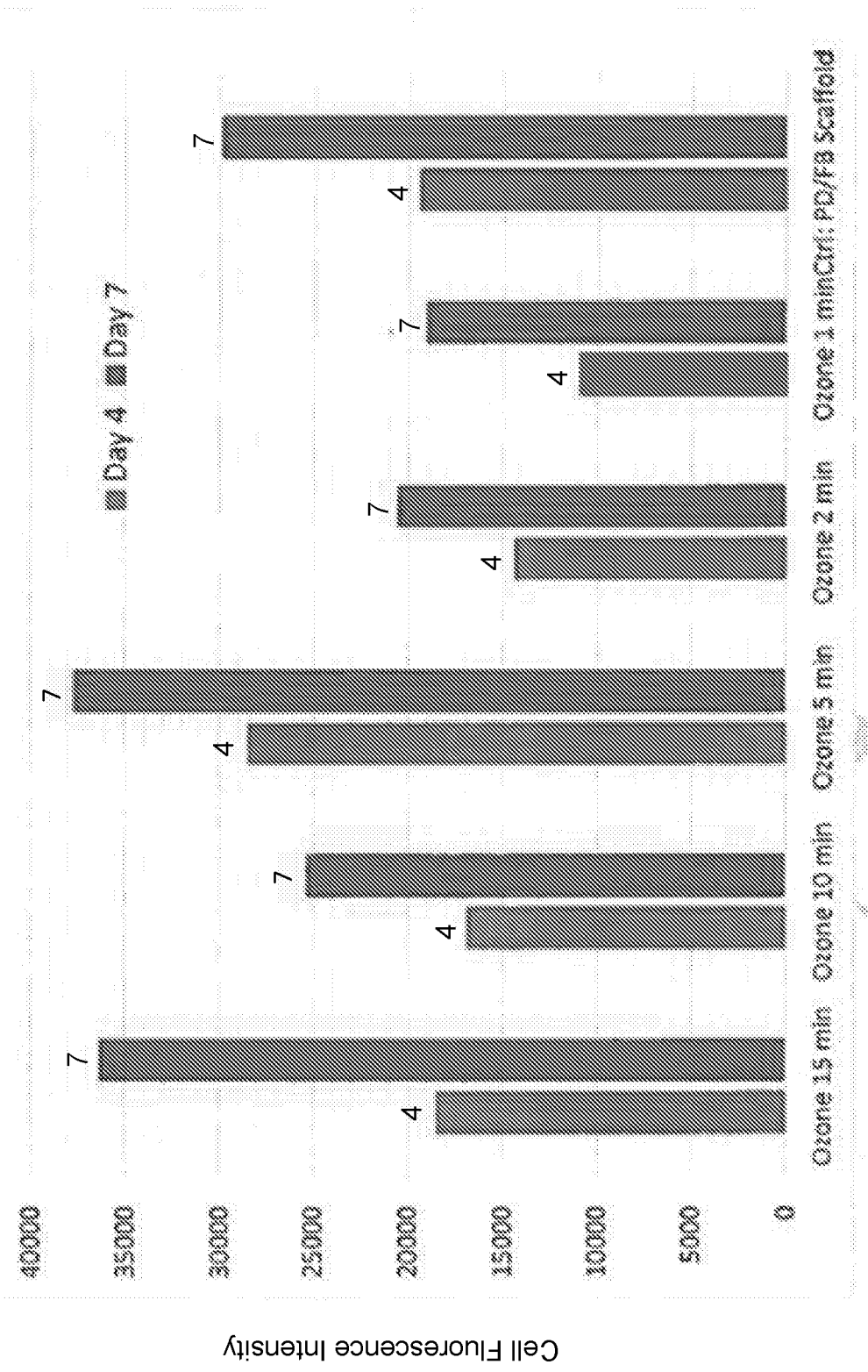
Cell Fluorescence Intensity
40000
35000
30000
25000
20000
15000
10000
5000
0
Day 4
Day 7
7
4
7
4
7
4
7
4
7
4
Ozone 15 min
Ozone 10 min
Ozone 5 min
Ozone 2 min
Ozone 1 min
Ctrl: PD/FB Scaffold

