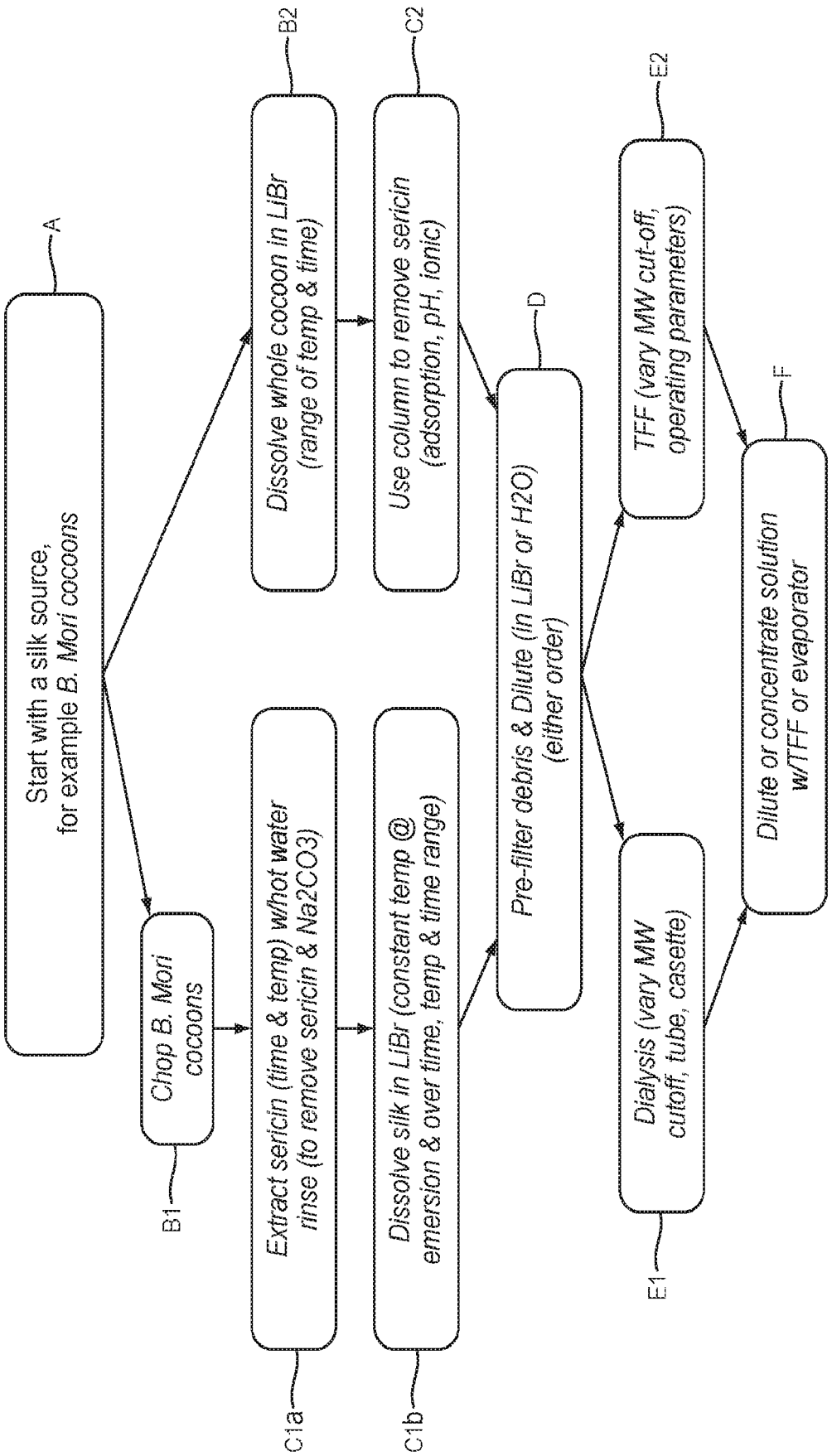

A
Start with a silk source, for example B. Mori cocoons
B1
Chop B. Mori cocoons
B2
Dissolve whole cocoon in LiBr (range of temp & time)
C1a
Extract sericin (time & temp) w/hot water rinse (to remove sericin & Na2CO3)
C1b
Dissolve silk in LiBr (constant temp @ emersion & over time, temp & time range)
C2
Use column to remove sericin (adsorption, pH, ionic)
D
Pre-filter debris & Dilute (in LiBr or H2O) (either order)
E1
Dialysis (vary MW cutoff, tube, casette)
E2
TFF (vary MW cut-off, operating parameters)
F
Dilute or concentrate solution w/TFF or evaporator

FIG. 1

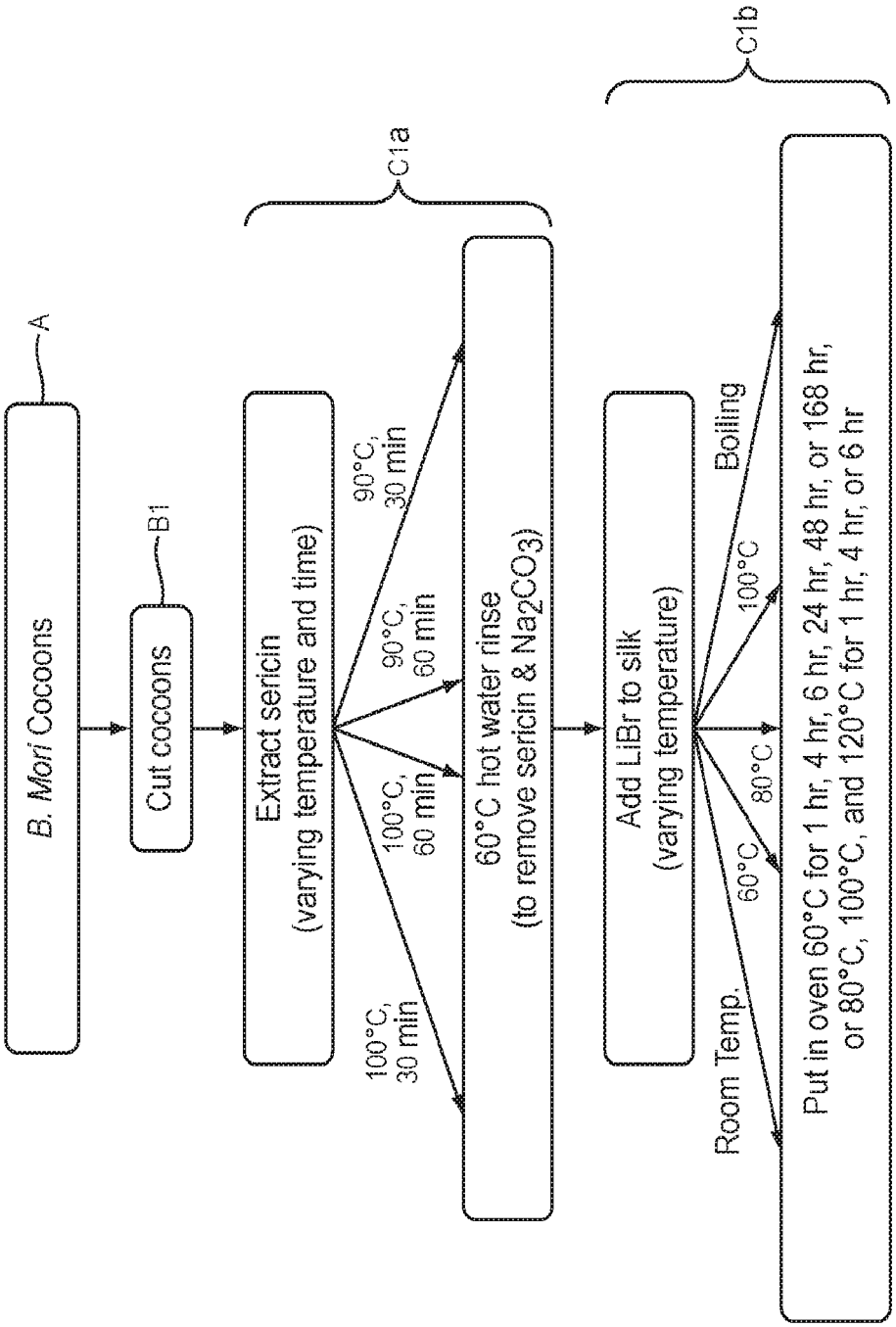

A
B. Mori Cocoons
B1
Cut cocoons
Extract sericin
(varying temperature and time)
C1a
90°C, 30 min
90°C, 60 min
100°C, 60 min
100°C, 30 min
60°C hot water rinse
(to remove sericin & Na2CO3)
C1b
Add LiBr to silk
(varying temperature)
Boiling
100°C
80°C
60°C
Room Temp.
Put in oven 60°C for 1 hr, 4 hr, 6 hr, 24 hr, 48 hr, or 168 hr,
or 80°C, 100°C, and 120°C for 1 hr, 4 hr, or 6 hr

FIG. 2



FIG. 3

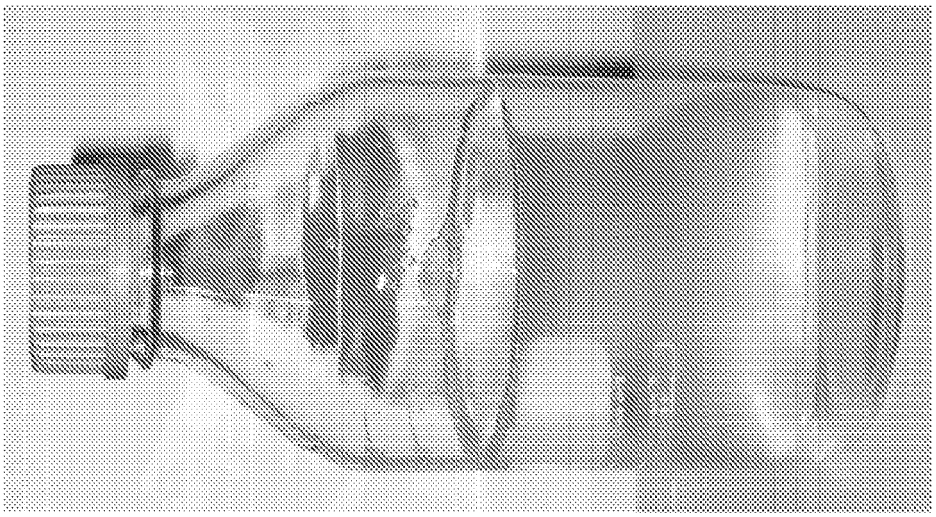


FIG. 4

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	Some undissolved silk	Some undissolved silk	Significant amount of undissolved silk	Significant amount of undissolved silk

