RECTANGULAR PATTERN
MAXIMUM NUMBER OF CIRCLES INSIDE THE 10 X 10 RECTANGLE IS: 196

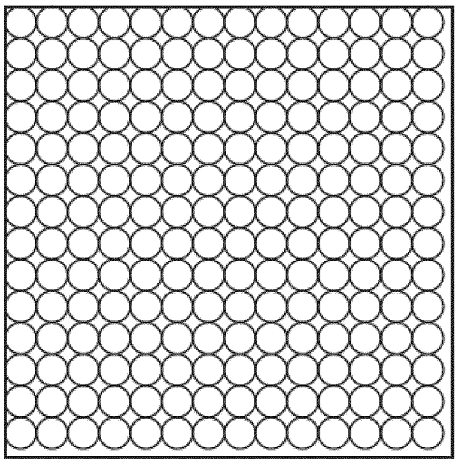

FIG. 1A

TRIANGULAR PATTERN
MAXIMUM NUMBER OF CIRCLES WITH THE TRIANGULAR PATTERN
INSIDE THE 10 X 10 RECTANGLE IS: 216

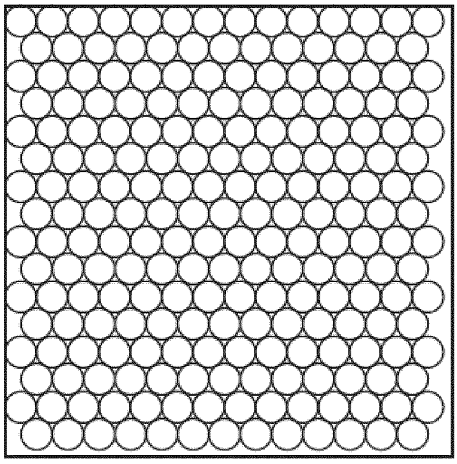

FIG. 1B

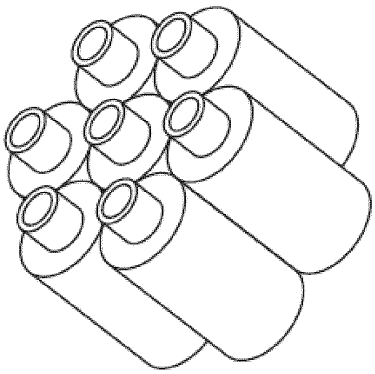

FIG. 2A

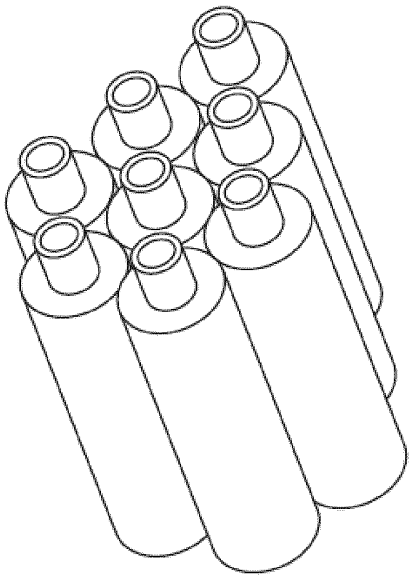

FIG. 2B

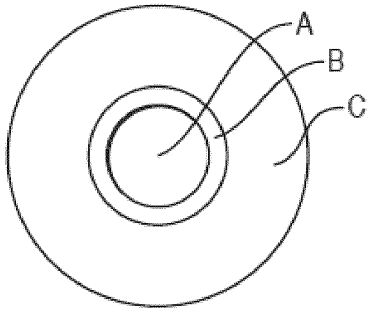

FIG. 3

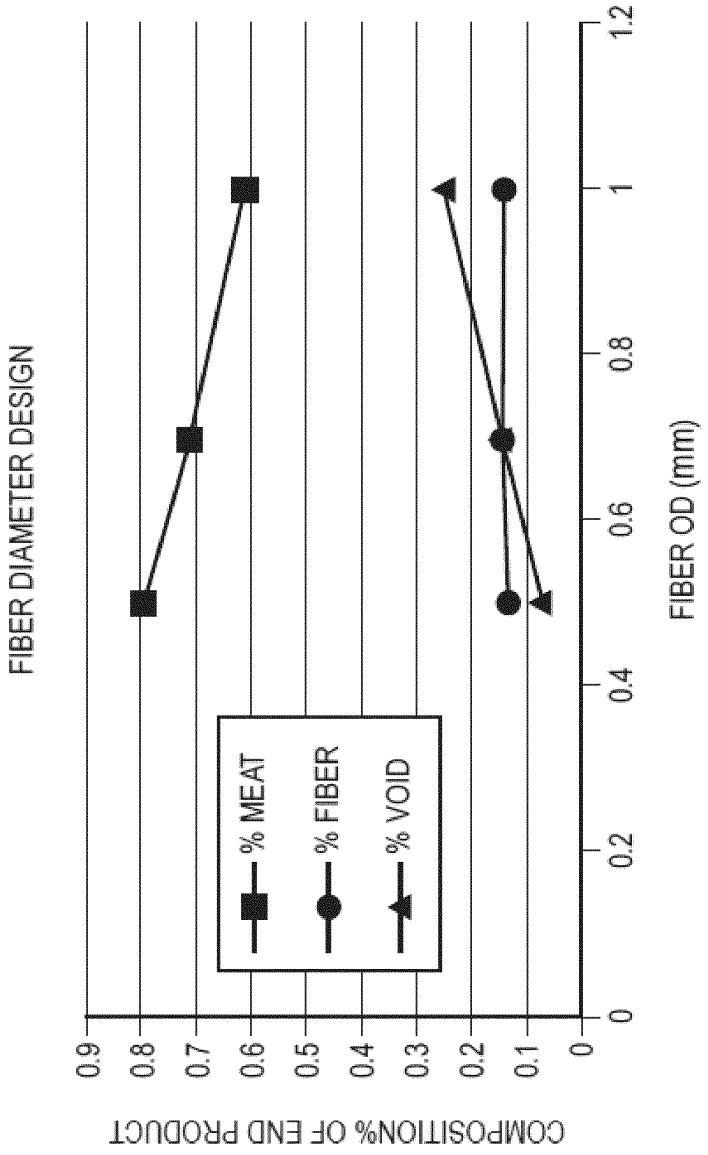
FIBER DIAMETER DESIGN
% MEAT
% FIBER
% VOID
FIBER OD (mm)
COMPOSITION% OF END PRODUCT
0
0.2
0.4
0.6
0.8
1
1.2
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

FIG. 4

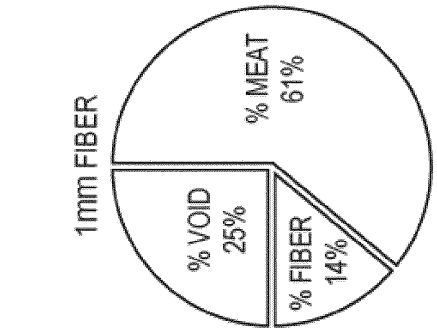

FIG. 5C

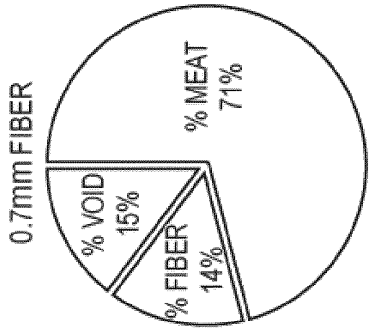

FIG. 5B

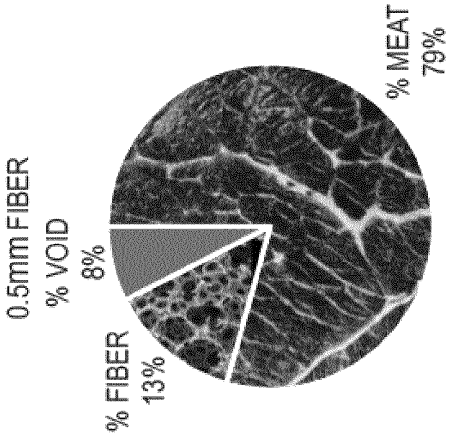

FIG. 5A

FIBER DIAMETER SCENERIO (mm)	MEAT DIAMETER (mm)	FINAL/MEAT AREA (mm2)	HF AREA (mm2)	VOID AREA (HF ID) (mm2)	TOTAL (mm2)
0.5	1.1	0.754	0.1253	0.0707	0.95
0.7	1.3	0.942	0.189	0.196	1.327
1	1.6	1.226	0.282	0.503	2.011

ASSUPTIONS:
FIBER WALL THICKNESS = 0.1mm
MEAT THICKNESS = um PER WALL

FIG. 6

FIBER OD (cm)	FIBER COUNT (0.5 OD)	HEIGHT (cm)	DIAMETER (cm)	END PRODUCT (kg)	% MEAT (kg)	SINGLE FIBER SURFACE AREA (cm2)
0.05	14569	40	15	7	5.53	6.28
0.05	9320	60	12	6.785	5.36015	9.42
0.05	6467	50	10	3.926	3.10154	7.85
0.1	12237	50	20	15.7	9.577	15.72

FIG. 7A

TOTAL SURFACE AREA (cm2)	TOTAL SURFACE AREA (cm2)	MEAT BIOMASS/AREA (kg/m2)	SCAFFOLD + MEAT + VOID END PRODUCT (kg/m2)	FINAL CELL COUNT
91550.50333	9.155050333	0.604038186	0.764605299	1.6037E+12
87830.981	8.7830981	0.610280102	0.772506458	1.55444E+12
50791.33298	5.079133298	0.610643552	0.772966522	8.99447E+11
192313.0209	19.23130209	0.497990201	0.816377379	2.77733E+12

FIG. 7B

2.9×10^{11} SYSTEM VOLUME (ml)	CELLS IN 1kg/MEAT FINAL CELL DENSITY (cells/cm3)	SURFACE AREA PER HFBR (m2/L)
7065	2.27E+08	1.307864333
6782.4	2.29E+08	1.294487561
3925	2.29E+08	1.293717091
15700	1.77E+08	1.2249237