FIG. 19

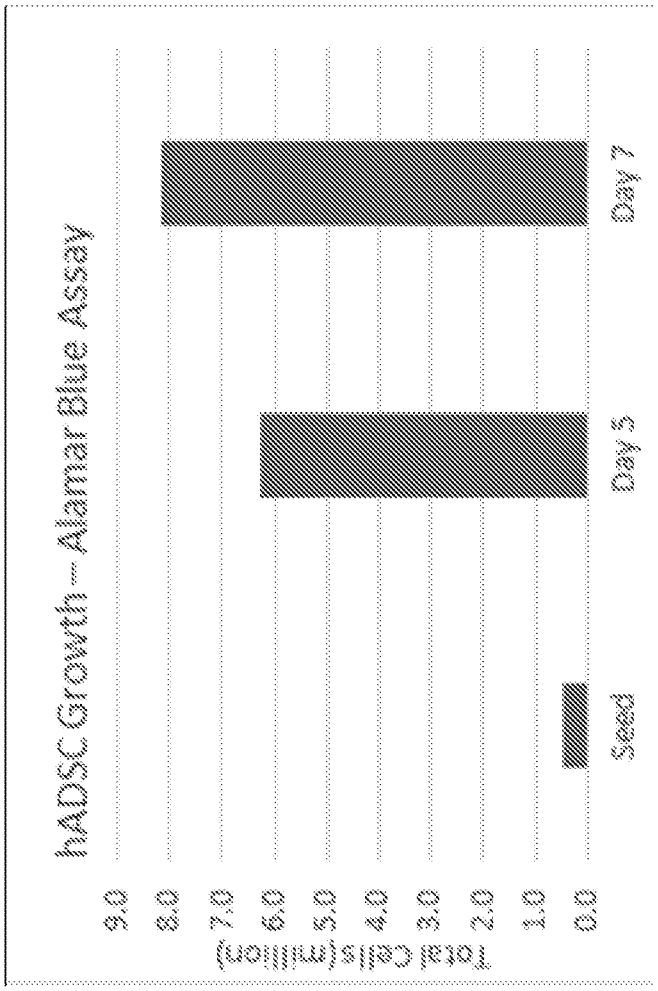
hADSC Growth – Alamar Blue Assay
Total cells (million)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Seed
Day 5
Day 7

FIG. 20

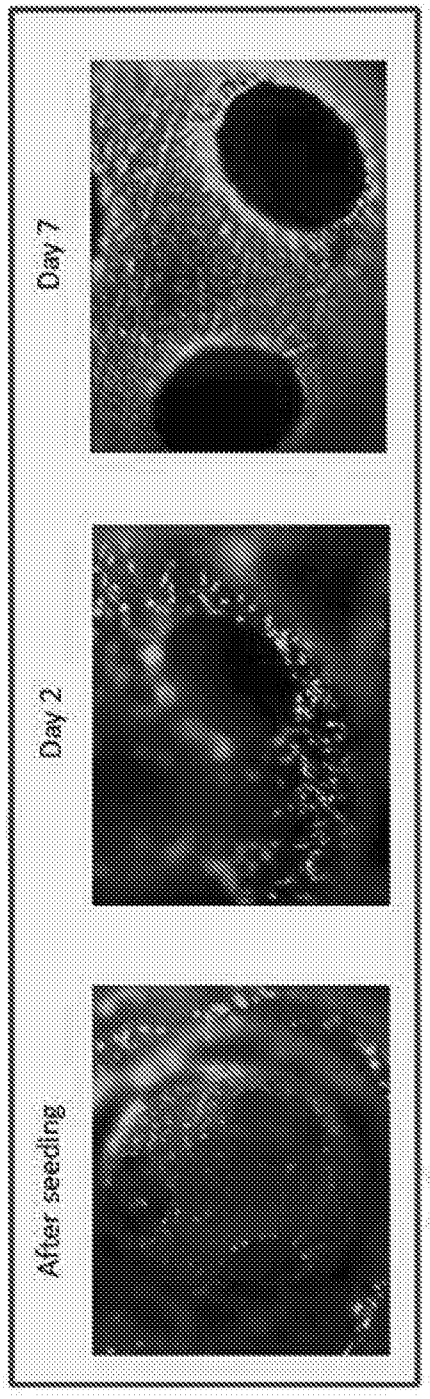

FIG. 21