FIG. 5A FIG. 5B FIG. 5C FIG. 5D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Some undissolved silk	Small amount of undissolved silk	Small amount of undissolved silk	Some undissolved silk

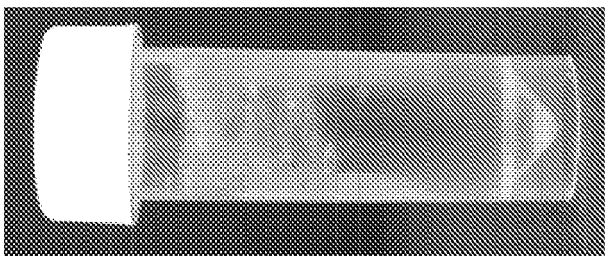


FIG. 6A

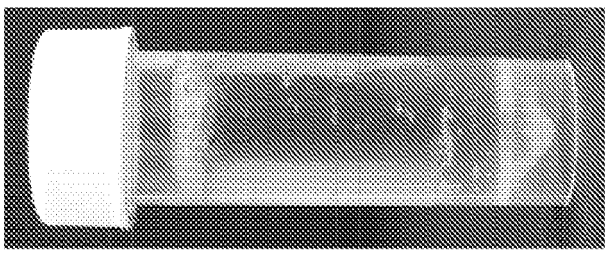


FIG. 6B

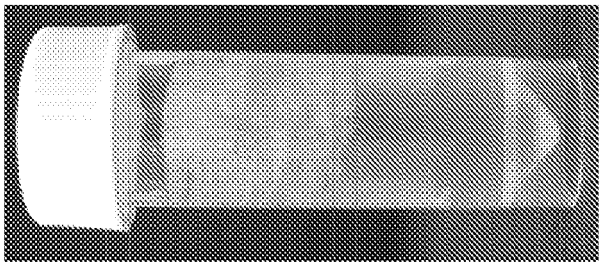


FIG. 6C

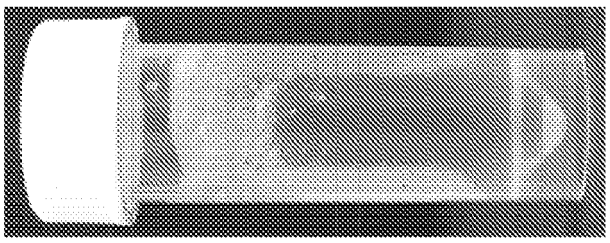


FIG. 6D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
8 Hours	Small amount of undissolved silk	Little to no undissolved silk	Significant amount of undissolved silk	Some undissolved silk

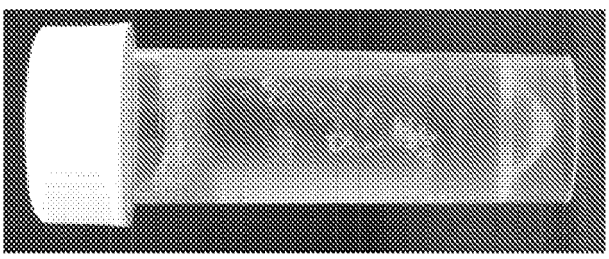


FIG. 7A

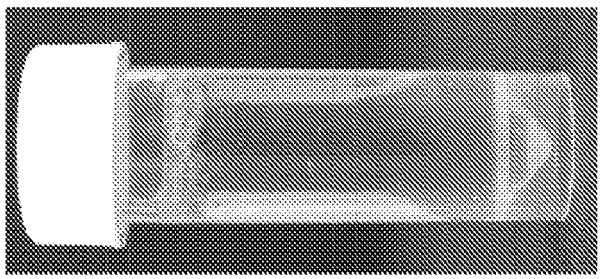


FIG. 7B

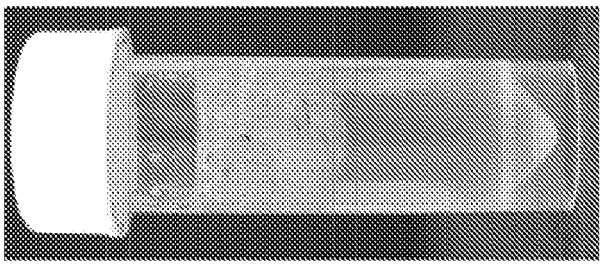


FIG. 7C

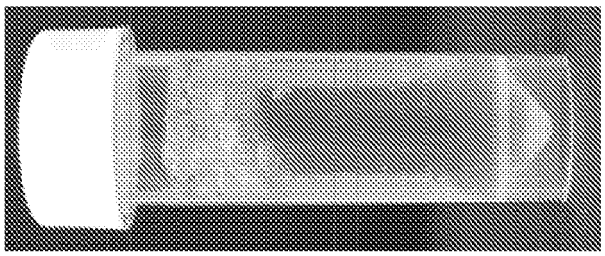


FIG. 7D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
12 Hours	Small amount of undissolved silk	Little to no undissolved silk	Some undissolved silk	All but small amount of silk undissolved

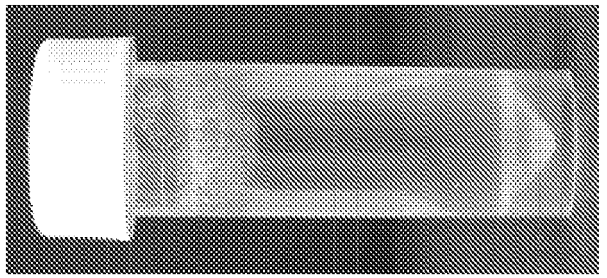


FIG. 8A

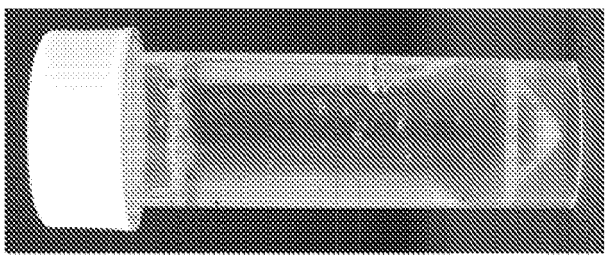


FIG. 8B

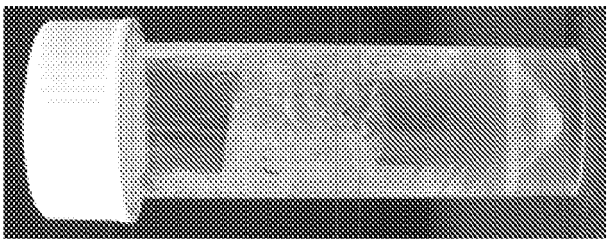


FIG. 8C

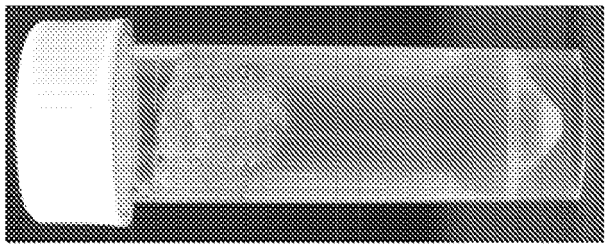


FIG. 8D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
24 Hours	Small amount of undissolved silk	Little to no undissolved silk	Some undissolved silk	All but small amount of silk undissolved

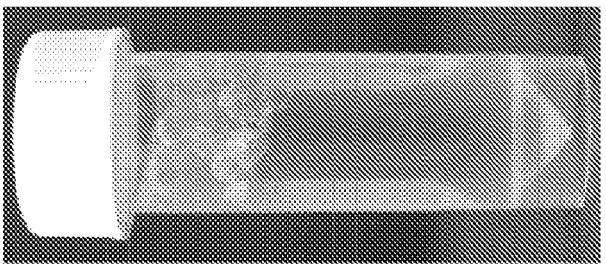


FIG. 9A

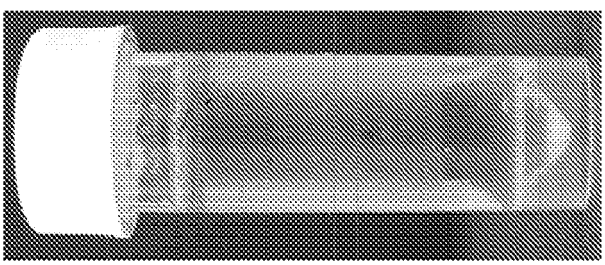


FIG. 9B

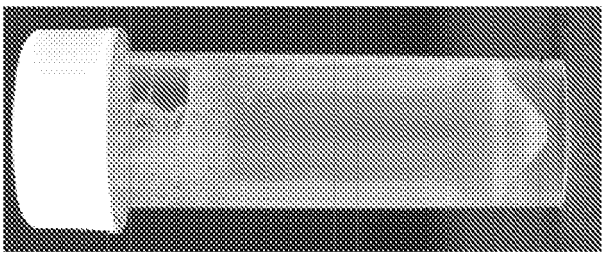


FIG. 9C

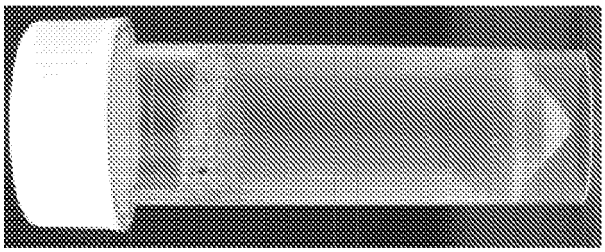


FIG. 9D

Time Point	1 Sericin was extracted at 100°C, 30 min	2 Sericin was extracted at 100°C, 30 min	3 Sericin was extracted at 90°C, 30 min	4 Sericin was extracted at 90°C, 60 min
168 Hours (1&2) 192 Hours (3&4)	No undissolved silk, only slightly cloudy	No undissolved silk, completely clear	Some undissolved silk	Slight amount of undissolved silk