FIG. 7C

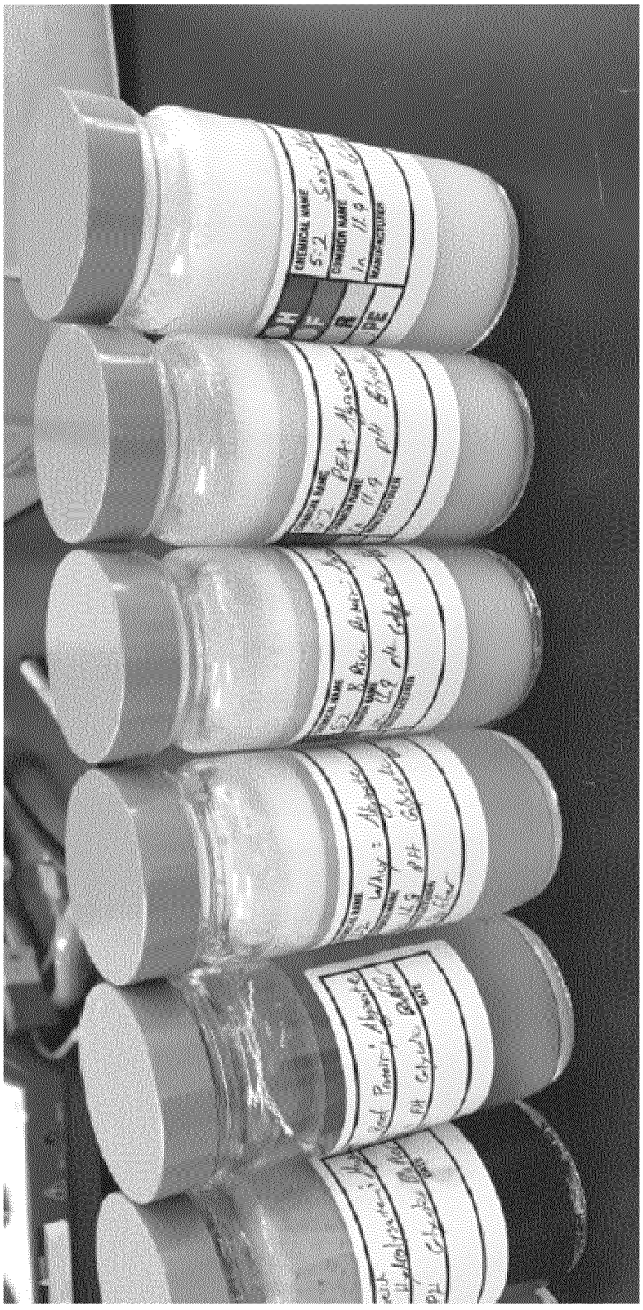

FIG. 8

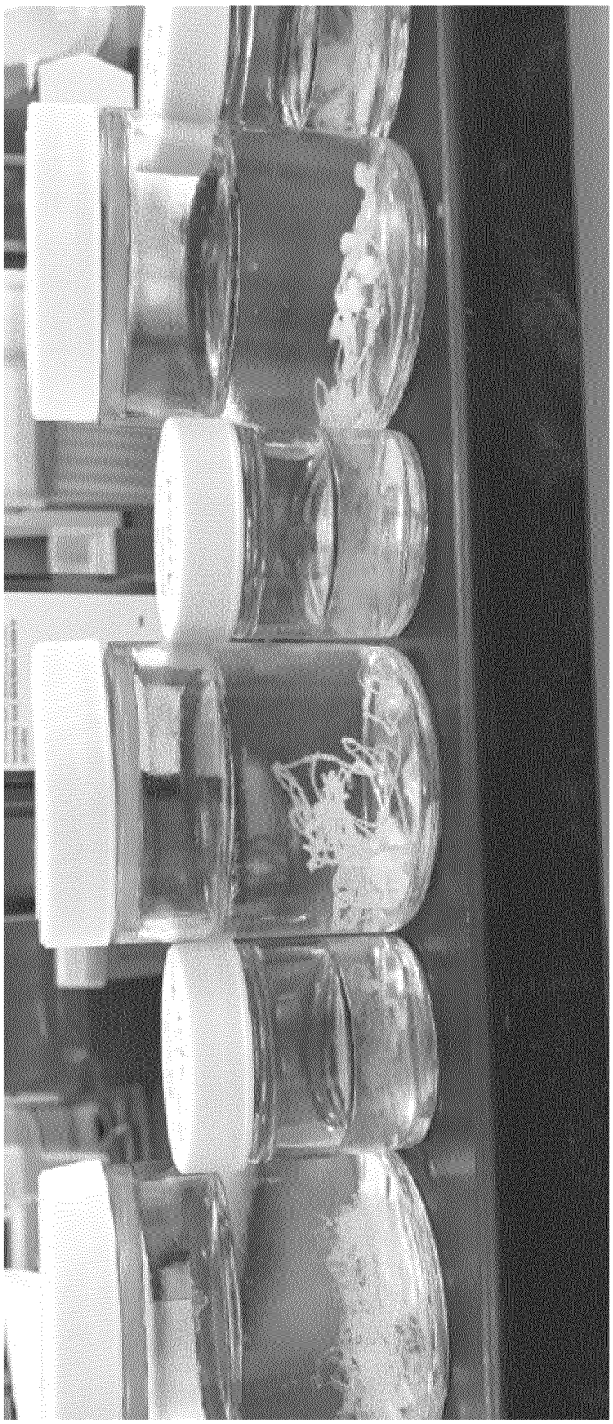

FIG. 9



FIG. 10A

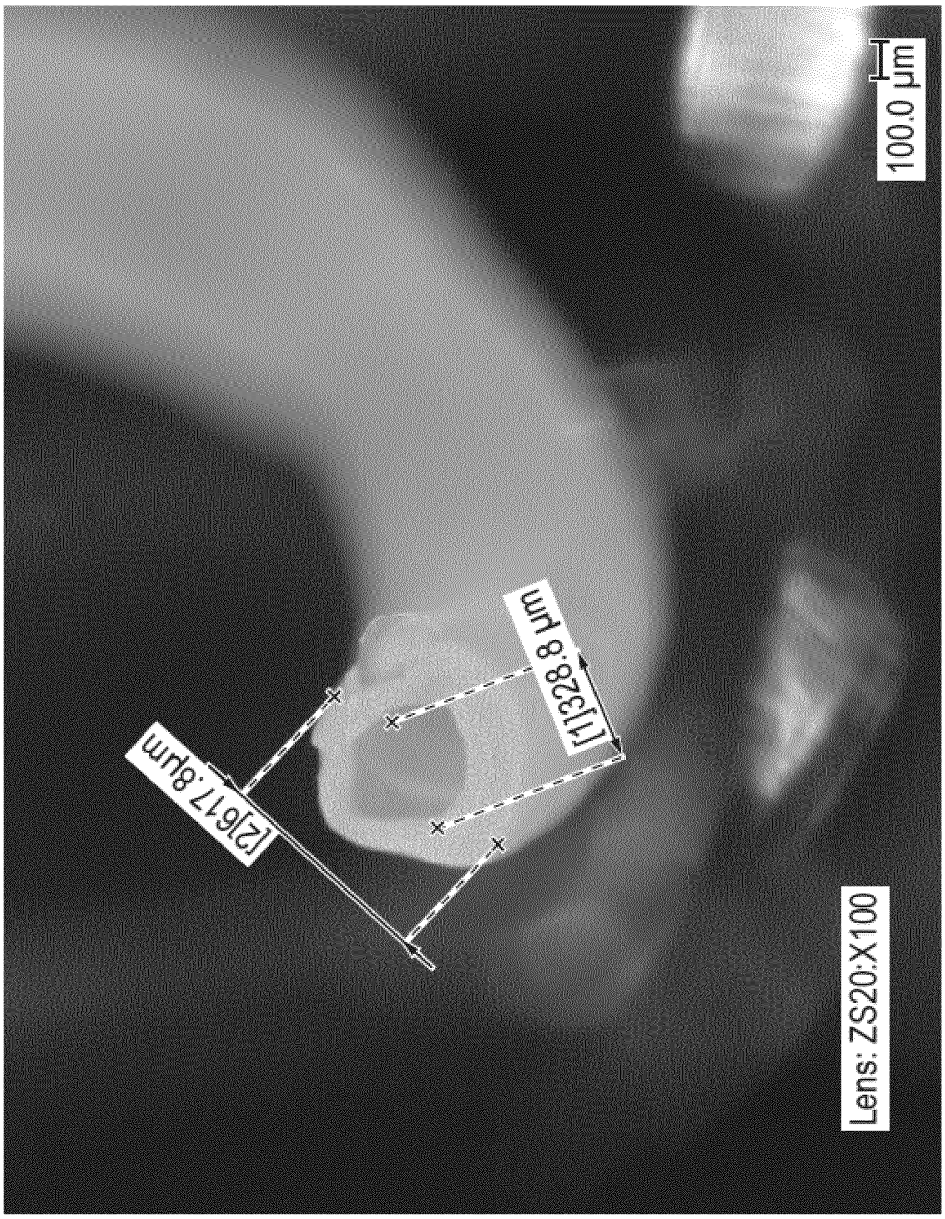

FIG. 10B

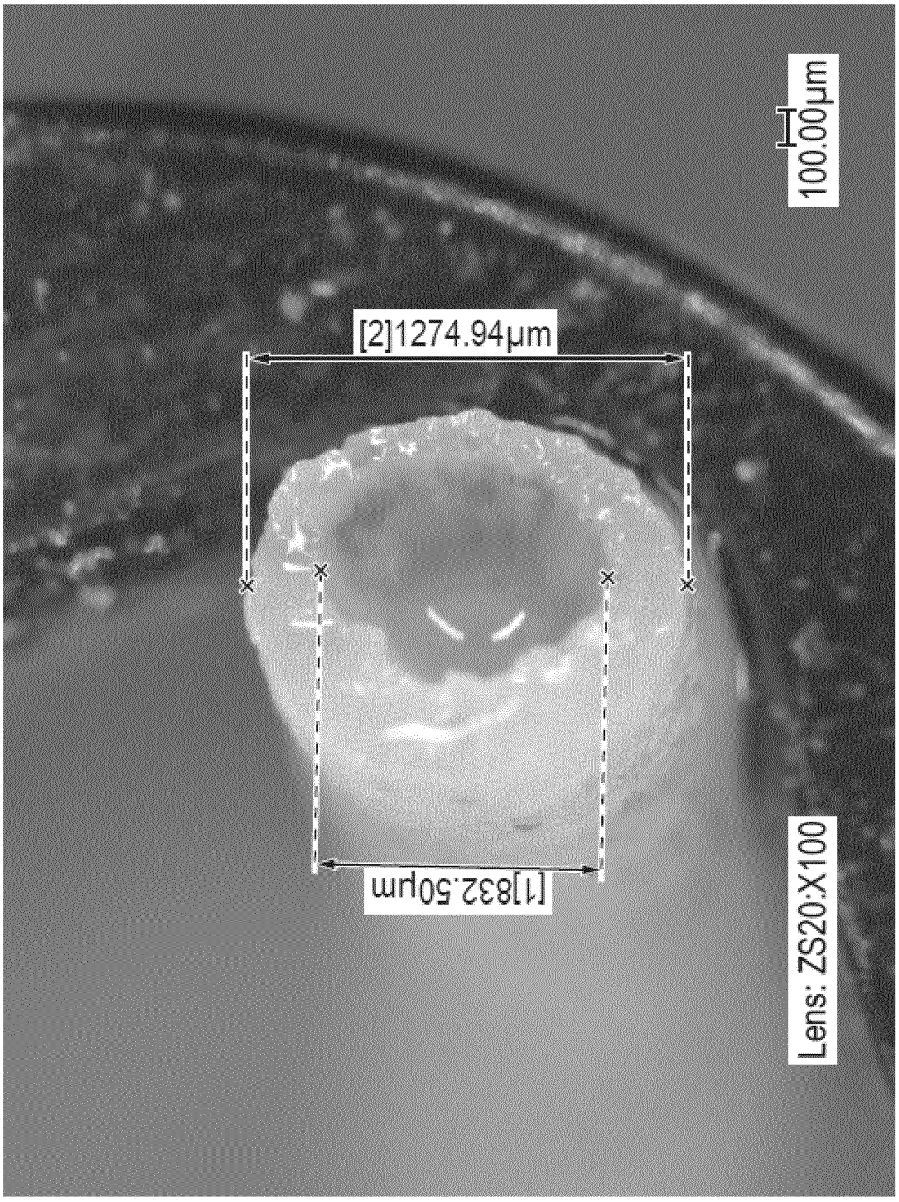

FIG. 10C

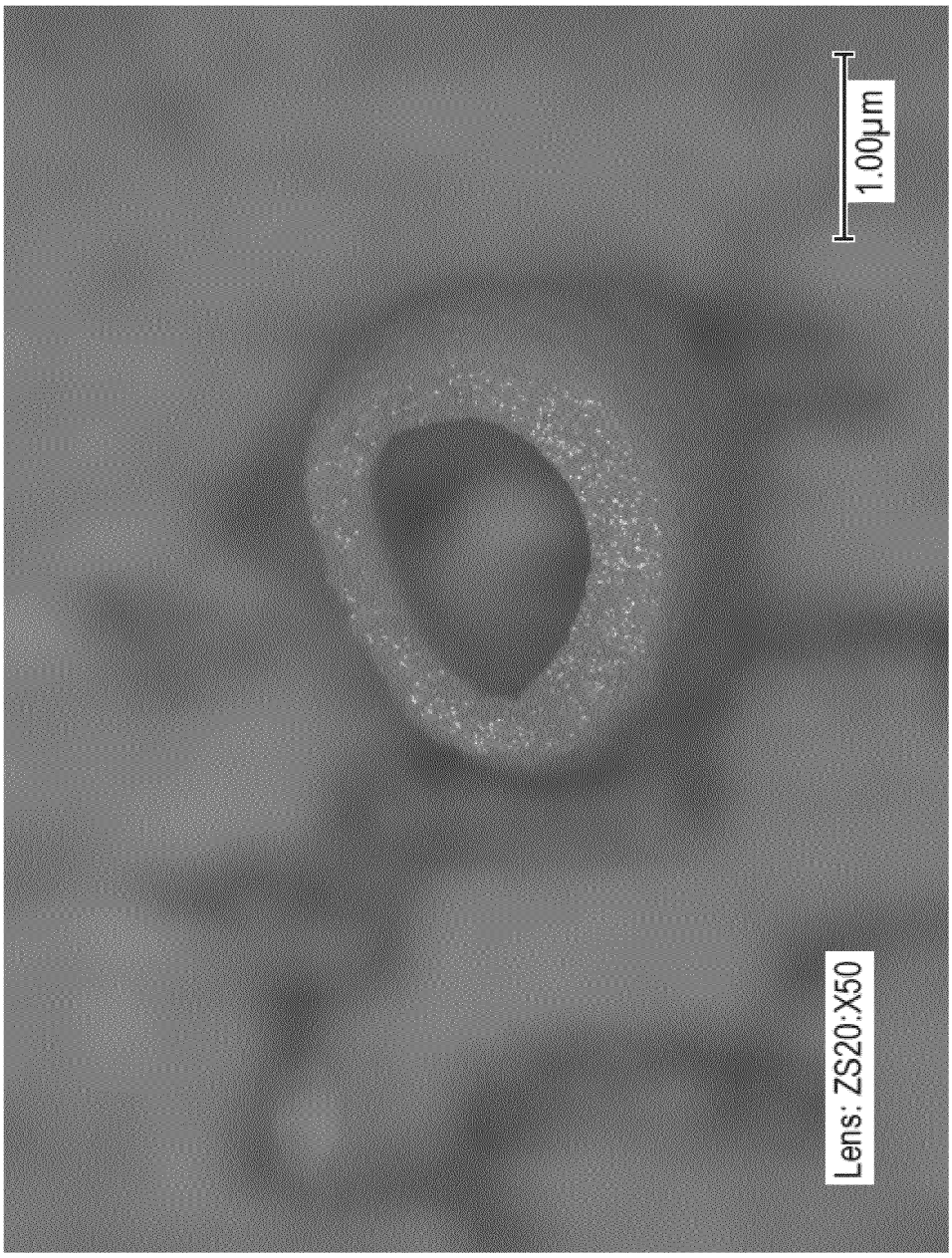

FIG. 10D

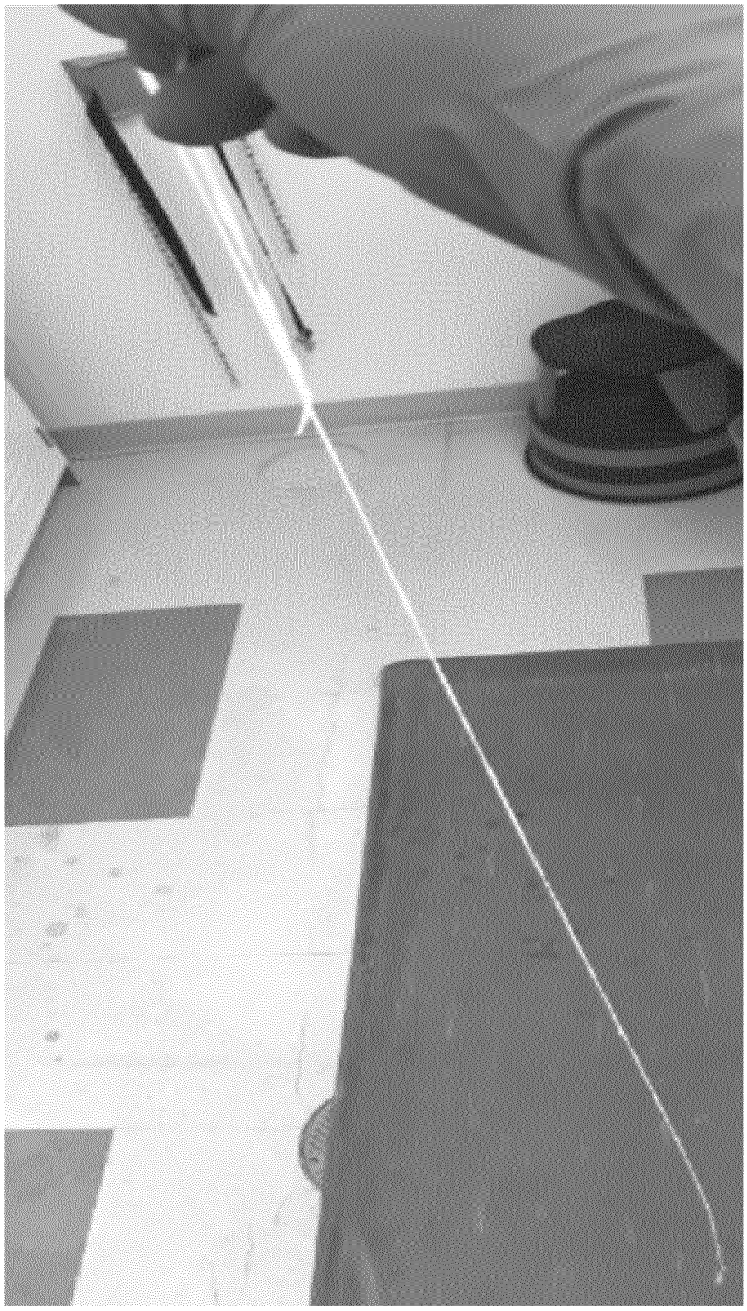

FIG. 11

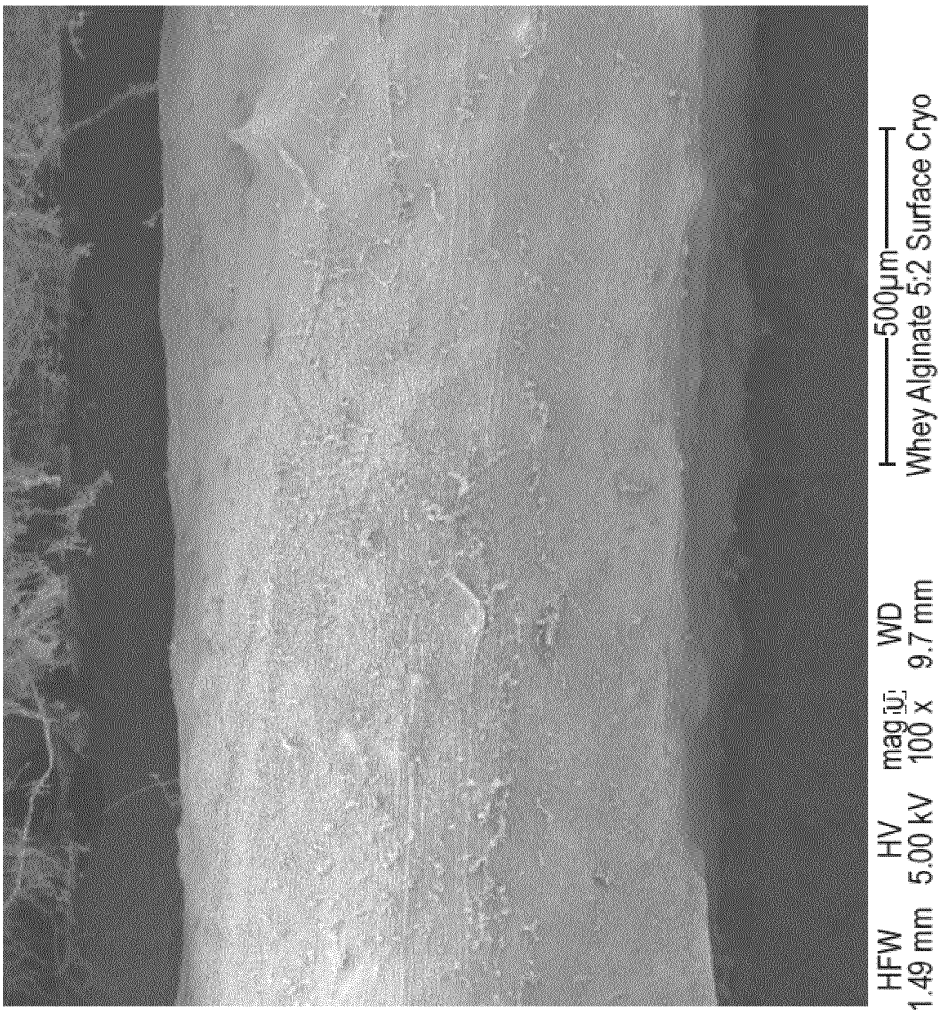
HFW
1.49 mm
HV
5.00 kV
mag
100 x
WD
9.7 mm
500µm
Whey Alginate 5:2 Surface Cryo