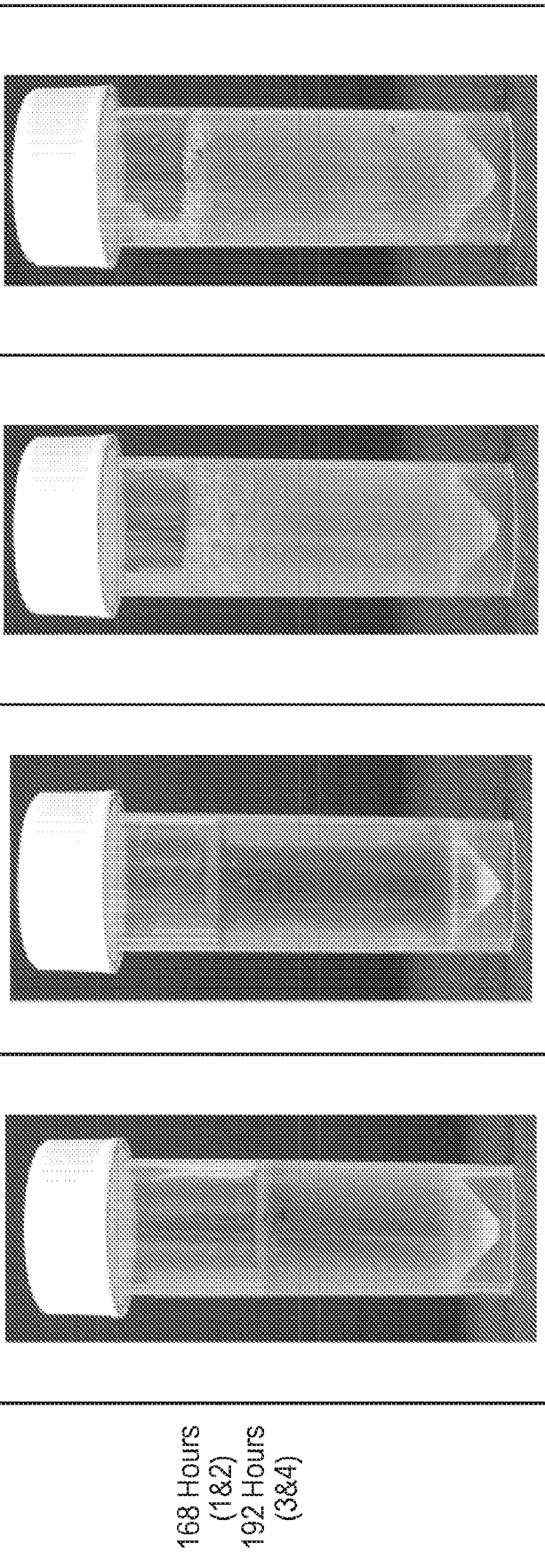


FIG. 10A FIG. 10B FIG. 10C FIG. 10D

Sericin was extracted at 100°C, 60 min

Hour 1	Hour 4	Hour 6
Large amount of undissolved silk	Small amounts of undissolved silk and debris	Small amounts of floating debris

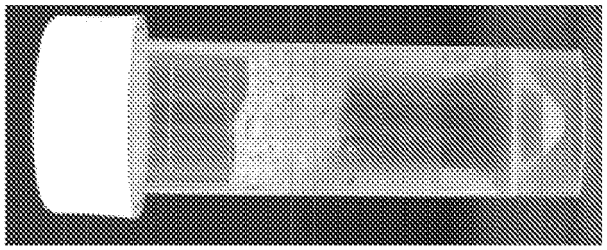


FIG. 11A

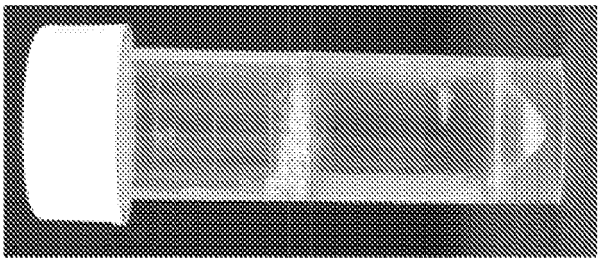


FIG. 11B

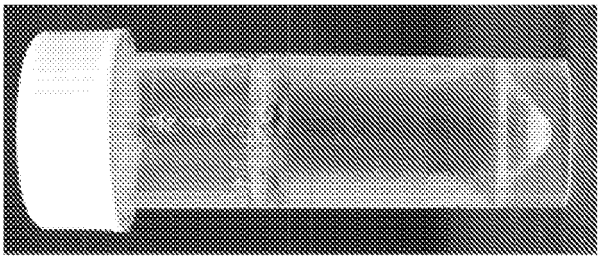


FIG. 11C

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	Significant amount of undissolved silk	Significant amount of undissolved silk and debris	Significant amount of undissolved silk, highly viscous	Significant amount of undissolved silk

FIG. 12A FIG. 12B FIG. 12C FIG. 12D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	Some undissolved silk	Some undissolved silk	Significant amount of undissolved silk, highly viscous	Some undissolved silk

FIG. 13A FIG. 13B FIG. 13C FIG. 13D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Small amount of undissolved silk	Small amount of silk undissolved	Some undissolved silk	Some undissolved silk

FIG. 14A FIG. 14B FIG. 14C FIG. 14D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	Very small amount of undissolved silk, quire viscous, precipitate formed from bubbles	Less viscous than set 1, no undissolved silk	Highly viscous, some undissolved silk	Less viscous than set 3, some undissolved silk

FIG. 15A FIG. 15B FIG. 15C FIG. 15D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	Extremely small amount of undissolved silk	No undissolved silk	Highly viscous, some undissolved silk	Some undissolved silk

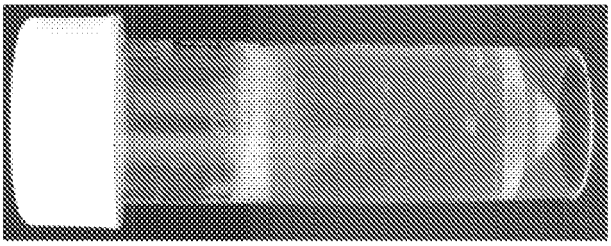


FIG. 16A

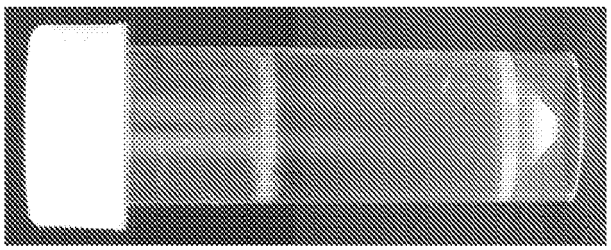


FIG. 16B

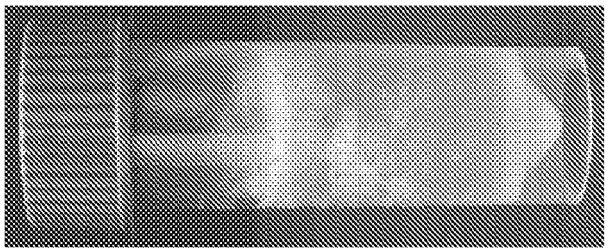


FIG. 16C

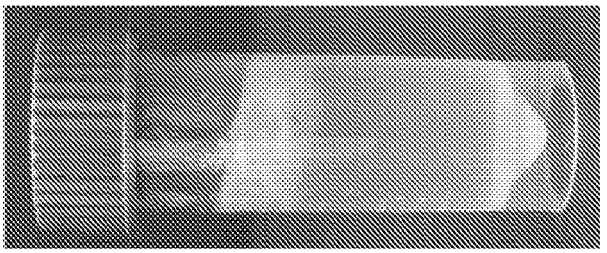
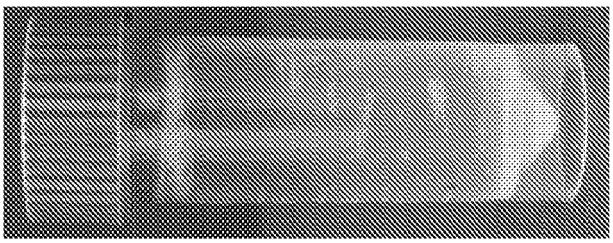
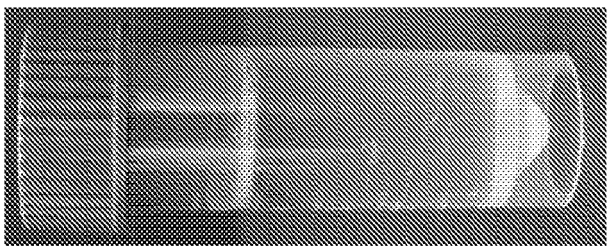
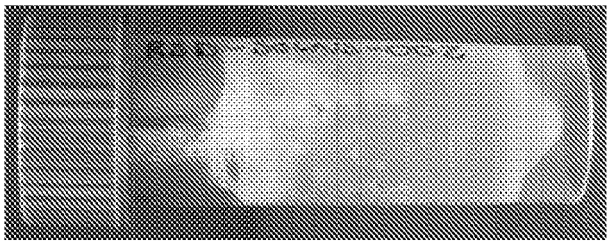


FIG. 16D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Extremely small amount of undissolved silk	No undissolved silk	Highly viscous, some undissolved silk	Almost no undissolved silk







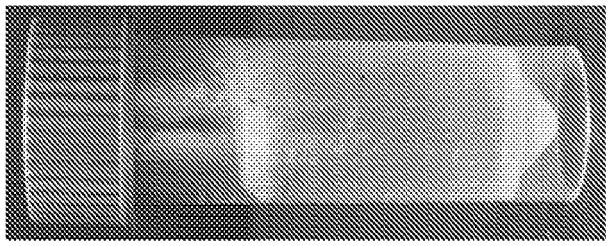


FIG. 17A FIG. 17B FIG. 17C FIG. 17D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	Small amount of undissolved silk, some precipitate from bubbles	All silk dissolved, some precipitate from bubbles	Some precipitate from bubbles and undissolved silk	Some precipitate from bubbles and undissolved silk

FIG. 18A FIG. 18B FIG. 18C FIG. 18D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	All silk dissolved, some precipitate from bubbles	Completely clear with no precipitate	Some undissolved silk	Some precipitate from bubbles, mostly clear solution

FIG. 19A FIG. 19B FIG. 19C FIG. 19D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Some precipitate from bubbles, no undissolved silk	Clear with no precipitate or silk	Some undissolved silk	Clear and no undissolved silk