FIG. 12A

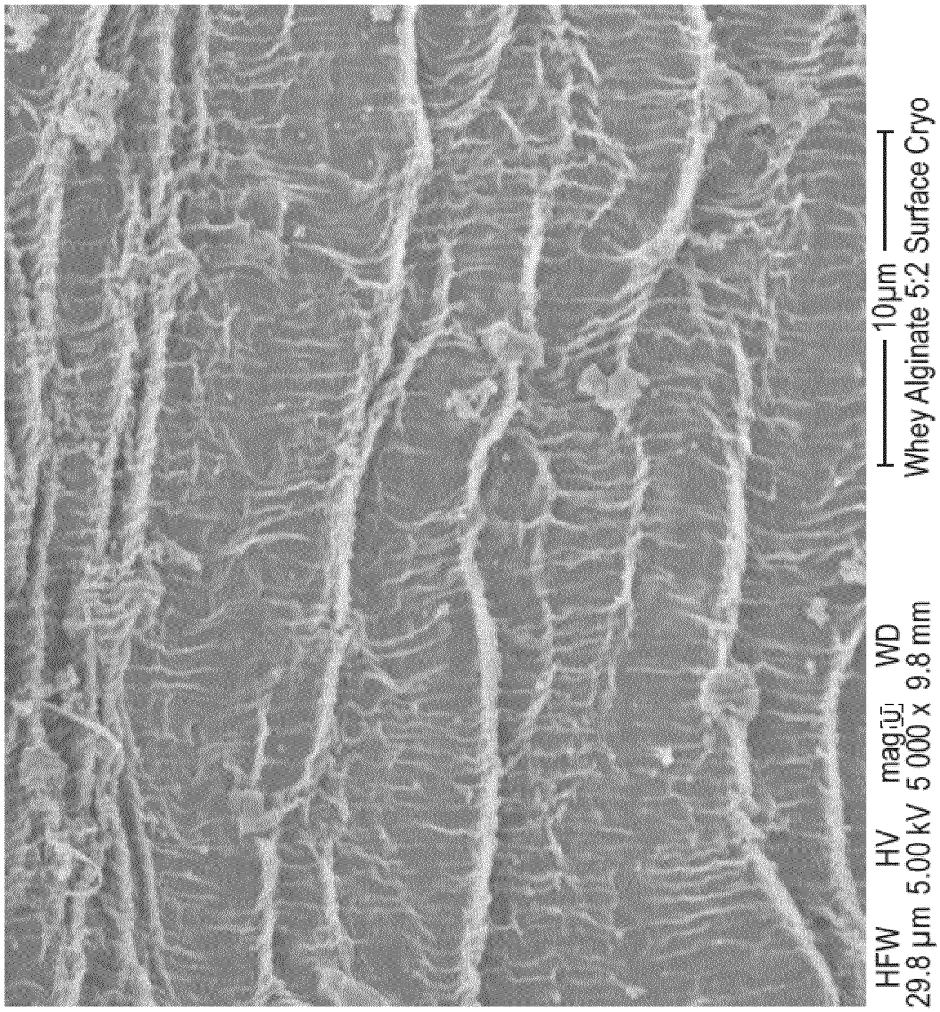
HFW HV mag WD
29.8 µm 5.00 kV 5 000 x 9.8 mm
10µm
Whey Alginate 5:2 Surface Cryo

FIG. 12B

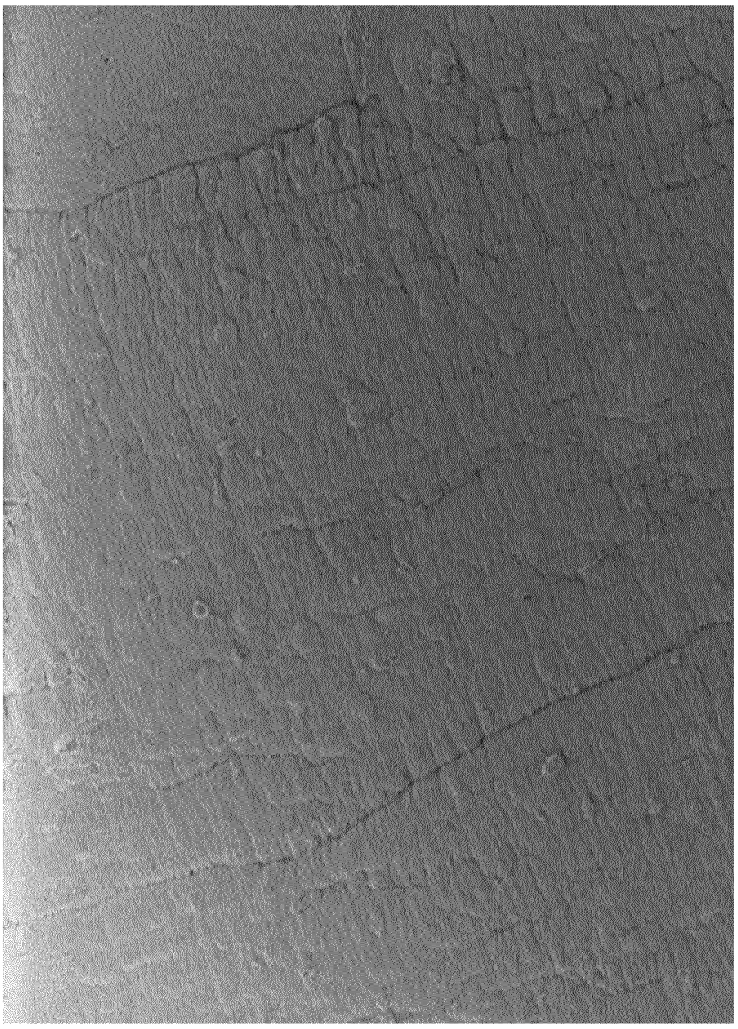
MPI-P
User Name = GLASSER
10µm
Stage at R = 90.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.0 mm
Stage at Z = 23.400 mm
Image Pixel Size = 117.2 nm
Signal A = InLens
Cycle Time = 15.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 8.68e-007 mbar
Gun Vacuum = 4.52e-010 mbar
Date :4 May 2021
Noise Reduction = Continuous Avg
File Name = 77642-01.tif
Time :15:05:39

FIG. 13A

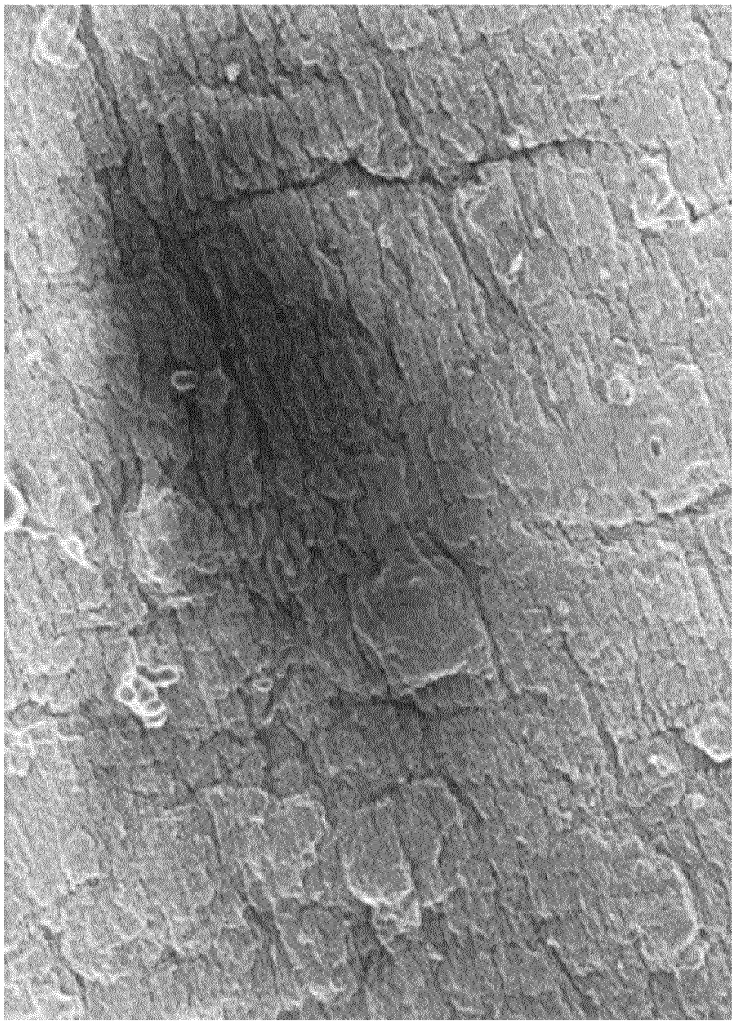
MPI-P
User Name = GLASSER
1µm
Stage at R = 90.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 1.8 mm
Stage at Z = 23.400 mm
Image Pixel Size = 29.30 nm
Signal A = InLens
Cycle Time = 15.7 Secs
Aperture Size = 30.00 µm
System Vacuum = 8.53e-007 mbar
Gun Vacuum = 4.54e-010 mbar
Date :4 May 2021
Noise Reduction = Continuous Avg
File Name = 77642-04.tif
Time :15:08:38

FIG. 13B

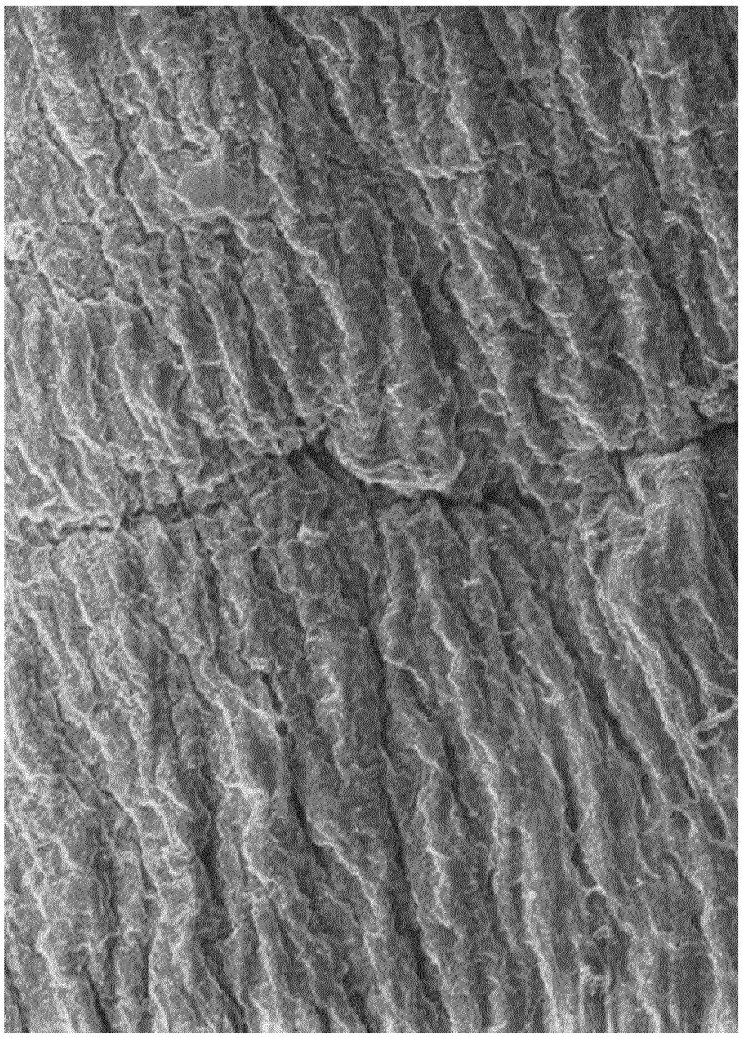
MPI-P
User Name = GLASSER
1µm
Stage at R = 90.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.0 mm
Stage at Z = 23.400 mm
Image Pixel Size = 5.859 nm
Signal A = InLens
Cycle Time = 45.3 Secs
Aperture Size = 10.00 µm
System Vacuum = 8.20e-007 mbar
Gun Vacuum = 4.80e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77642-10.tif
Time :15:16:18

FIG. 13C

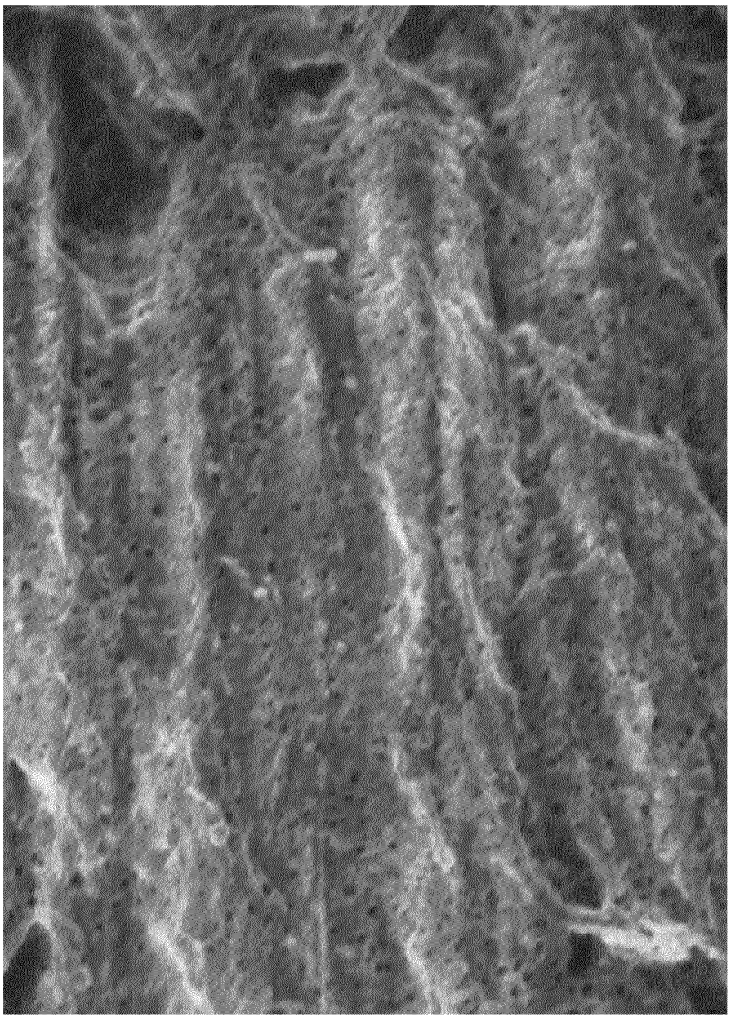
MPI-P
User Name = GLASSER
100µm
Stage at R = 90.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.0 mm
Stage at Z = 23.400 mm
Image Pixel Size = 1.465 nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 8.25e-007 mbar
Gun Vacuum = 4.77e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77642-09.tif
Time :15:15:13