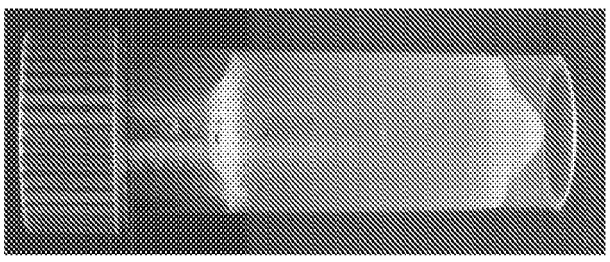


FIG. 20A

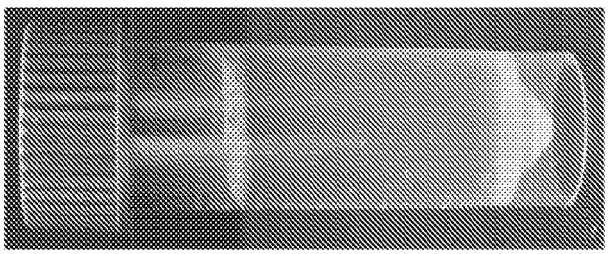


FIG. 20B

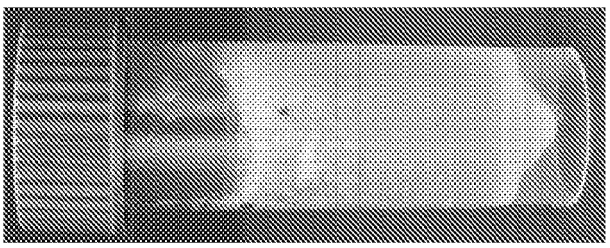


FIG. 20C

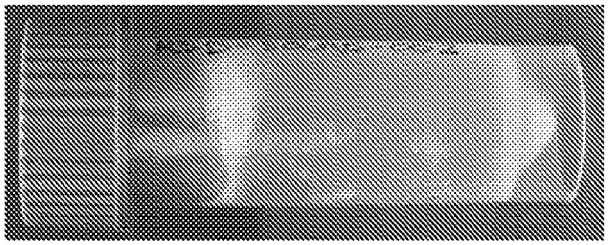


FIG. 20D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	Most silk dissolved, some precipitate from bubbles	Most silk dissolved, some slight precipitate from bubbles	Some precipitate from bubbles and significant amount of dissolved silk	Significant amount of undissolved silk

FIG. 21A FIG. 21B FIG. 21C FIG. 21D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	Completely clear, no silk or precipitate	Some precipitate from bubbles	Cloudy with some undissolved silk	Very viscous with some undissolved silk

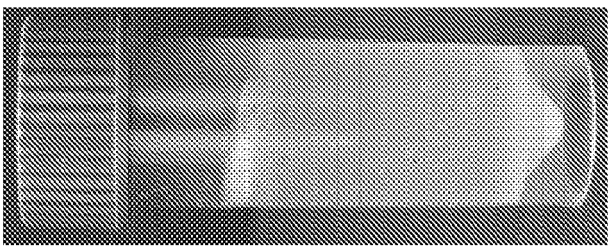


FIG. 22A

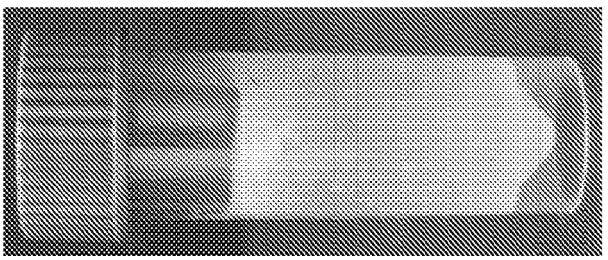


FIG. 22B

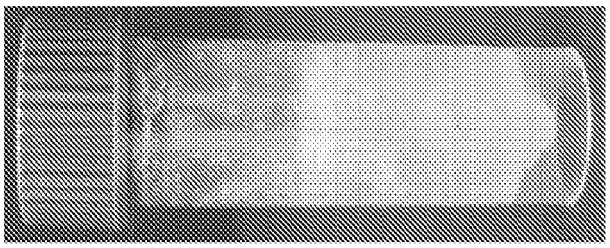


FIG. 22C

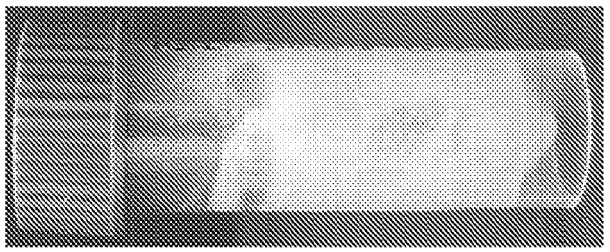
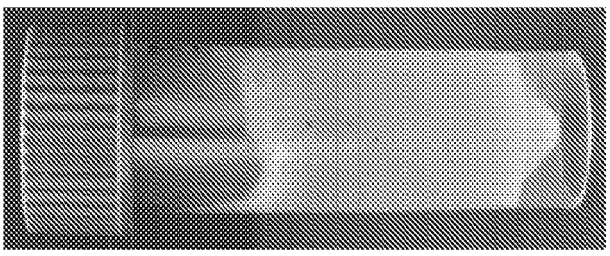
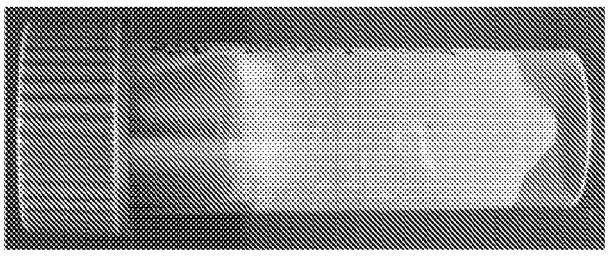
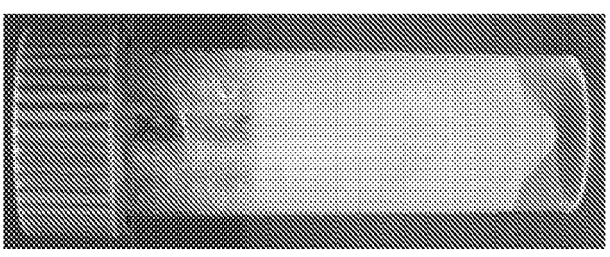


FIG. 22D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Slightly cloudy with silk particles on top	Cloudy with precipitate from bubbles	Highly viscous, cloudy, almost solid	Highly viscous, cloudy, almost solid







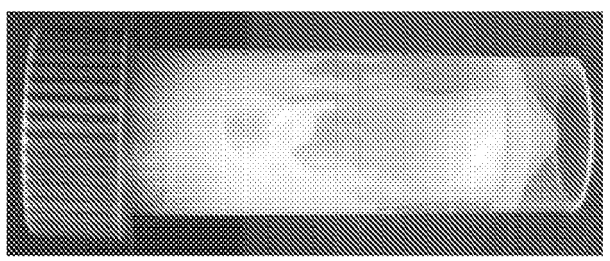


FIG. 23A FIG. 23B FIG. 23C FIG. 23D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	Some undissolved silk, viscosity slightly highter than set 2	Viscosity similar to water, nearly all silk completely dissolved and no precipitate, clear orange/yellow	Highly viscous, some undissolved silk and bubbles	Some undissolved silk but not too viscous

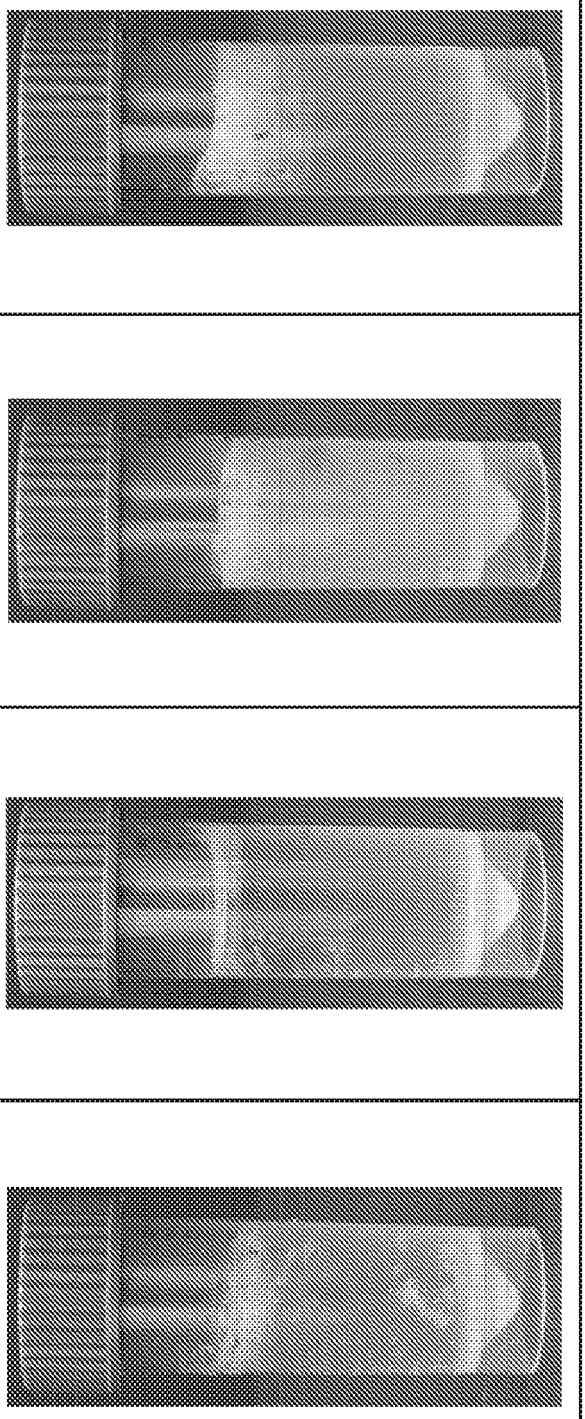
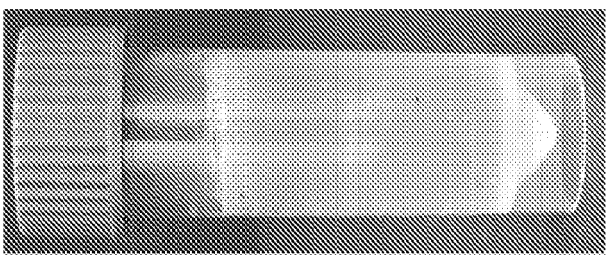
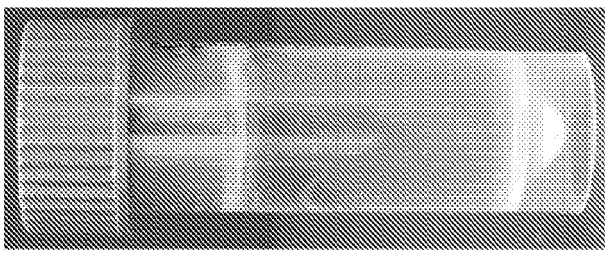
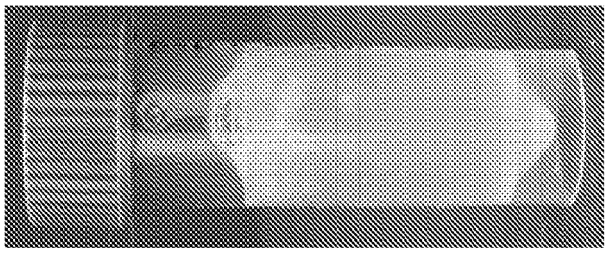


FIG. 24A FIG. 24B FIG. 24C FIG. 24D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	Some undissolved silk, cloudy, slightly viscous	Very slight amount of silk undissolved, clear with darker color	Some undissolved silk, highly viscous	Small amount of undissolved silk, not too viscous