FIG. 13D

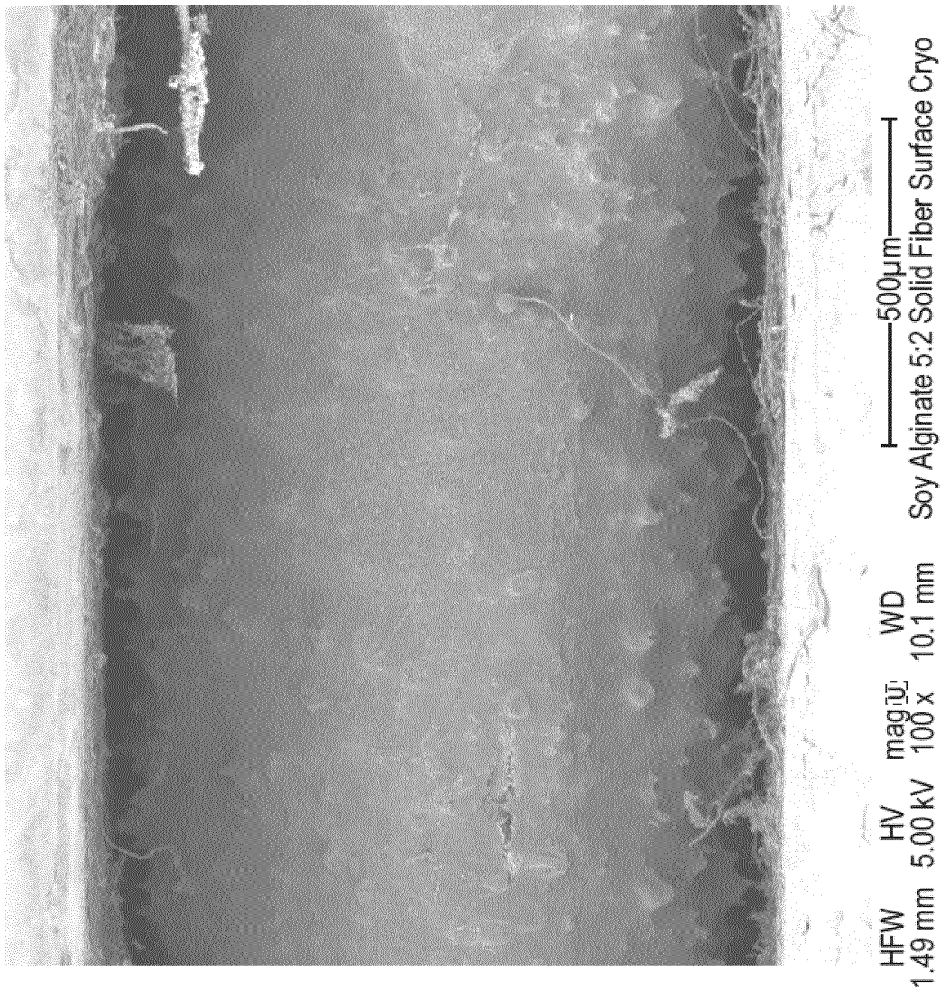
HFW
1.49 mm
HV
5.00 kV
mag
100 x
WD
10.1 mm
500µm
Soy Alginate 5:2 Solid Fiber Surface Cryo

FIG. 14A

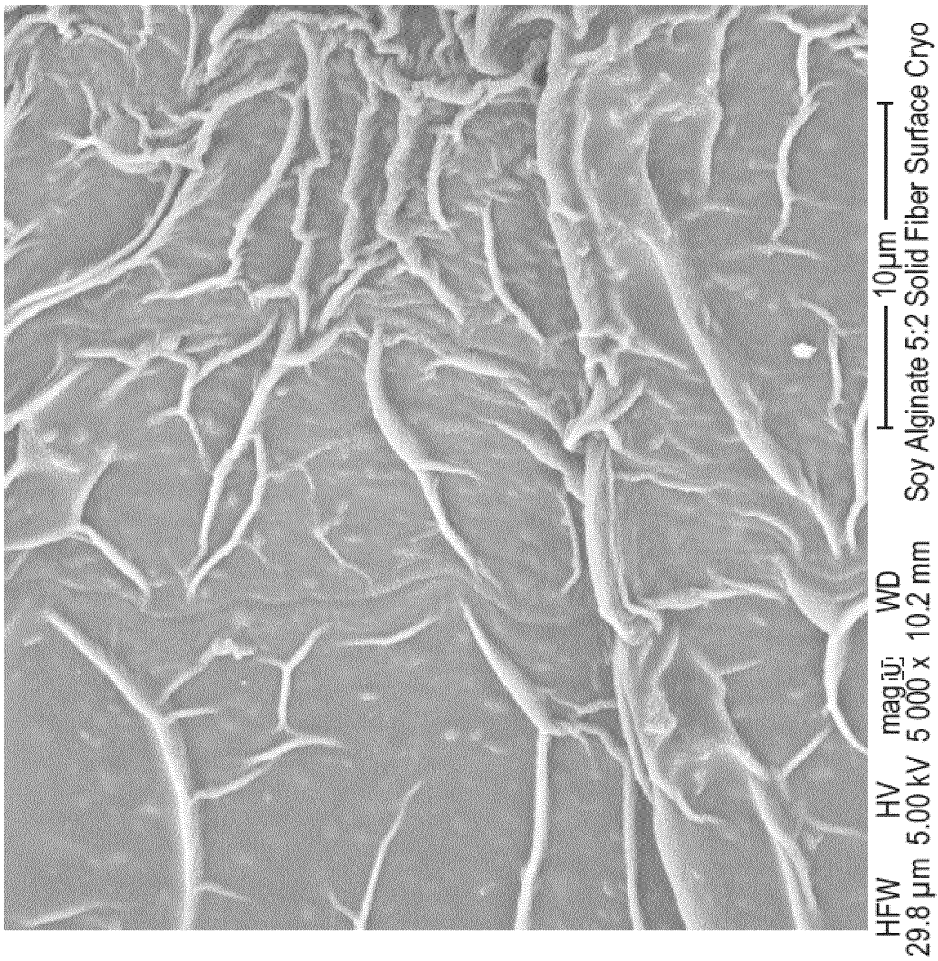
HFW HV mag WD
29.8 µm 5.00 kV 5 000 x 10.2 mm
10µm
Soy Alginate 5:2 Solid Fiber Surface Cryo

FIG. 14B


MPI-P
User Name = GLASSER
10µm
Stage at R = 135.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.1 mm
Stage at Z = 23.400 mm
Image Pixel Size = 39.06 nm
Signal A = InLens
Cycle Time = 49.1 Secs
Aperture Size = 10.00 µm
System Vacuum = 7.93e-007 mbar
Gun Vacuum = 4.78e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77643-02.tif
Time :15:23:18

FIG. 15A

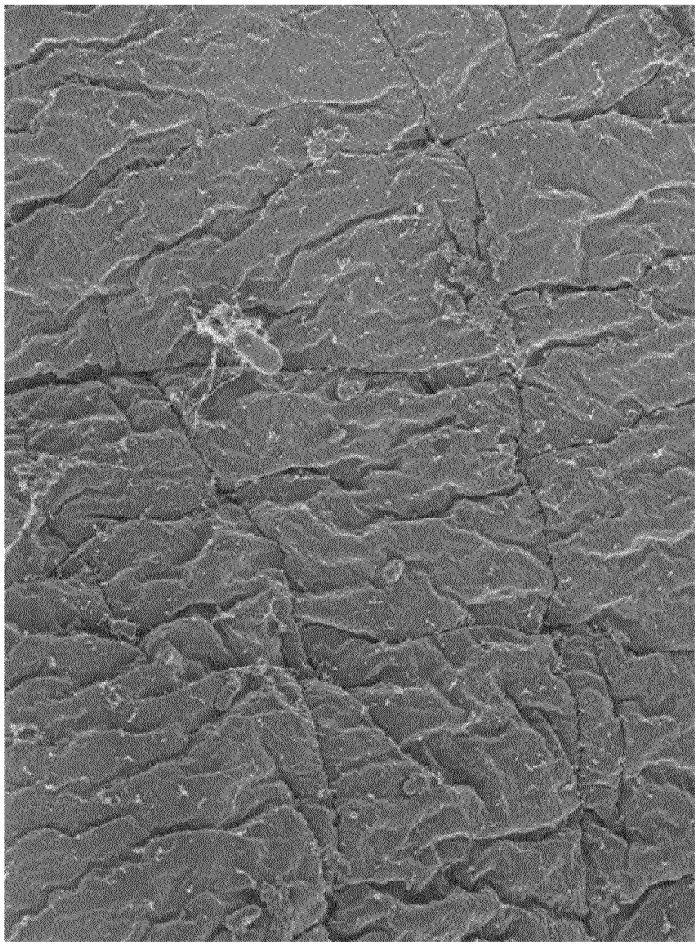
MPI-P
User Name = GLASSER
1µm
Stage at R = 135.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.1 mm
Stage at Z = 23.400 mm
Image Pixel Size = 9.766 nm
Signal A = InLens
Cycle Time = 49.1 Secs
Aperture Size = 10.00 µm
System Vacuum = 7.84e-007 mbar
Gun Vacuum = 4.77e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77643-04.tif
Time :15:24:33

FIG. 15B

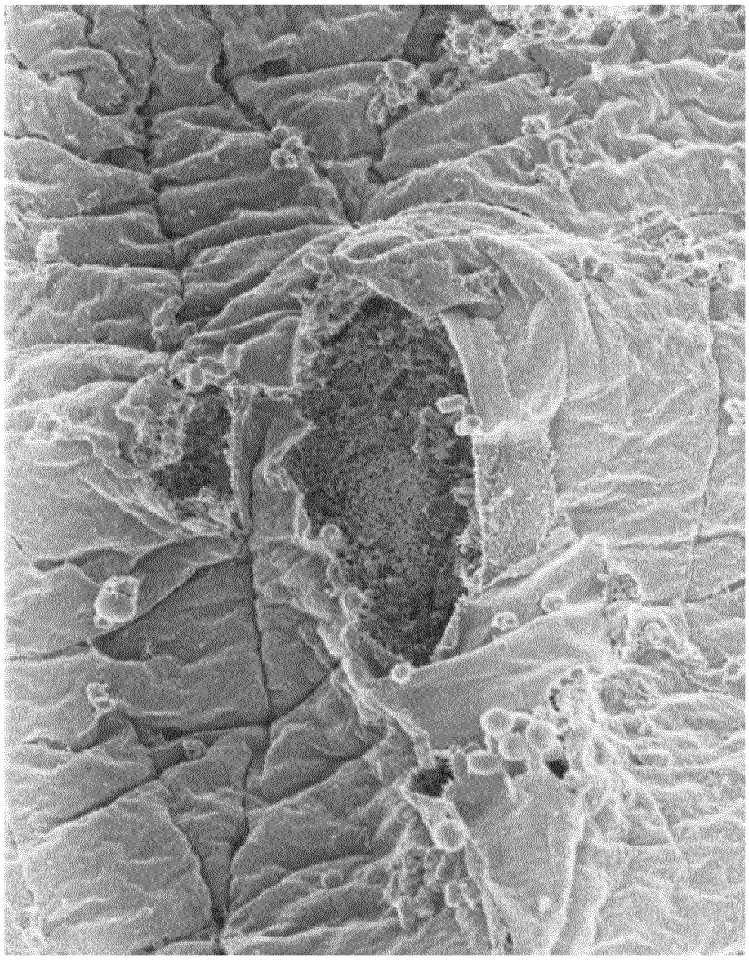
MPI-P
User Name = GLASSER
1µm
Stage at R = 135.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.2 mm
Stage at Z = 23.400 mm
Image Pixel Size = 29.30 nm
Signal A = InLens
Cycle Time = 15.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 7.17e-007 mbar
Gun Vacuum = 4.77e-010 mbar
Date :4 May 2021
Noise Reduction = Continuous Avg
File Name = 77643-14.tif
Time :15:45:14

FIG. 16A

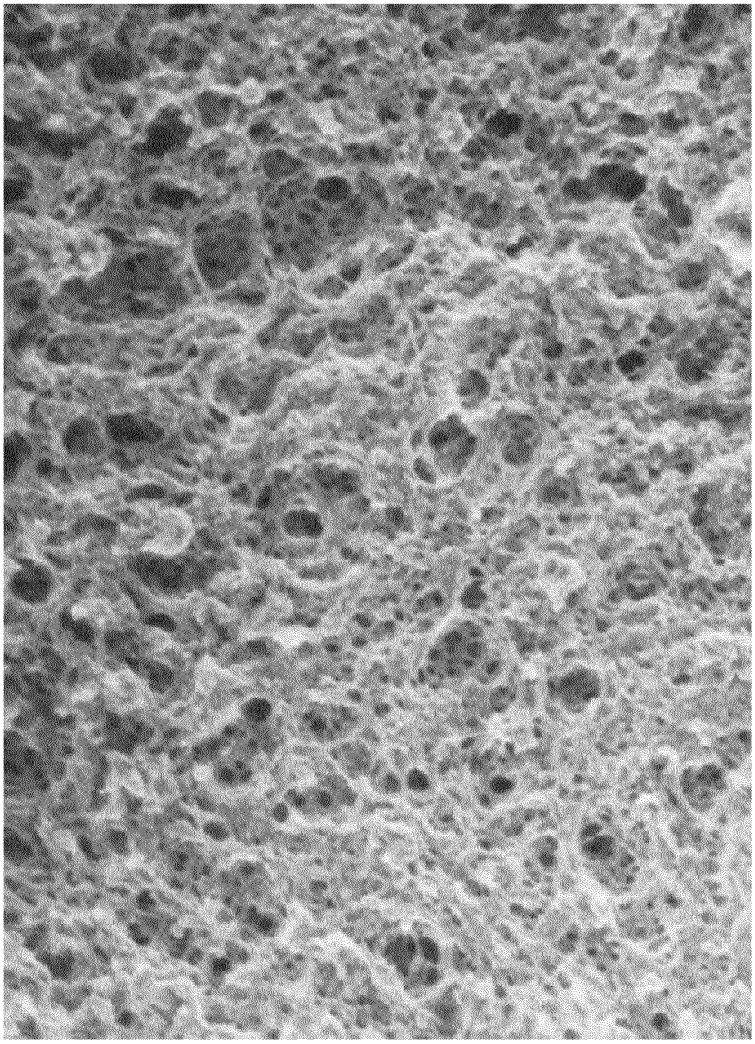
MPI-P
User Name = GLASSER
200µm
Stage at R = 135.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.2 mm
Stage at Z = 23.400 mm
Image Pixel Size = 1.465 nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 7.21e-007 mbar
Gun Vacuum = 4.72e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77643-13.tif
Time :15:44:49

FIG. 16B

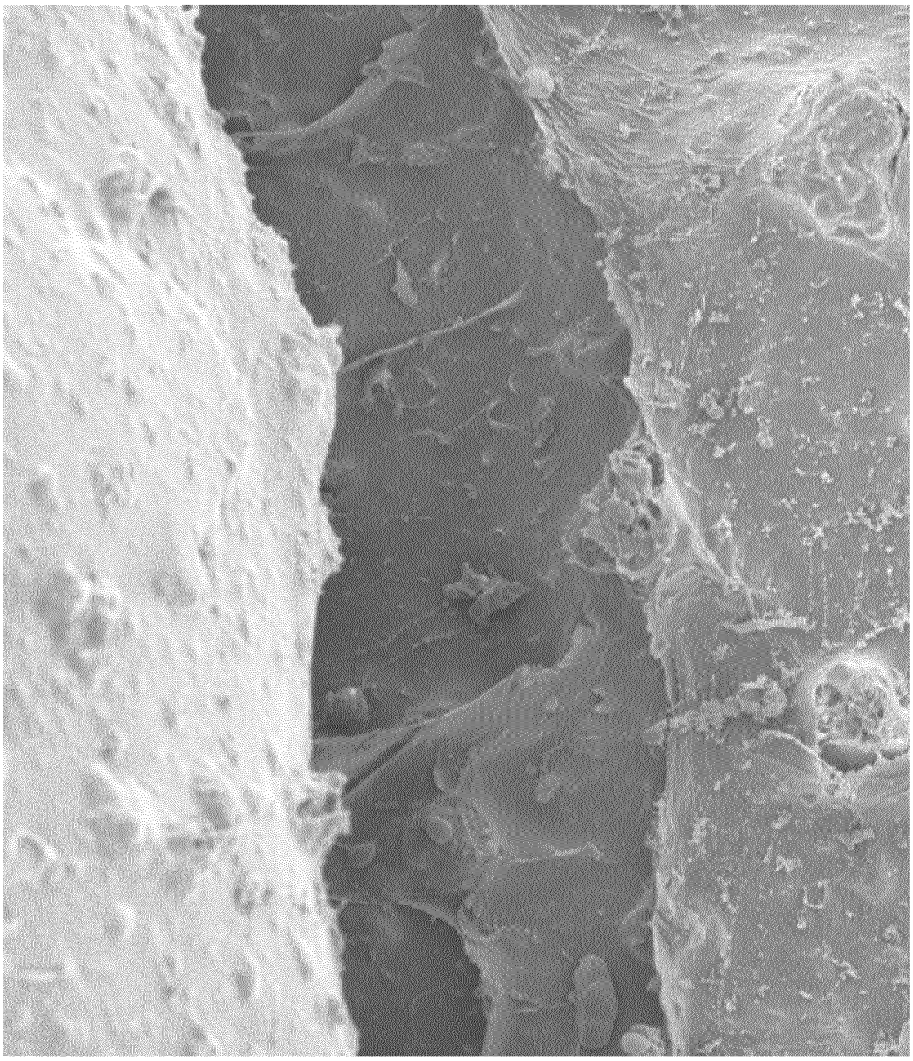
HFW
149 µm
HV
5.00 kV
mag
1 000 x
WD
6.9 mm
50µm
Pumpkin Alginate 5:2 SFSurface Cryo

FIG. 17A

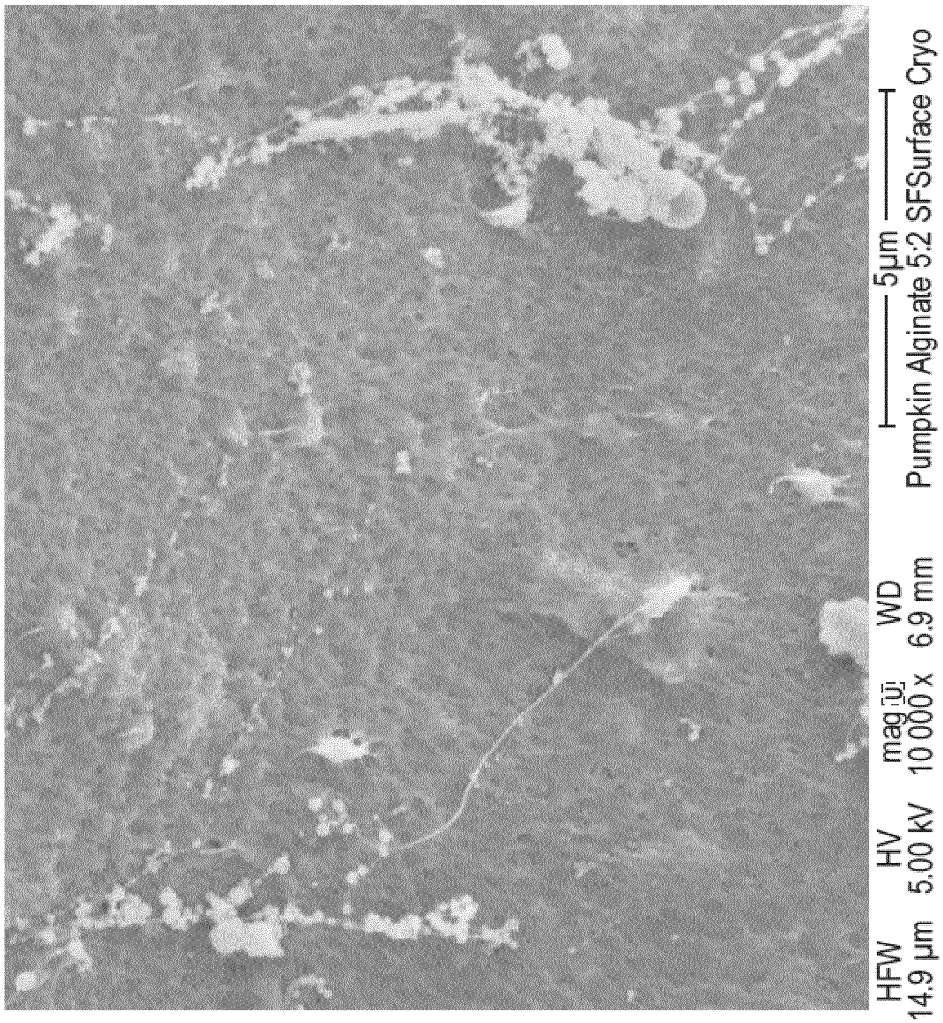
HFW
14.9 µm
HV
5.00 kV
mag
10 000 x
WD
6.9 mm
5µm
Pumpkin Alginate 5:2 SFSurface Cryo

FIG. 17B

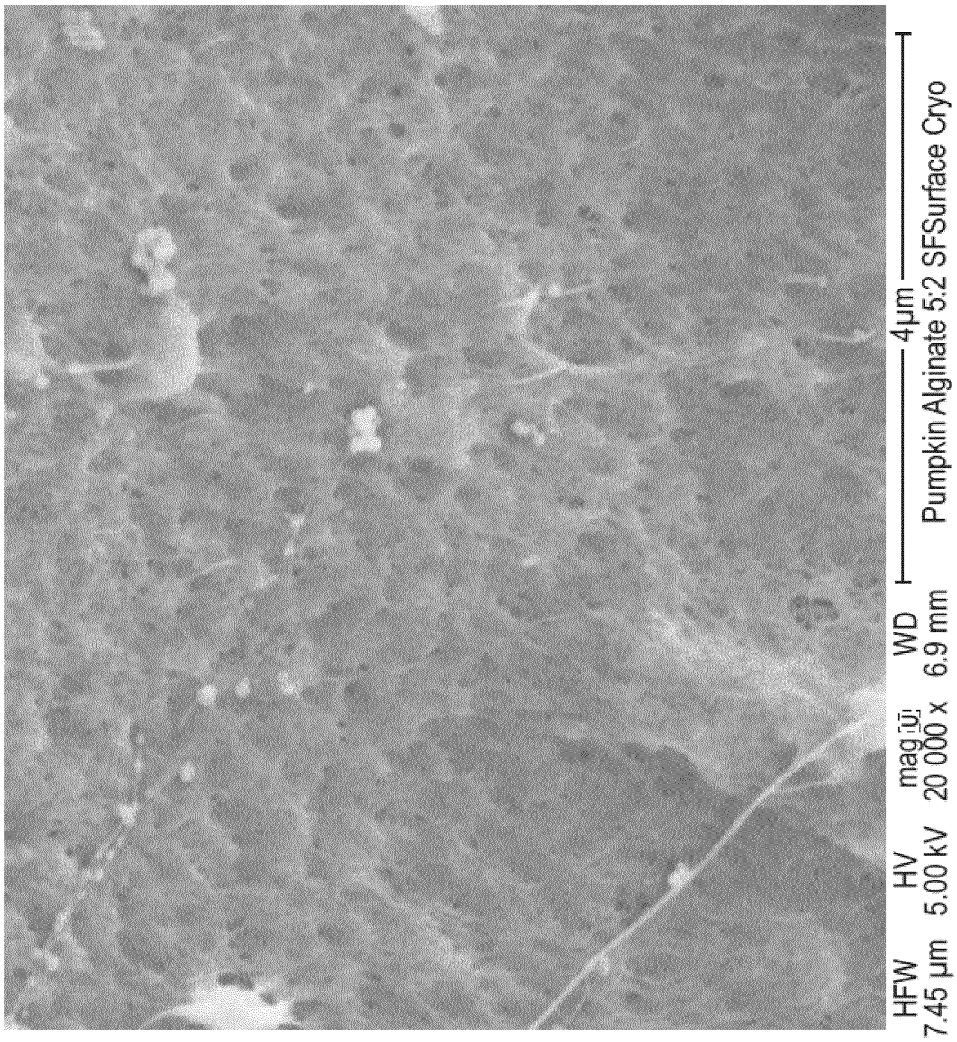
HFW
7.45 µm
HV
5.00 kV
mag
20 000 x
WD
6.9 mm
4µm
Pumpkin Alginate 5:2 SFSurface Cryo

FIG. 18A

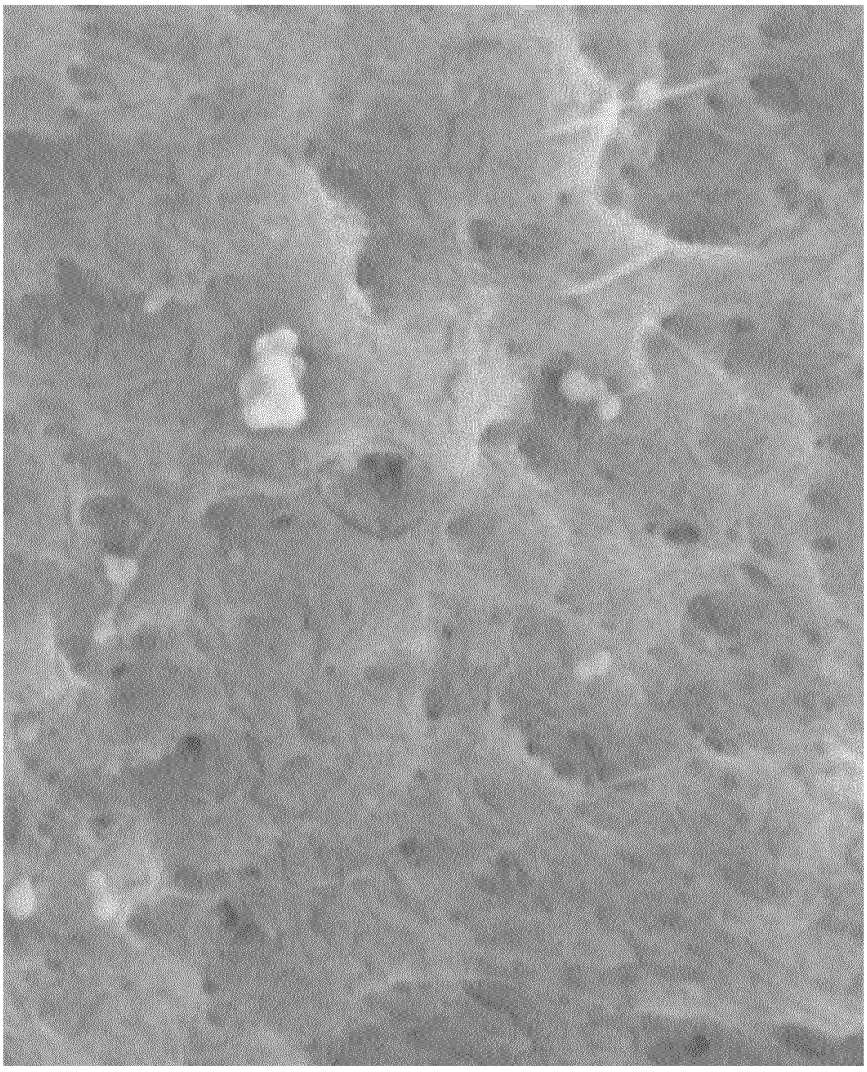
HFW
3.72 µm
HV
5.00 kV
mag
40 000 x
WD
6.9 mm
2µm
Pumpkin Alginate 5:2 SFSurface Cryo

FIG. 18B


MPI-P
User Name = GLASSER
10µm
Stage at R = 0.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.800 kV
WD = 1.8 mm
Stage at Z = 23.000 mm
Image Pixel Size = 117.2 nm
Signal A = InLens
Cycle Time = 15.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 1.12e-006 mbar
Gun Vacuum = 4.84e-010 mbar
Date :4 May 2021
Noise Reduction = Continuous Avg
File Name = 77640-11.tif
Time :14:36:35

FIG. 19A


MPI-P
User Name = GLASSER
1µm
Stage at R = 0.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.700 kV
WD = 1.9 mm
Stage at Z = 23.000 mm
Image Pixel Size = 5.859 nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 1.34e-006 mbar
Gun Vacuum = 5.71e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77640-06.tif
Time :14:24:45