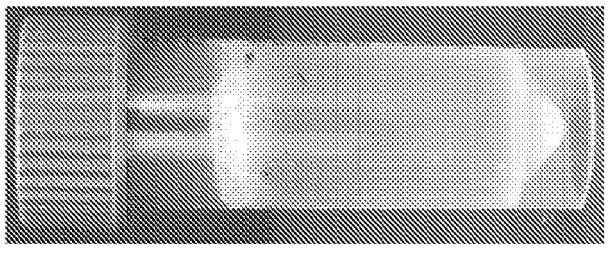


FIG. 25A FIG. 25B FIG. 25C FIG. 25D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Slightly cloudy with some undissolved silk	Clear with darker color	Some undissolved silk, viscous	Darker color, some undissolved silk, slightly cloudy

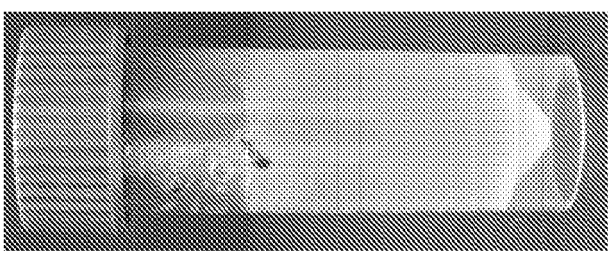


FIG. 26A

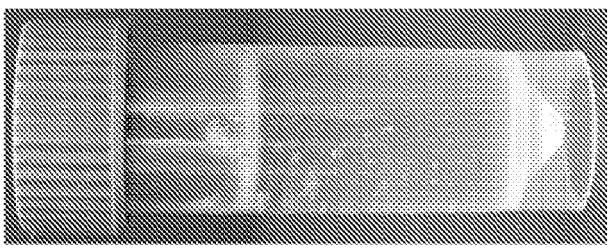


FIG. 26B

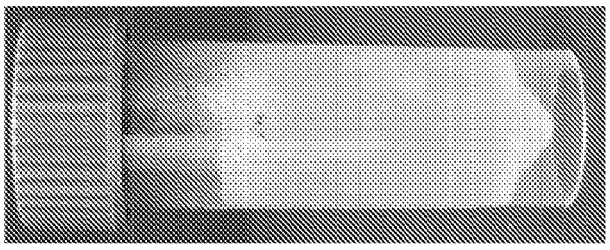


FIG. 26C

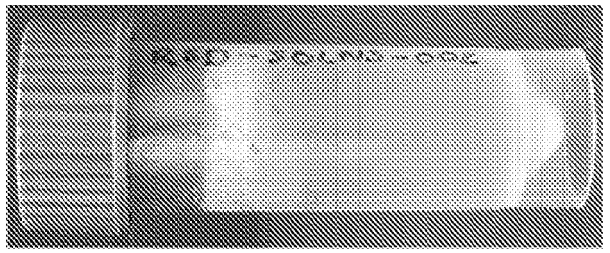
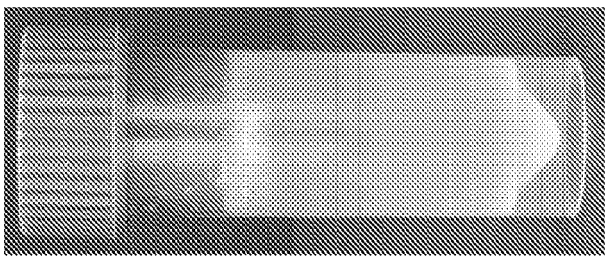


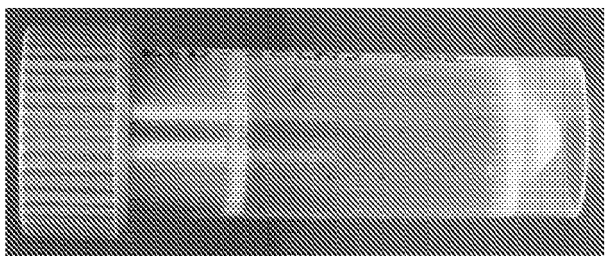
FIG. 26D

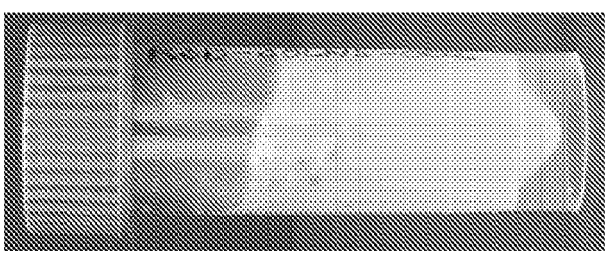
Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	Somewhat cloudy with darker color, some silk particles	Completely clear with dark color, slight amount of silk particles	Cloudy, some undissolved silk, highly viscous	Small amount of undissolved silk, partially cloudy, darker color

FIG. 27A FIG. 27B FIG. 27C FIG. 27D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	Small amount of undissolved silk, highly cloudy	Little to no undissolved silk, deep auburn color	Some undissolved silk, highly cloudy	Slight amount of silk particles, dark color, less viscous







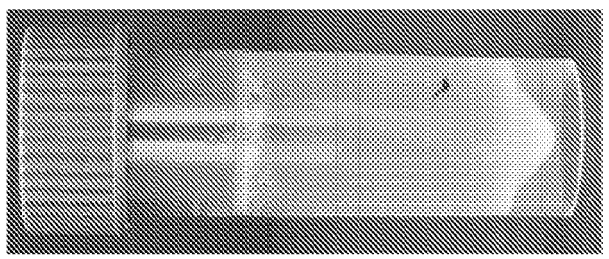
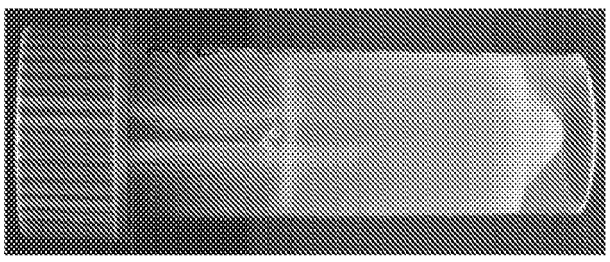


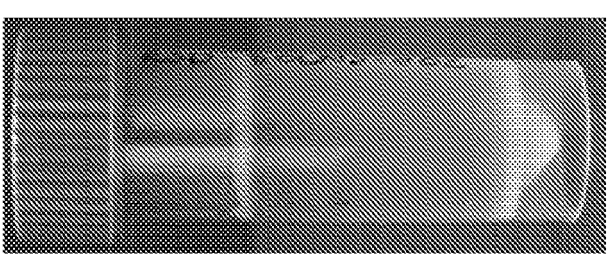
FIG. 28A FIG. 28B FIG. 28C FIG. 28D

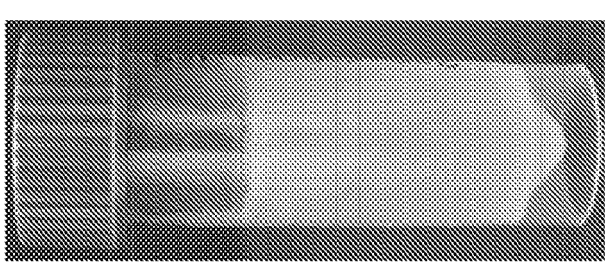
Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	Slightly cloudy, slight amount of dissolved silk	No undissolved silk, completely clear, dark auburn	Cloudy, viscous, some undissolved silk	Slight amount of undissolved silk, slightly cloudy

FIG. 29A FIG. 29B FIG. 29C FIG. 29D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
1 Hour	All silk dissolved, cloudy	All silk dissolved, clear	All silk dissolved, viscous, cloudy	All silk dissolved, viscous, cloudy







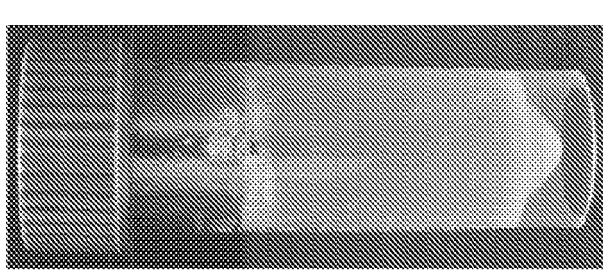
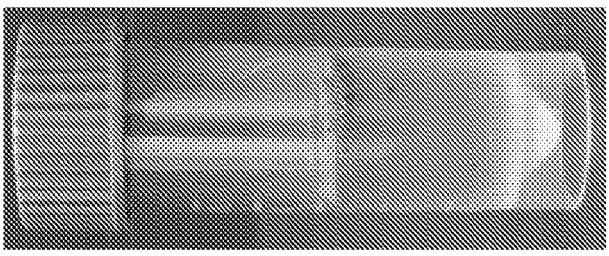
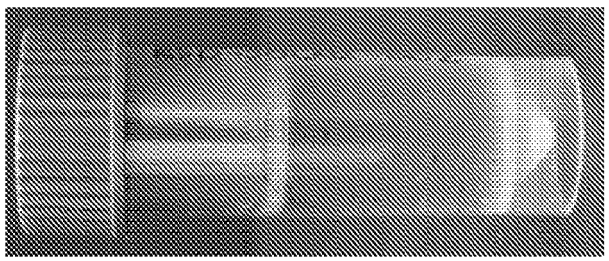
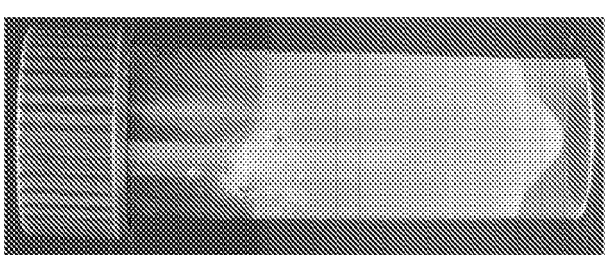


FIG. 30A FIG. 30B FIG. 30C FIG. 30D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
4 Hours	All silk dissolved, slightly cloudy but mostly clear	All silk dissolved, clear, dark	All silk dissolved, cloudy	All silk dissolved, cloudy