FIG. 19B

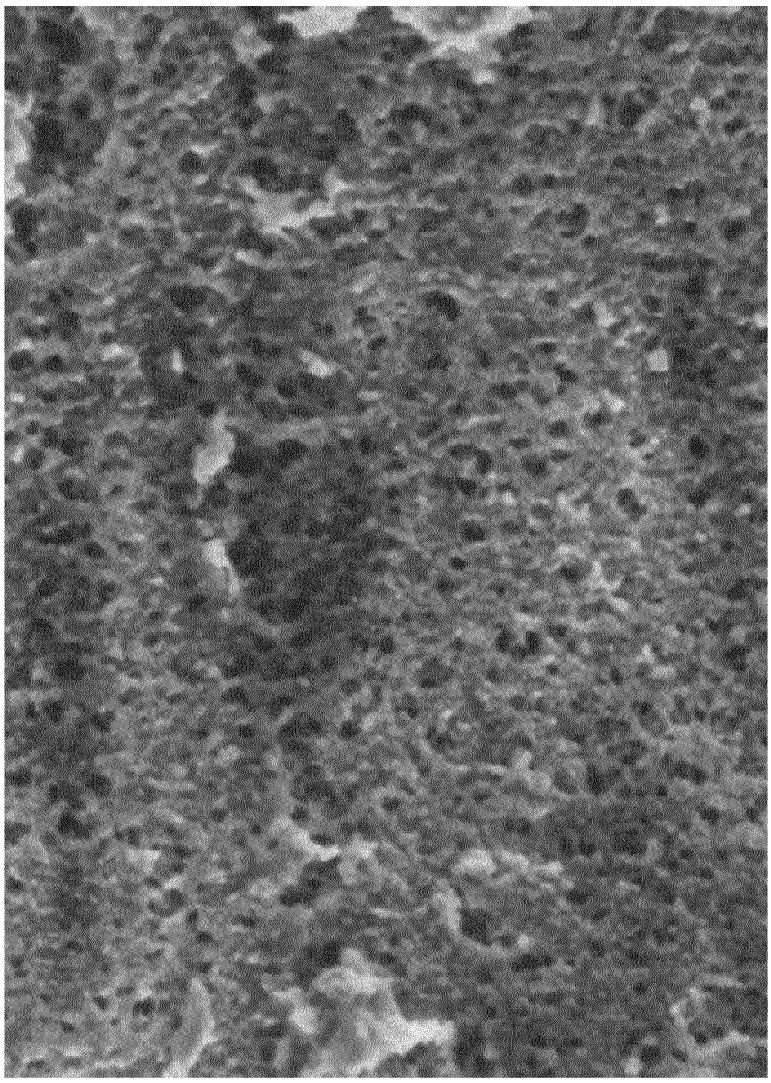
MPI-P
User Name = GLASSER
100 nm
Stage at R = 0.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.800 kV
WD = 1.8 mm
Stage at Z = 23.000 mm
Image Pixel Size = 1.465 nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 1.15e-006 mbar
Gun Vacuum = 4.92e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77640-09.tif
Time :14:34:13

FIG. 19C

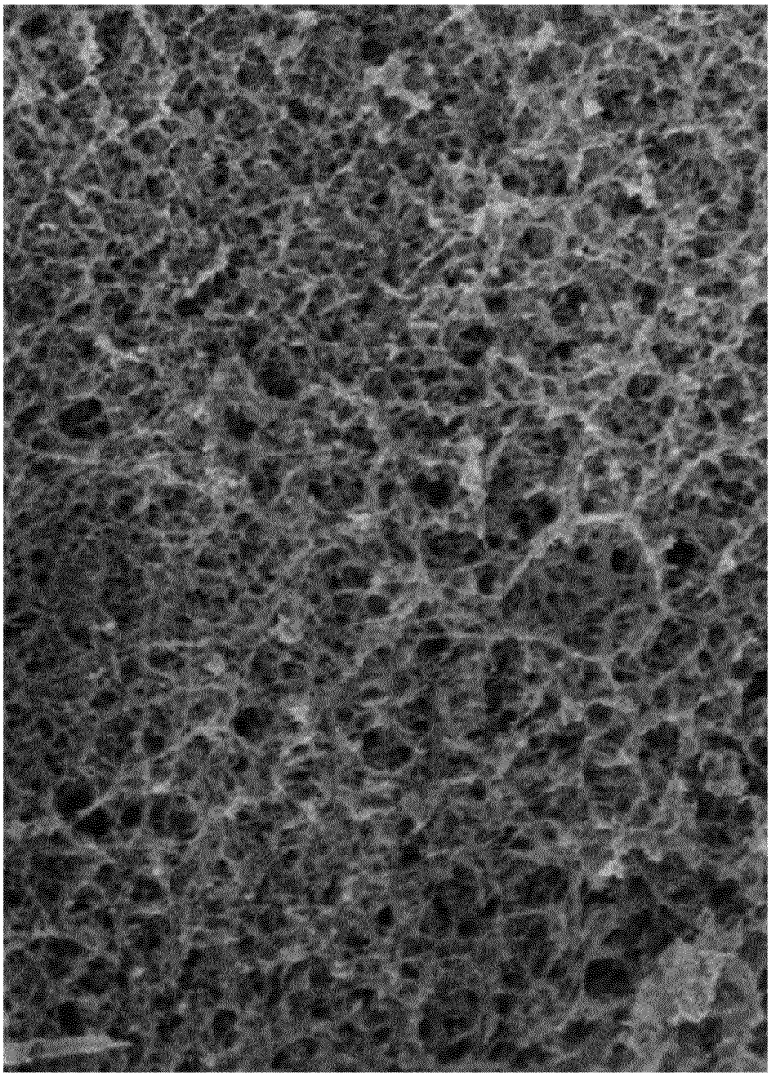
MPI-P
User Name = GLASSER
1 µm
Stage at R = 0.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.700 kV
WD = 1.9 mm
Stage at Z = 23.000 mm
Image Pixel Size = 2.930 nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 1.38e-006 mbar
Gun Vacuum = 5.84e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77640-04.tif
Time :14:23:03

FIG. 19D

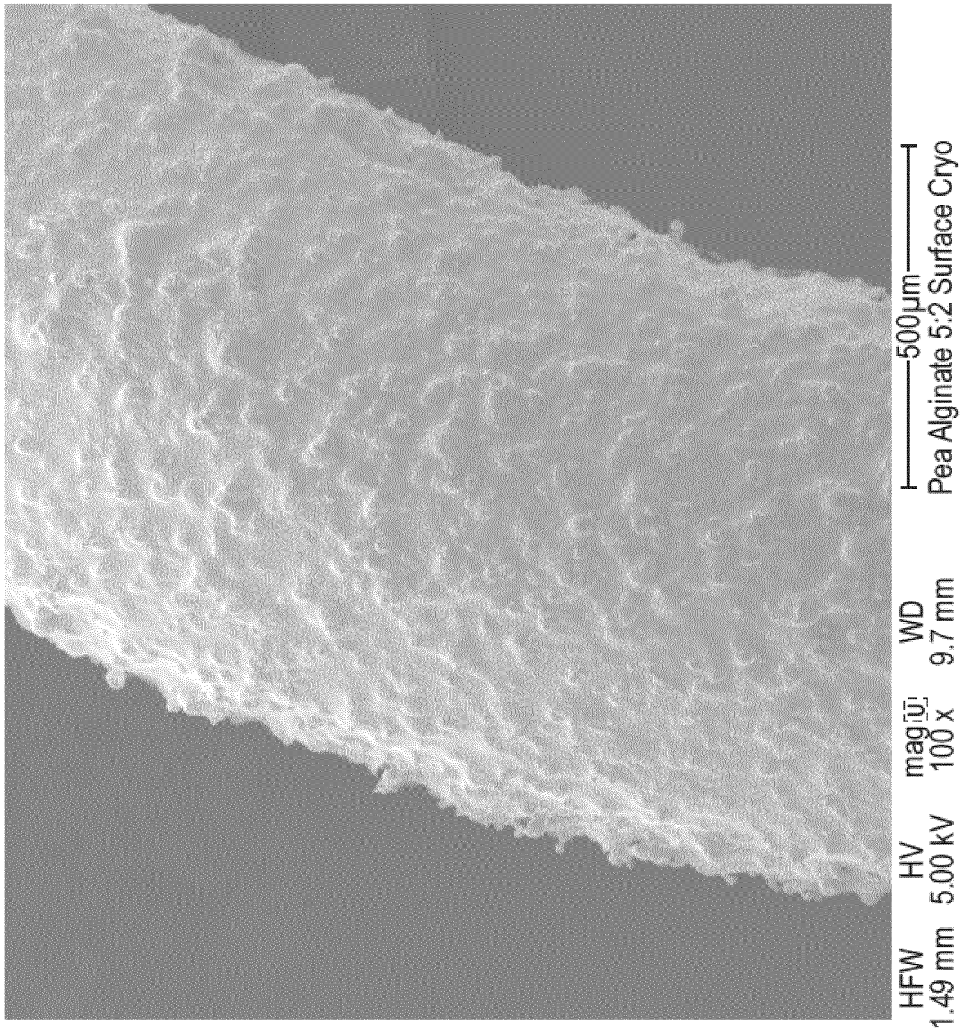
HFW
1.49 mm
HV
5.00 kV
mag
100 x
WD
9.7 mm
500µm
Pea Alginate 5:2 Surface Cryo

FIG. 20A

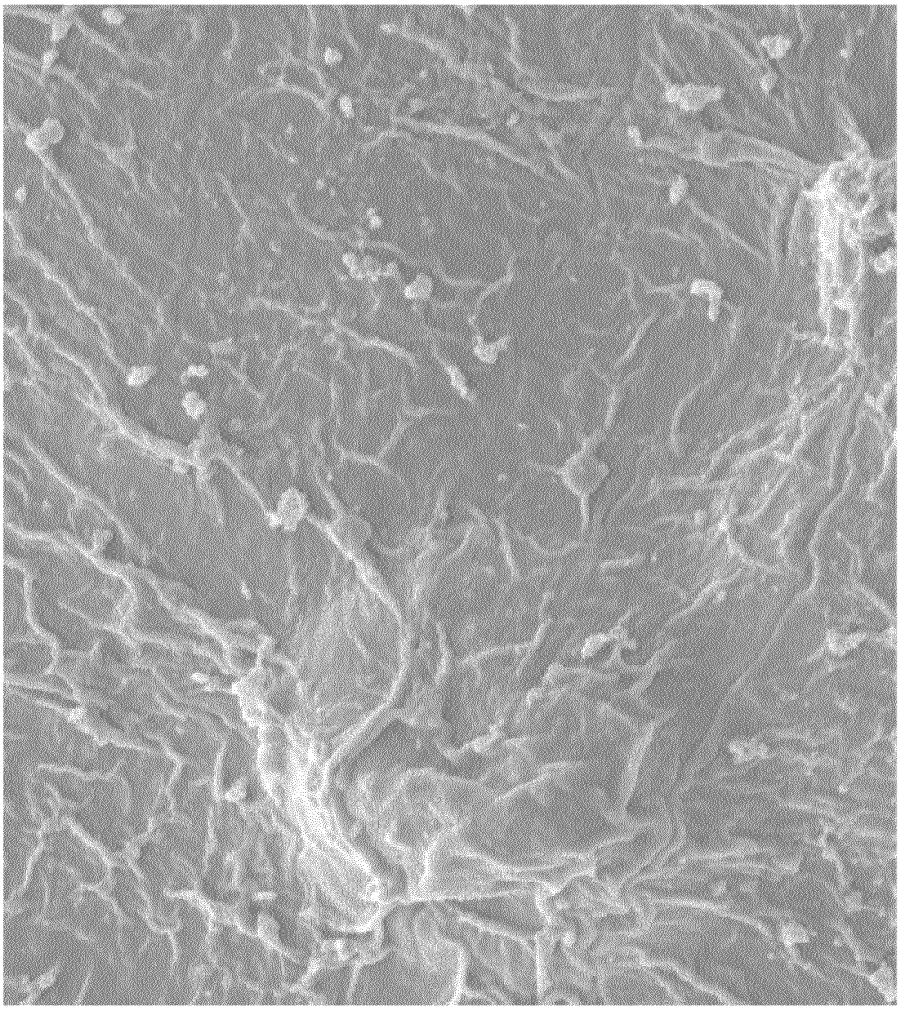
HFW
29.8 µm
HV
5.00 kV
magnification
5 000 x
WD
9.7 mm
10µm
Pea Alginate 5:2 Surface Cryo

FIG. 20B

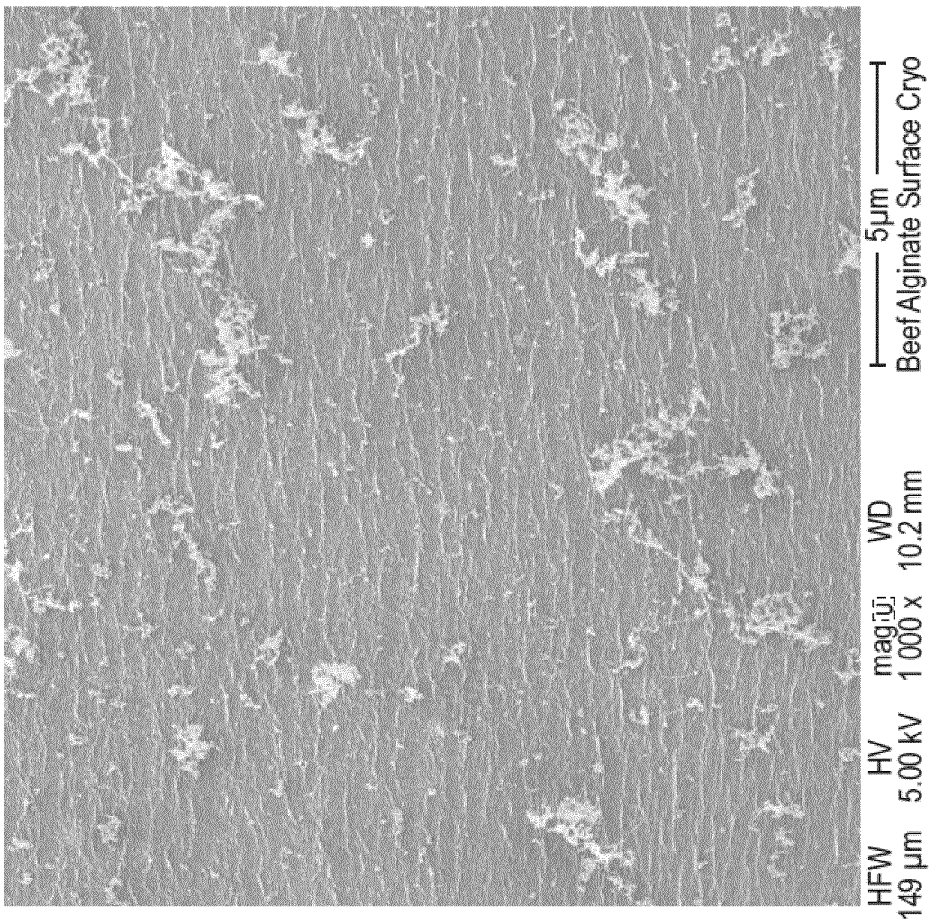
HFW
149 µm
HV
5.00 kV
magn
1 000 x
WD
10.2 mm
5µm
Beef Alginate Surface Cryo