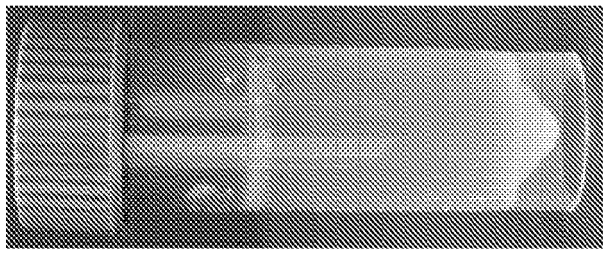


FIG. 31A FIG. 31B FIG. 31C FIG. 31D

Time Point	Sericin was extracted at 100°C, 30 min	Sericin was extracted at 100°C, 60 min	Sericin was extracted at 90°C, 30 min	Sericin was extracted at 90°C, 60 min
6 Hours	All silk dissolved, cloudy	All silk dissolved, clear	All silk dissolved, cloudy	All silk dissolved, only slightly cloudy

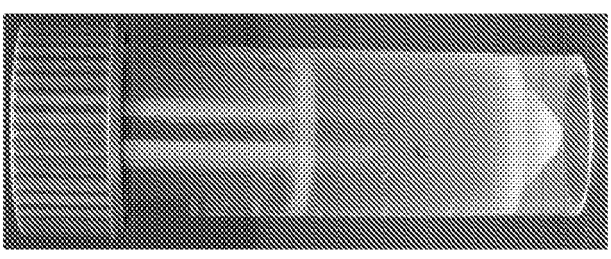


FIG. 32A

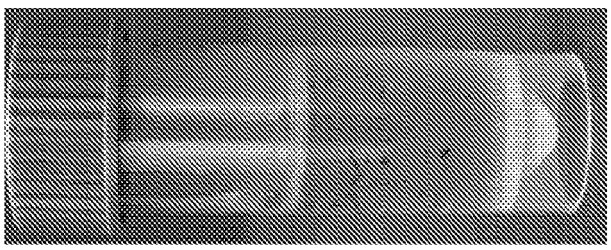


FIG. 32B

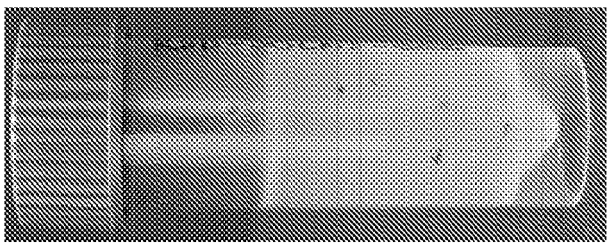


FIG. 32C

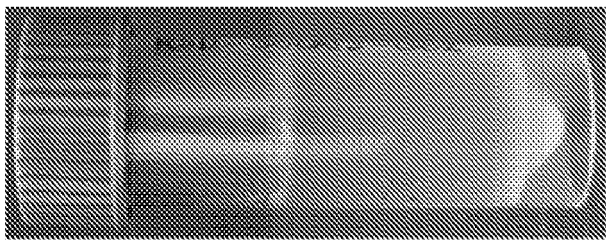


FIG. 32D

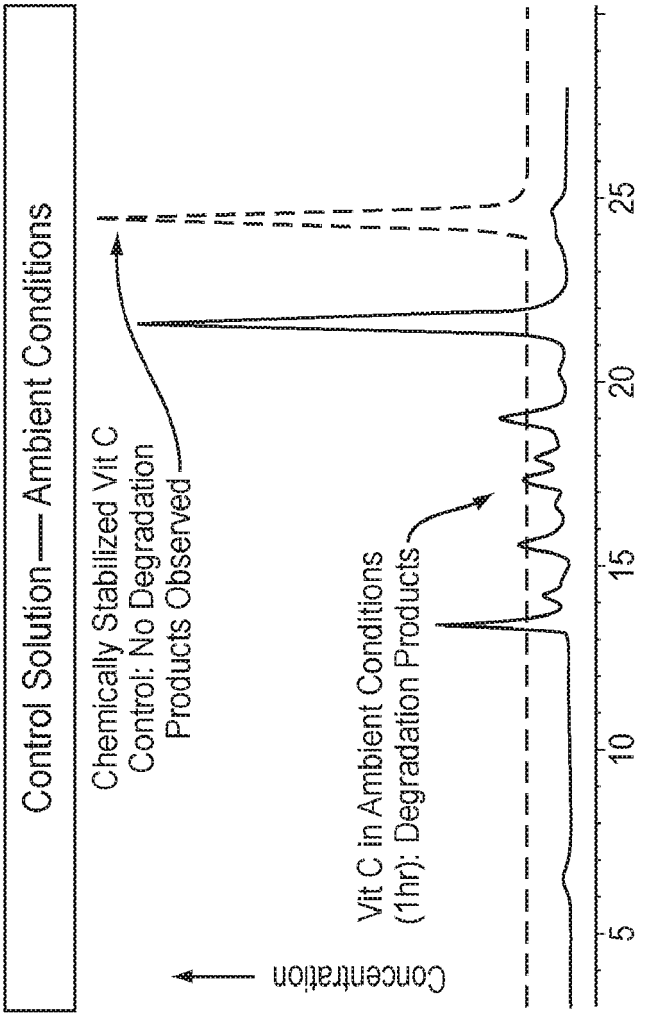

Control Solution — Ambient Conditions
Chemically Stabilized Vit C
Control: No Degradation
Products Observed
Vit C in Ambient Conditions
(1hr): Degradation Products
Concentration
5
10
15
20
25

FIG. 33

Lithium Bromide and Sodium Carbonate Concentration in Silk Protein Solution

Sample ID	Sample Description	Average Concentration of Na_2CO_3 (ppm)	Average Concentration of LiBr (ppm)
A	TFF 5kDa	32.13	90.85
B	TFF 10 kDa	42.91	107
C	TFF 10 kDa	49.06	78.55
D	STI 1(TFF-10-0019)	2.17	129.07
E	STI 2(TFF-10-0033)	2.63	196.2
F	STI 3(TFF-10-0034)	4.18	248.93

Method: 100C extraction for 60 min, 60C rinse, 100C LiBr in 100C oven for 60 min. Note that TFF could be run for longer and/or at different flow rates (as varied between A-C and D-F) to alter ppm of $Na_2C_2O_3$ and LiBr.

FIG. 34

Lithium Bromide and Sodium Carbonate content in Silk Protein Solution

Sample ID	Solution Volume Equivalent to (X) Films	Sample Weight (mg)	Concentration	
			Na2CO3	LiBr
1	6	0.171	ND	ND
2	8	0.228	ND	ND
3	10	0.285	ND	ND
4	12	0.342	ND	ND
5	Neat	-	ND	ND

*ND = None Detected

Method: 100C boil for 60 min, 60C rinse, LiBr in 60C oven for 4-6 hours

FIG. 35

Stability to Vitamin C in Solution

Sample ID	Time (hour)	Actual Conc. (µg/mL)	Area	Concentration Vit C (µg/mL)	Recovered (%)	Stability (%) After 24 hrs.
A	0	82.4	4277.9	80.53	97.73	
B	26	82.4	4088.94	77.62	94.2	
Average =			4183.42	79.07	95.96	96.39
Std. Dev. =			133.62	2.06	2.49	
% Error			3%	3%	3%	

Method: Vitamin C solution (no silk)

FIG. 36

Molecular Weights of Silk Protein Solutions

Sample ID	Sample Description	Mn	Mw	Polydispersity (PD) (Mw/Mn)
A	TFF 5kDa	14,497	33,874	2.3366
B	TFF 10 kDa	14,542	33,455	2.3006
C	TFF 10 kDa	14,972	34,026	2.2726
D	Silk protein solution in water	12,055	26,531	2.2008

Method:
TFF: 100C extraction for 60 min, 60C rinse, 100C LiBr in 100C oven for 60 min.
Silk Protein: 100C extraction for 20 min, RT rinse, LiBr in 60C oven for 4-6 hours

FIG. 37

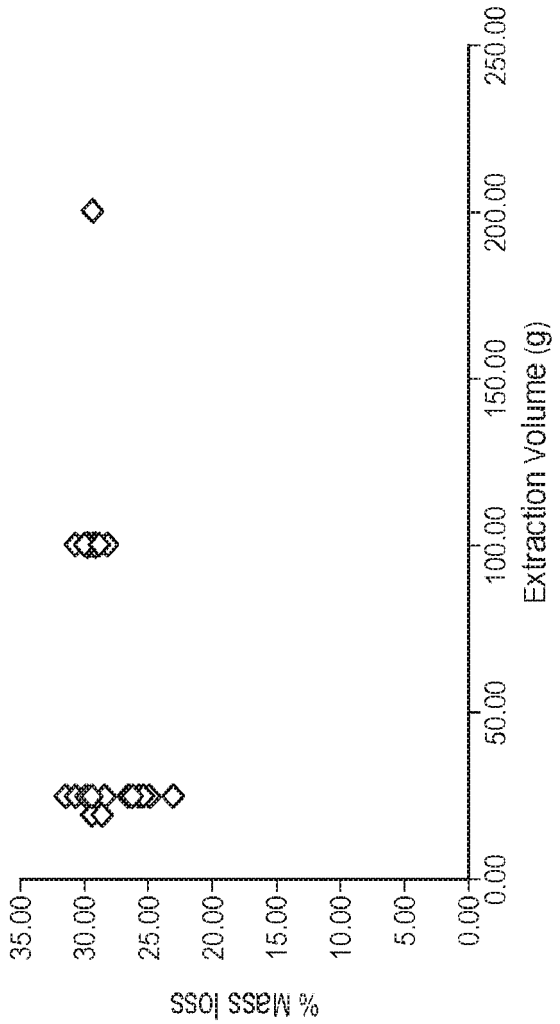


FIG. 38A

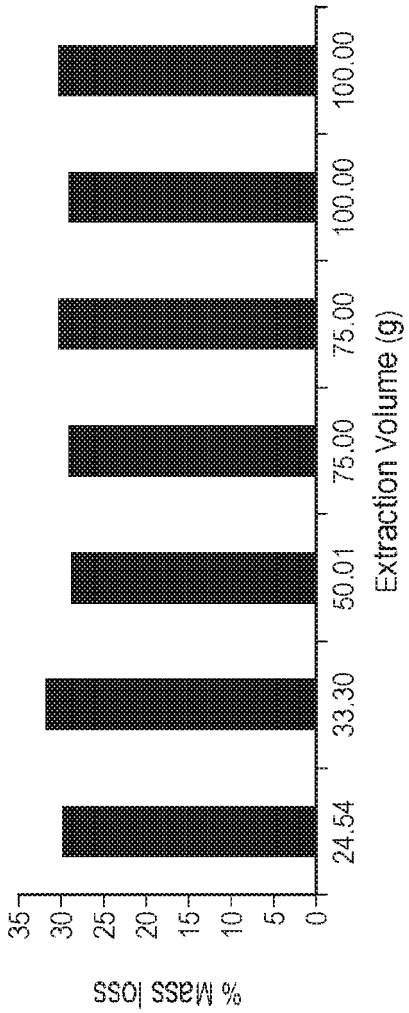


FIG. 38B

Sample	LiBr (M)	Avg MW	PD
STI 1(TFF-10-0019)	9.3	15727	2.033
STI 2(TFF-10-0033)	9.3	24587	2.3669
STI 3(TFF-10-0034)	9.3	25273	2.338
STI 9.3 M avg		21862	2.25
STI 1(TFF-10-0031)	~7.5	29645	3.0868
STI 2(TFF-10-0030)	~7.5	26856	2.9748
STI 7.5M avg		28250.5	3.0308