FIG. 21A

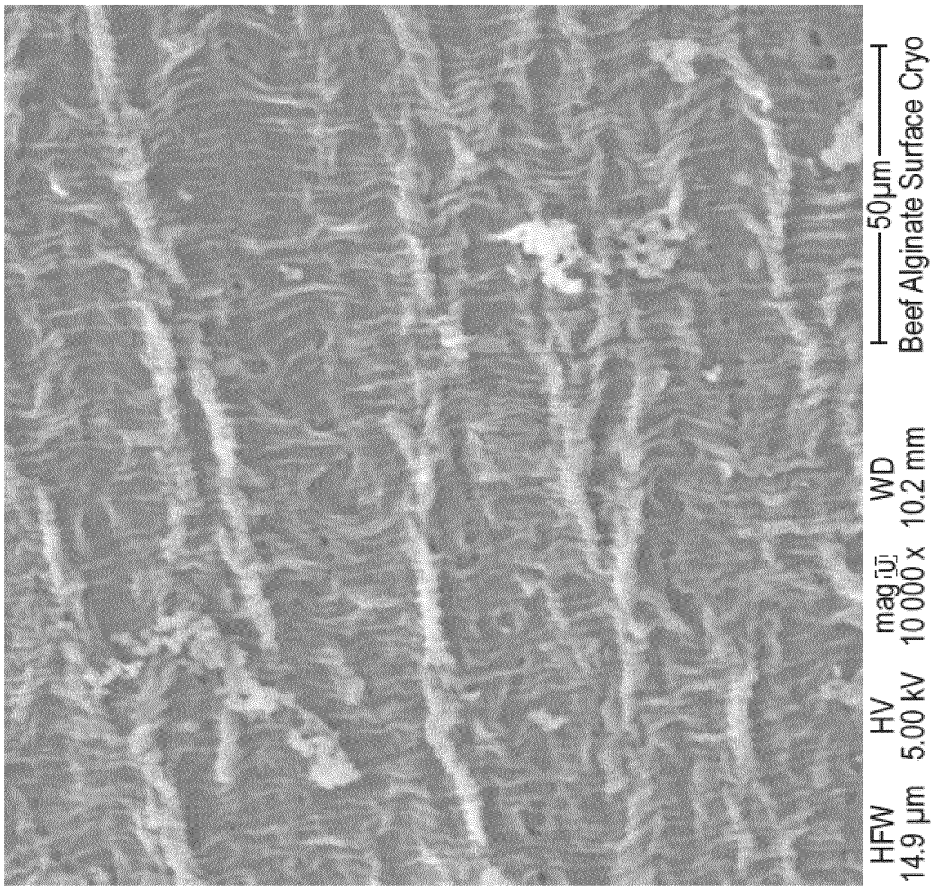
HFW
14.9 µm
HV
5.00 kV
mag
10 000 x
WD
10.2 mm
50µm
Beef Alginate Surface Cryo

FIG. 21B

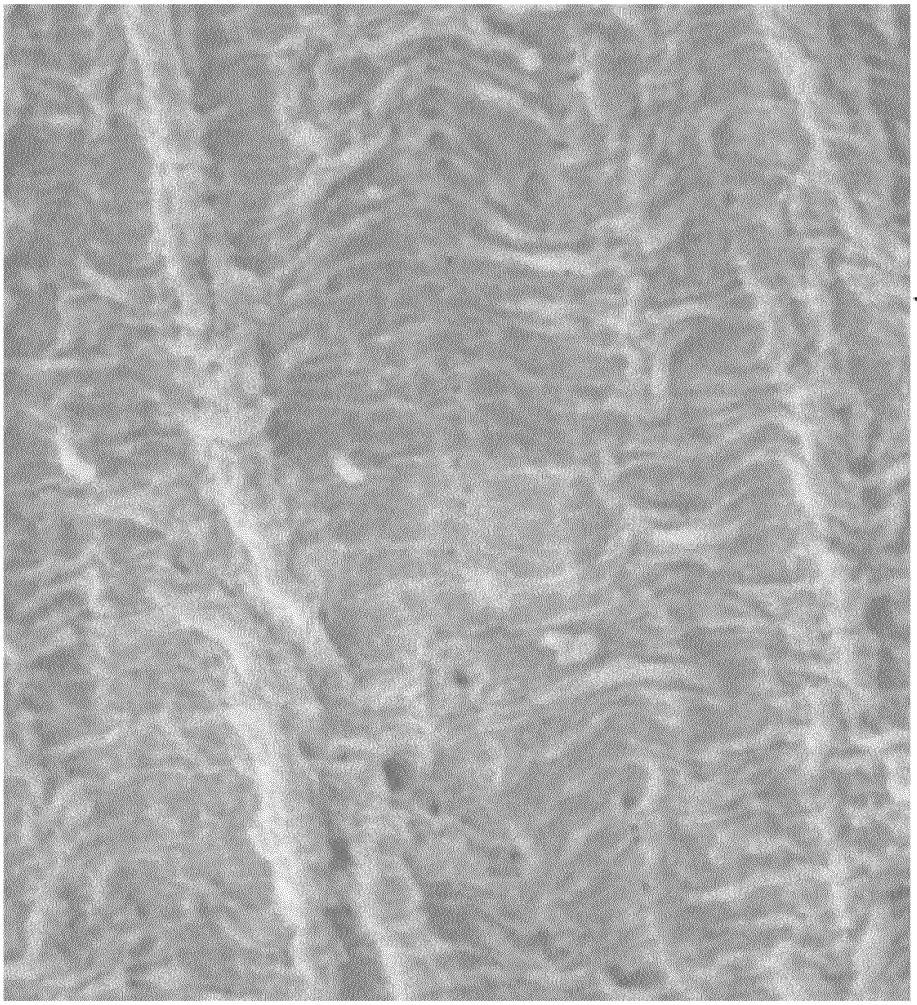
HFW
7.45 µm
HV
3.00 kV
mag
20 000 x
WD
10.2 mm
4µm
Beef Alginate Surface Cryo

FIG. 22A

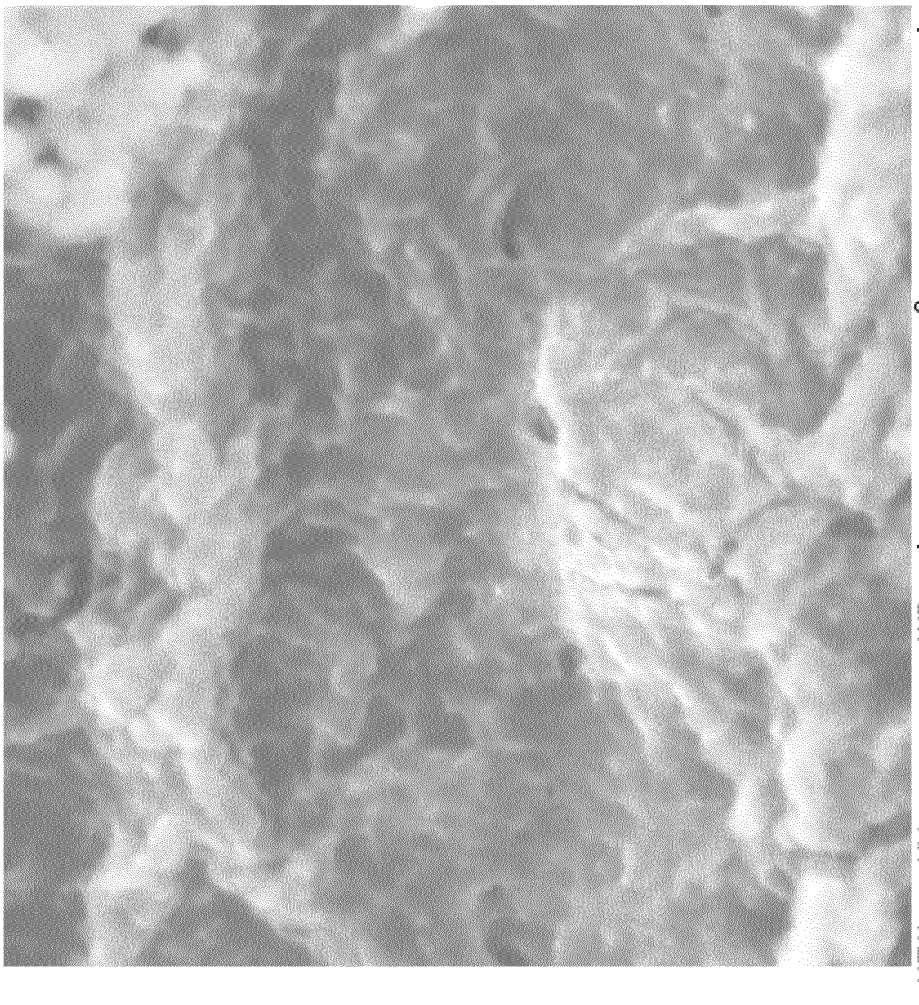
HFW
3.72 µm
HV
5.00 kV
mag
40 000 x
WD
7.6 mm
2µm
Beef Alginate Surface Cryo

FIG. 22B

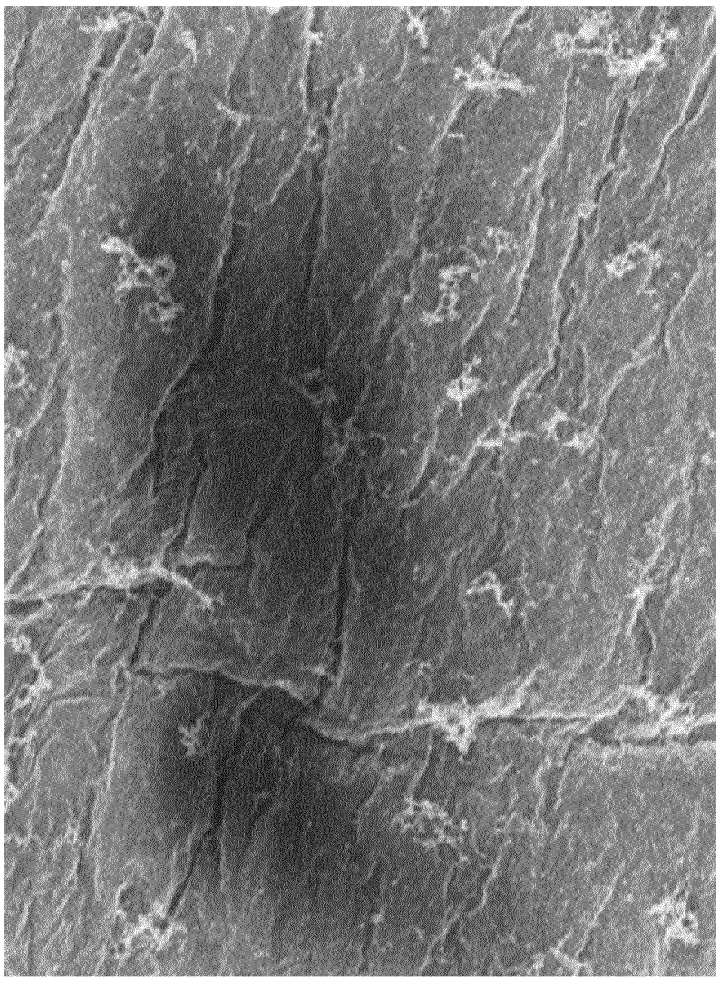
MPI-P
User Name = GLASSER
1 µm
Stage at R = 45.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.400 kV
WD = 2.0 mm
Stage at Z = 23.400 mm
Image Pixel Size = 11.72 nm
Signal A = InLens
Cycle Time = 15.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 8.98e-007 mbar
Gun Vacuum = 4.52e-010 mbar
Date :4 May 2021
Noise Reduction = Continuous Avg
File Name = 77641-09.tif
Time :14:59:15

FIG. 23A

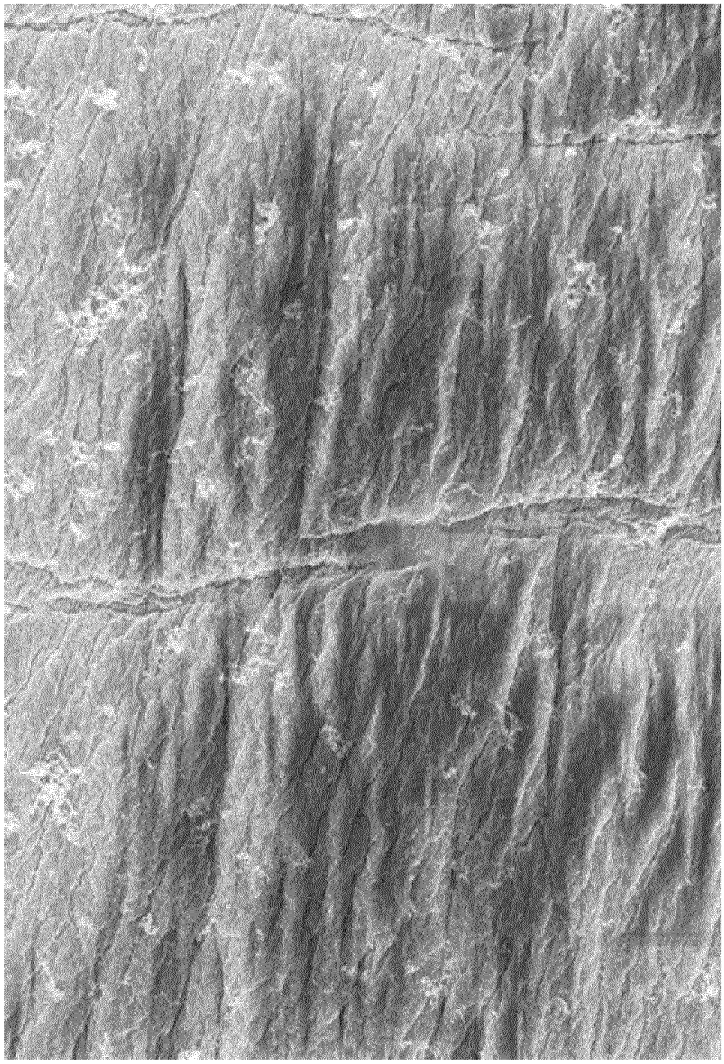
MPI-P
User Name = GLASSER
1 µm
Stage at R = 45.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.600 kV
WD = 1.7 mm
Stage at Z = 23.800 mm
Image Pixel Size = 14.65 nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 9.66e-007 mbar
Gun Vacuum = 4.70e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77641-02.tif
Time :14:50:29

FIG. 23B

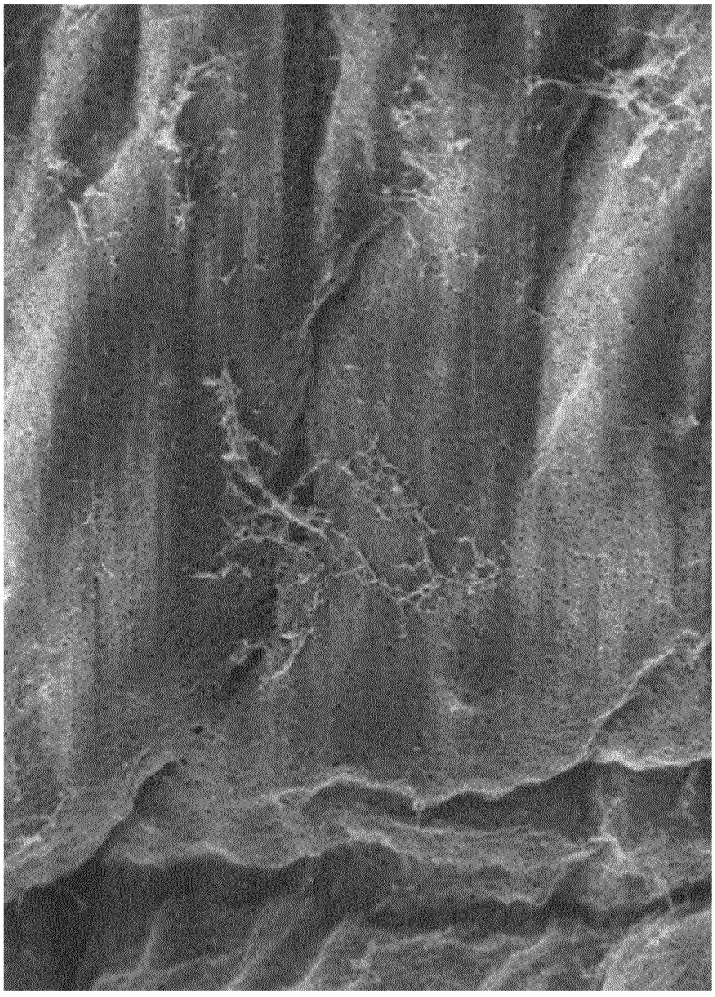
MPI-P
User Name = GLASSER
1 µm
Stage at R = 45.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.200 kV
WD = 1.8 mm
Stage at Z = 23.900 mm
Image Pixel Size = 1.953 nm
Signal A = InLens
Cycle Time = 49.1 Secs
Aperture Size = 10.00 µm
System Vacuum = 9.44e-007 mbar
Gun Vacuum = 4.53e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77641-05.tif
Time :14:54:12