* TFF-10-0019 from 2 25g extraction/ 35g dissolution
* TFF-10-0034 from 100g extraction/ 17-35 g dissolution

* TFF-10-0033 from 100g extraction/ 100 g dissolution

FIG. 39

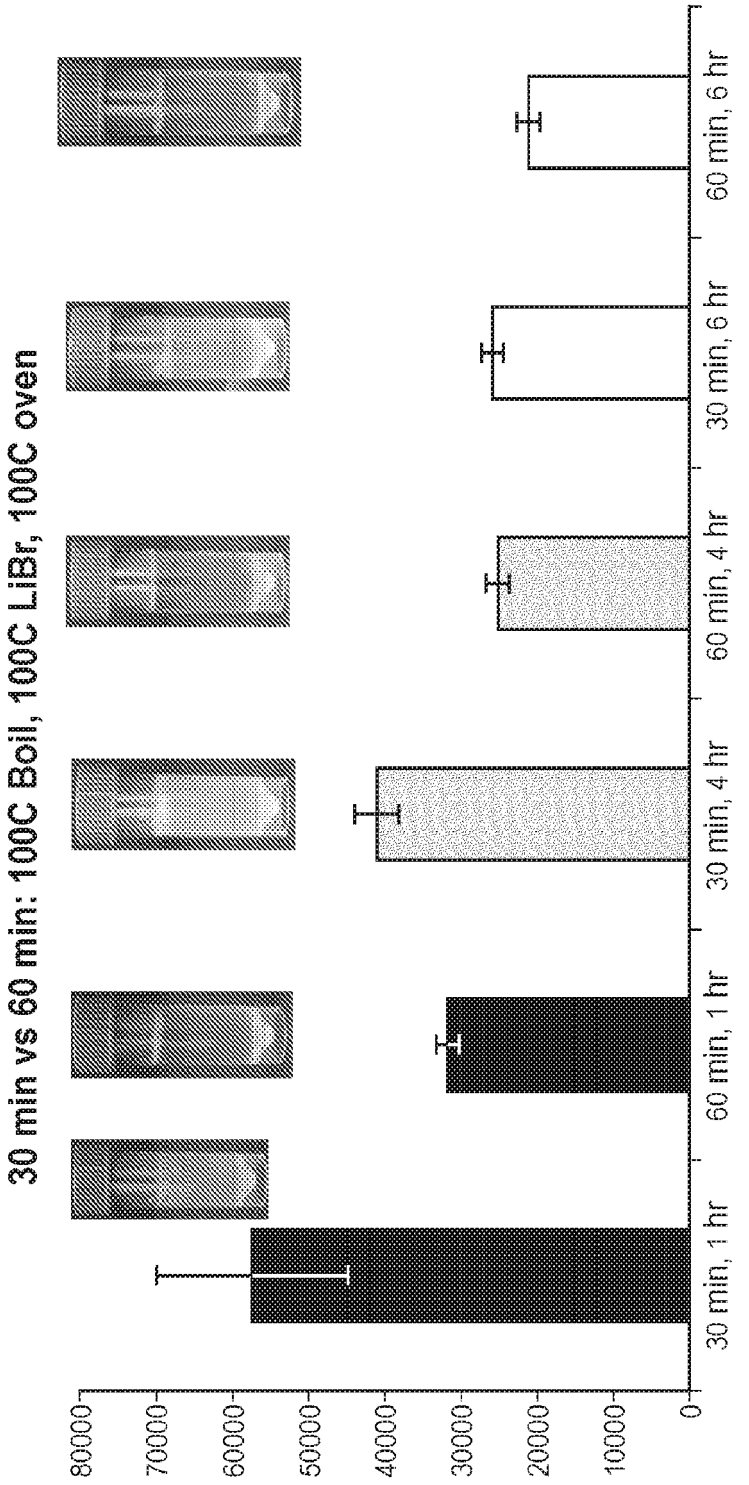

30 min vs 60 min: 100C Boil, 100C LiBr, 100C oven
80000
70000
60000
50000
40000
30000
20000
10000
0
30 min, 1 hr
60 min, 1 hr
30 min, 4 hr
60 min, 4 hr
30 min, 6 hr
60 min, 6 hr

FIG. 40

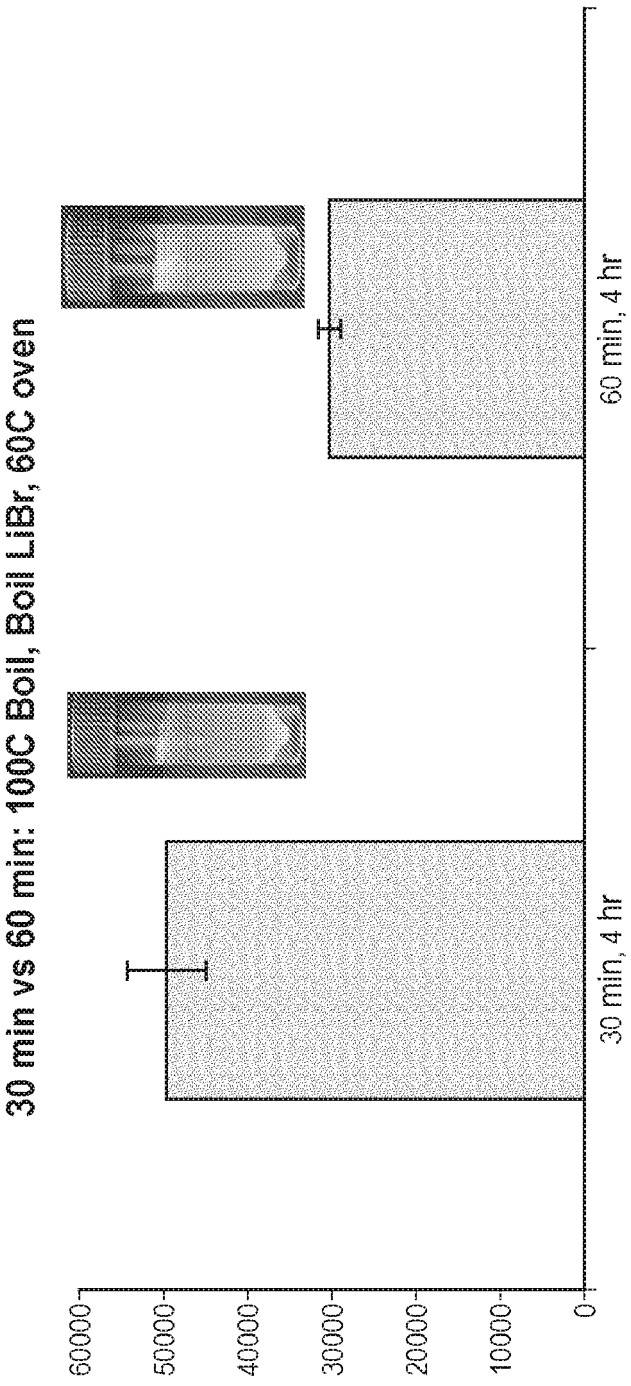

30 min vs 60 min: 100C Boil, Boil LiBr, 60C oven
60000
50000
40000
30000
20000
10000
0
30 min, 4 hr
60 min, 4 hr

FIG. 41

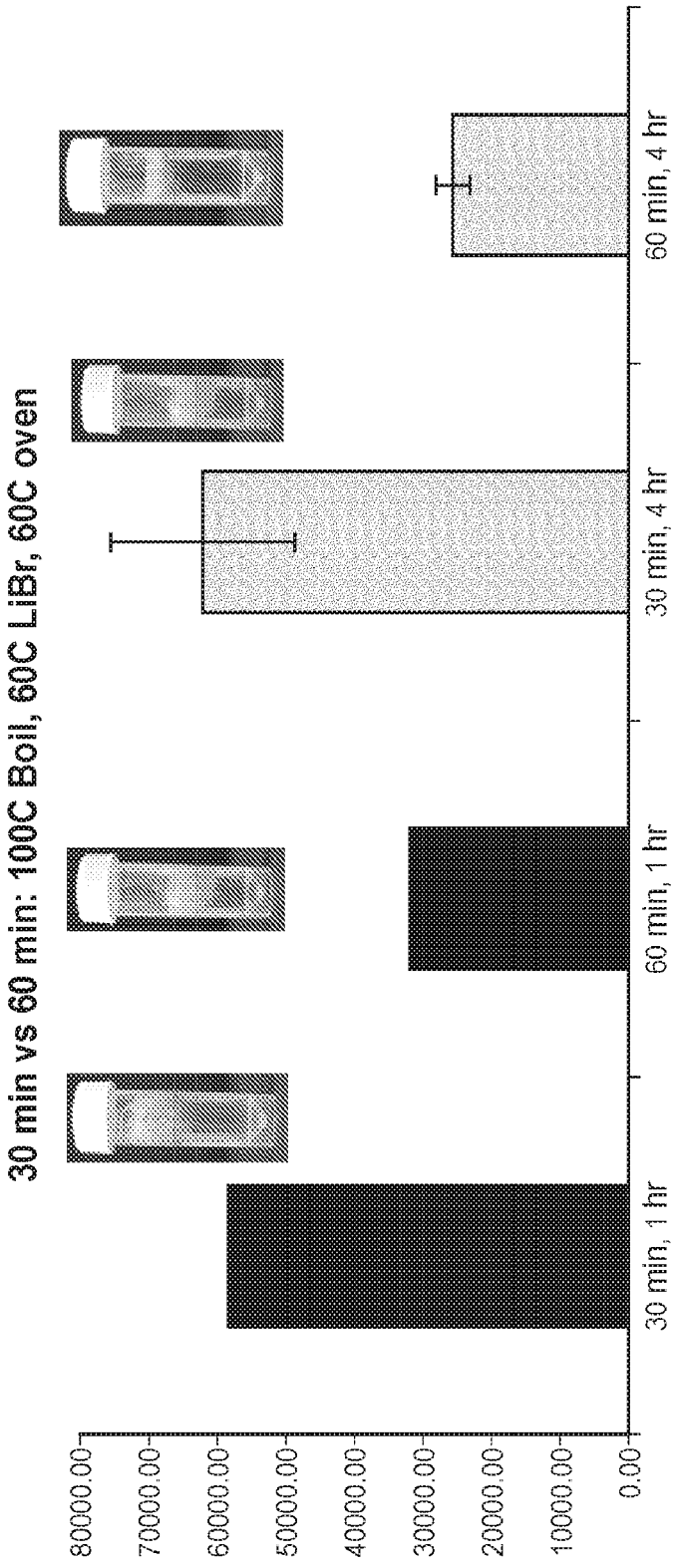

30 min vs 60 min: 100C Boil, 60C LiBr, 60C oven
80000.00
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
30 min, 1 hr
60 min, 1 hr
30 min, 4 hr
60 min, 4 hr