FIG. 24A

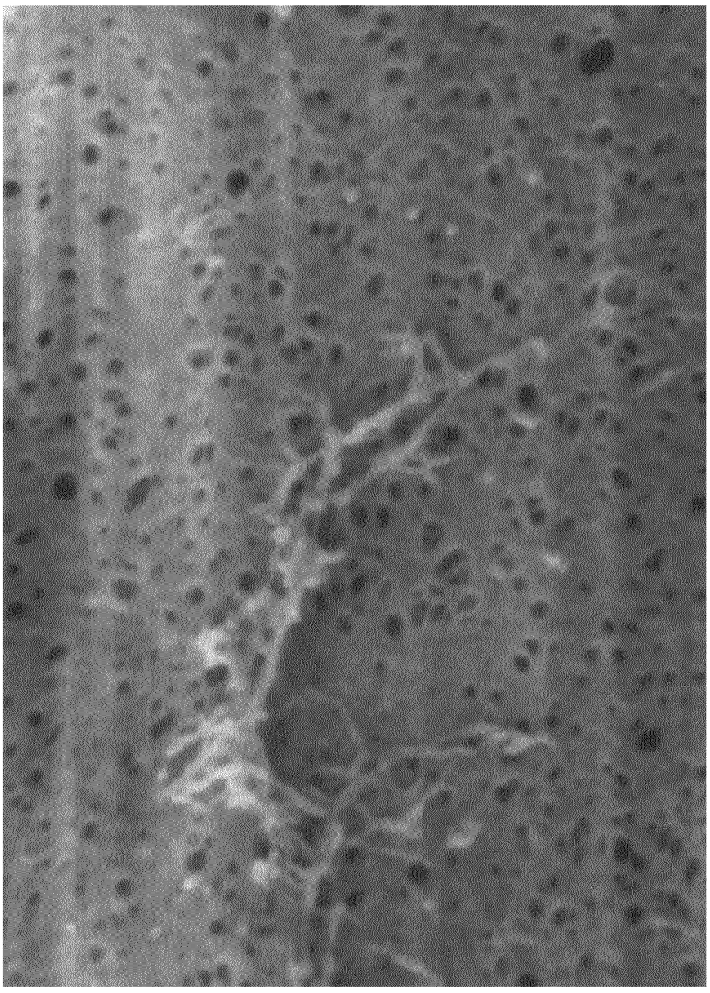
MPI-P
User Name = GLASSER
100 µm
Stage at R = 45.0°
Mixing = Off
Tilt Angle = 0.0°
Tilt Corrn = Off
Scan Rot = On
EHT = 0.200 kV
WD = 1.6 mm
Stage at Z = 23.800 mm
Image Pixel Size = 585.9nm
Signal A = InLens
Cycle Time = 22.7 Secs
Aperture Size = 10.00 µm
System Vacuum = 9.23e-007 mbar
Gun Vacuum = 4.47e-010 mbar
Date :4 May 2021
Noise Reduction = Line Avg
File Name = 77641-06 tif
Time :14:56:25

FIG. 24B

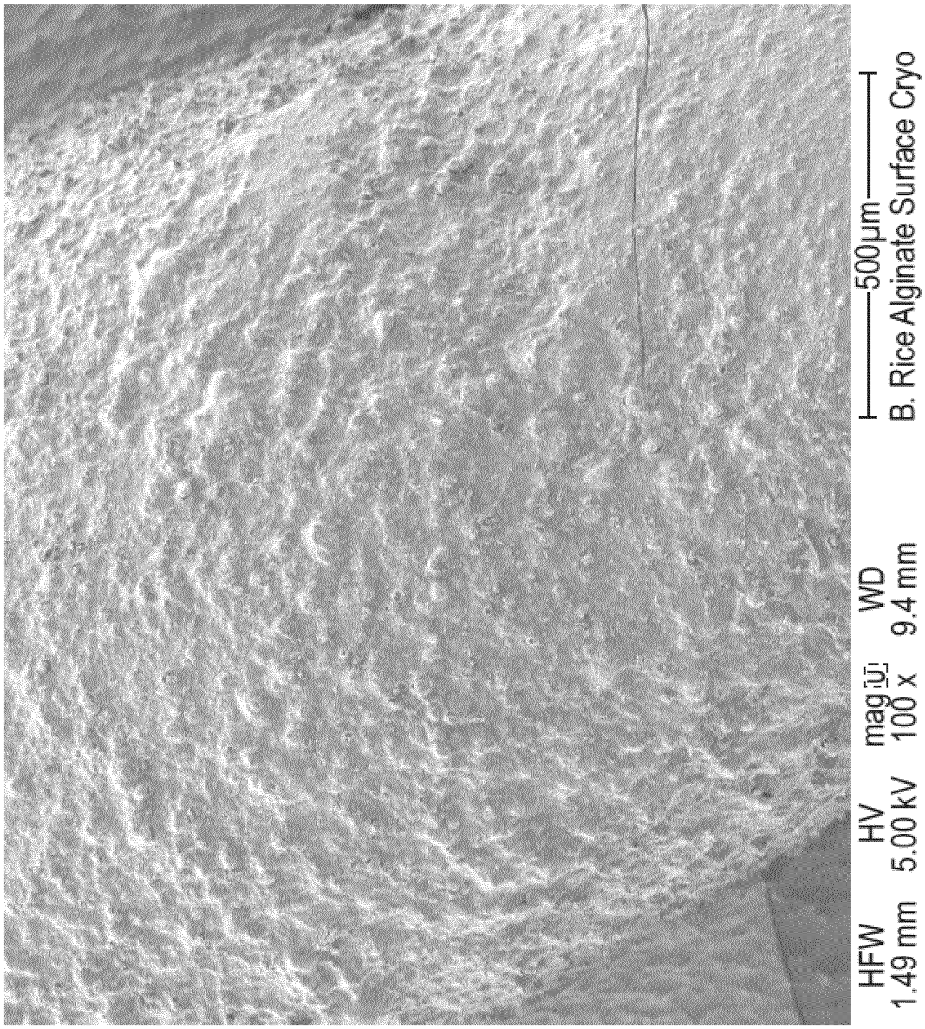
HFW
1.49 mm
HV
5.00 kV
mag
100 x
WD
9.4 mm
500µm
B. Rice Alginate Surface Cryo

FIG. 25A

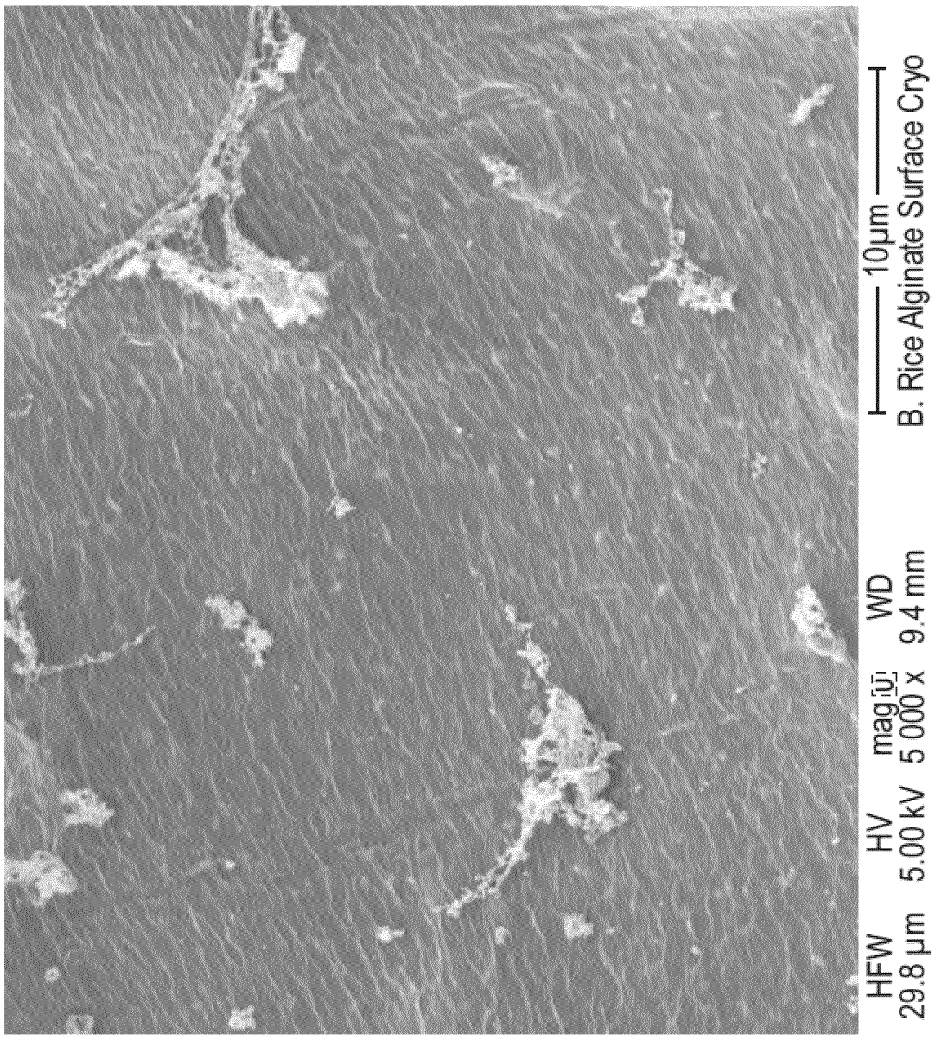
HFW
29.8 µm
HV
5.00 kV
mag
5 000 x
WD
9.4 mm
10µm
B. Rice Alginate Surface Cryo

FIG. 25B

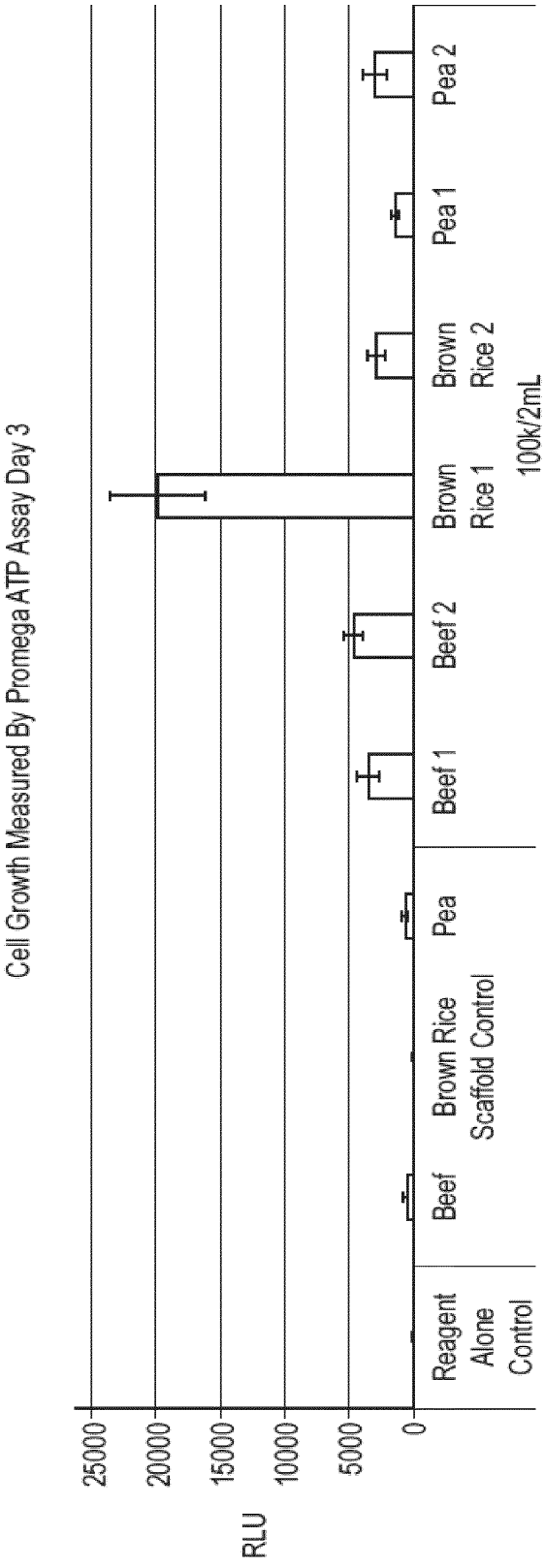
Cell Growth Measured By Promega ATP Assay Day 3
RLU
25000
20000
15000
10000
5000
0
Reagent Alone Control
Beef
Brown Rice
Pea
Scaffold Control
Beef 1
Beef 2
Brown Rice 1
Brown Rice 2
Pea 1
Pea 2
100k/2mL

FIG. 26

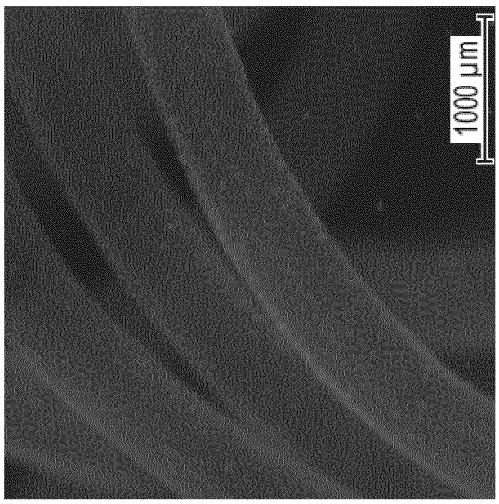

FIG. 27C

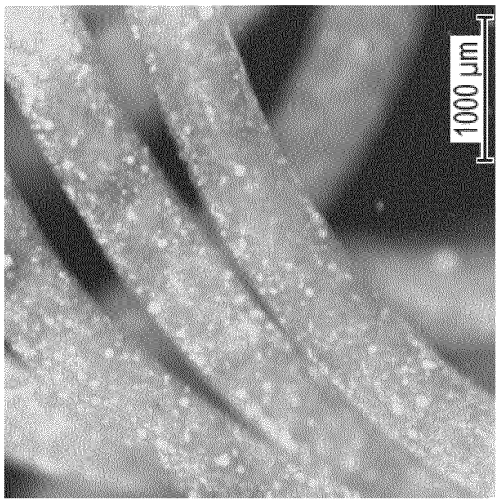

FIG. 27B

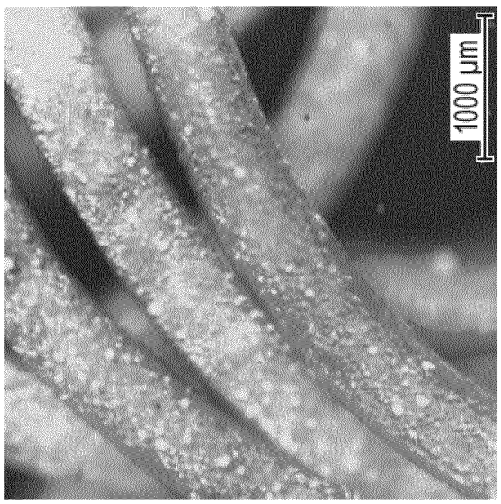

FIG. 27A