FIG. 42

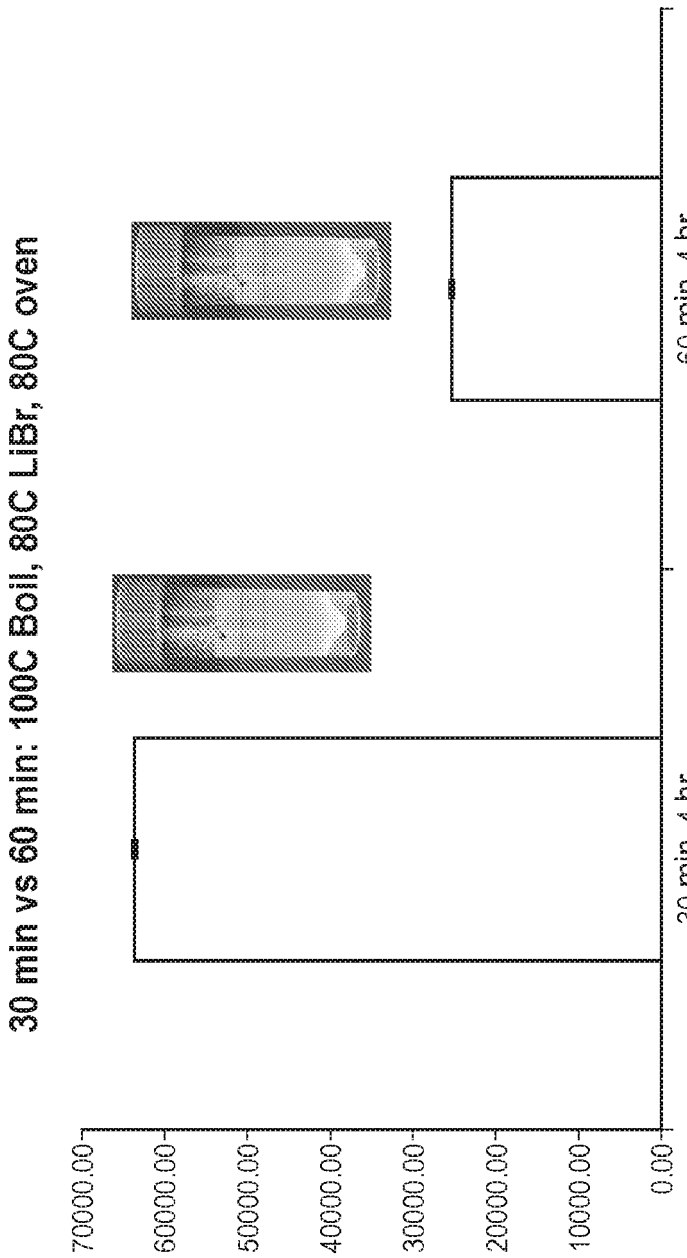

30 min vs 60 min: 100C Boil, 80C LiBr, 80C oven
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
30 min, 4 hr
60 min, 4 hr

FIG. 43

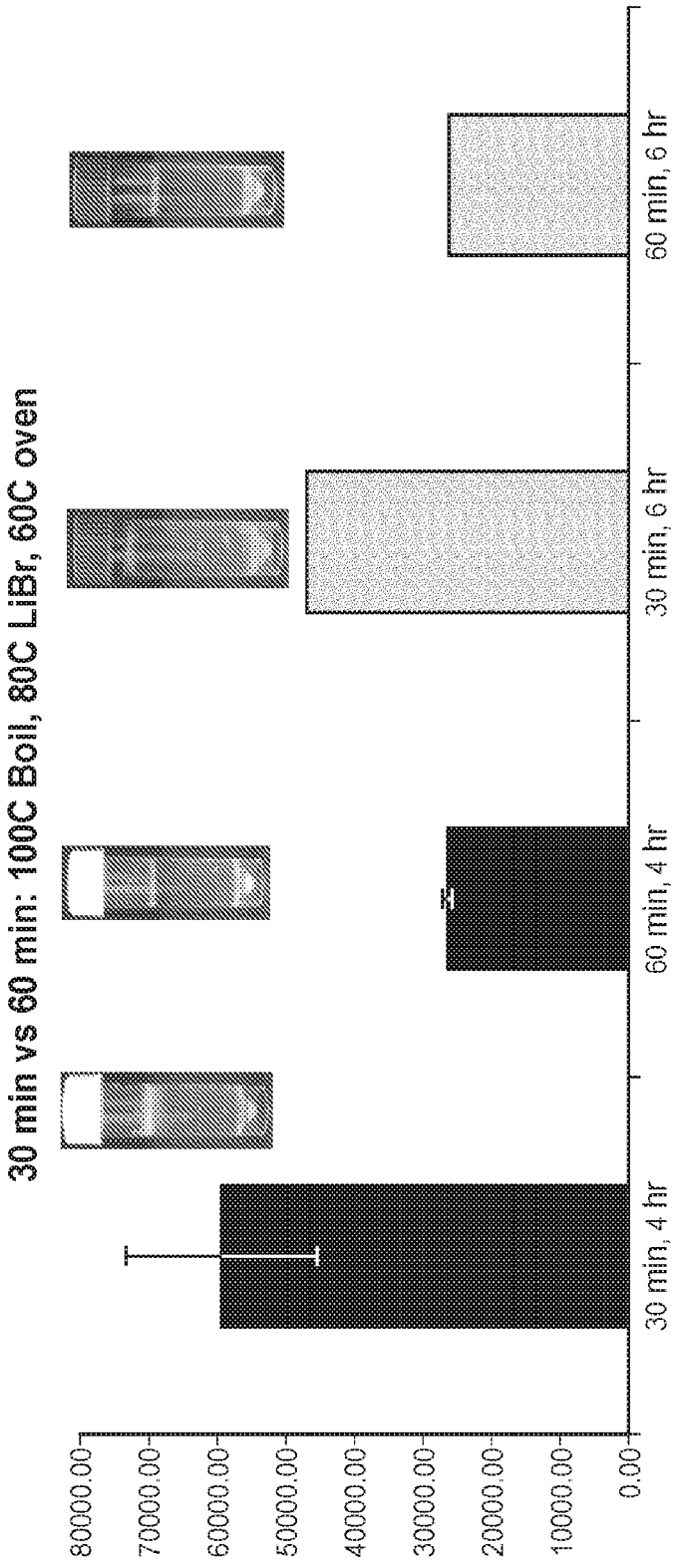

30 min vs 60 min: 100C Boil, 80C LiBr, 60C oven
80000.00
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
30 min, 4 hr
60 min, 4 hr
30 min, 6 hr
60 min, 6 hr

FIG. 44

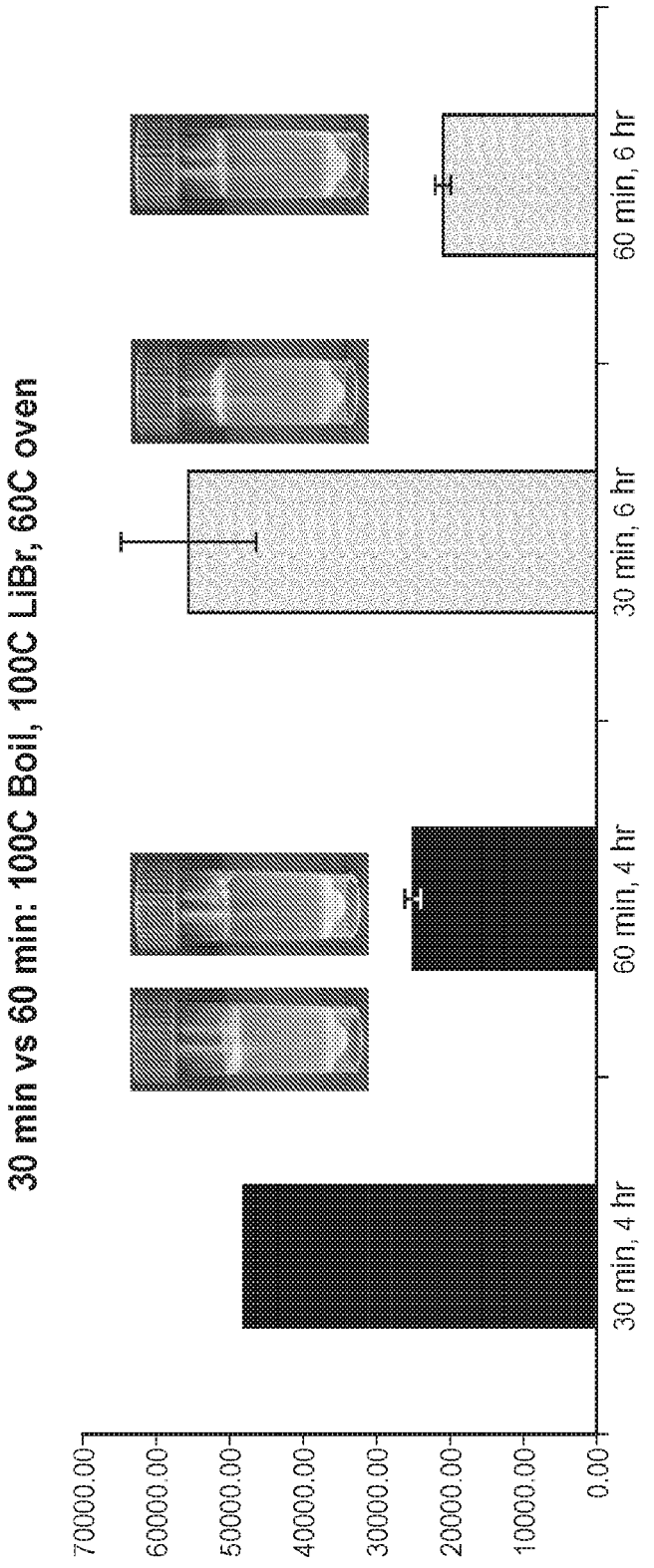

30 min vs 60 min: 100C Boil, 100C LiBr, 60C oven
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
30 min, 4 hr
60 min, 4 hr
30 min, 6 hr
60 min, 6 hr

FIG. 45

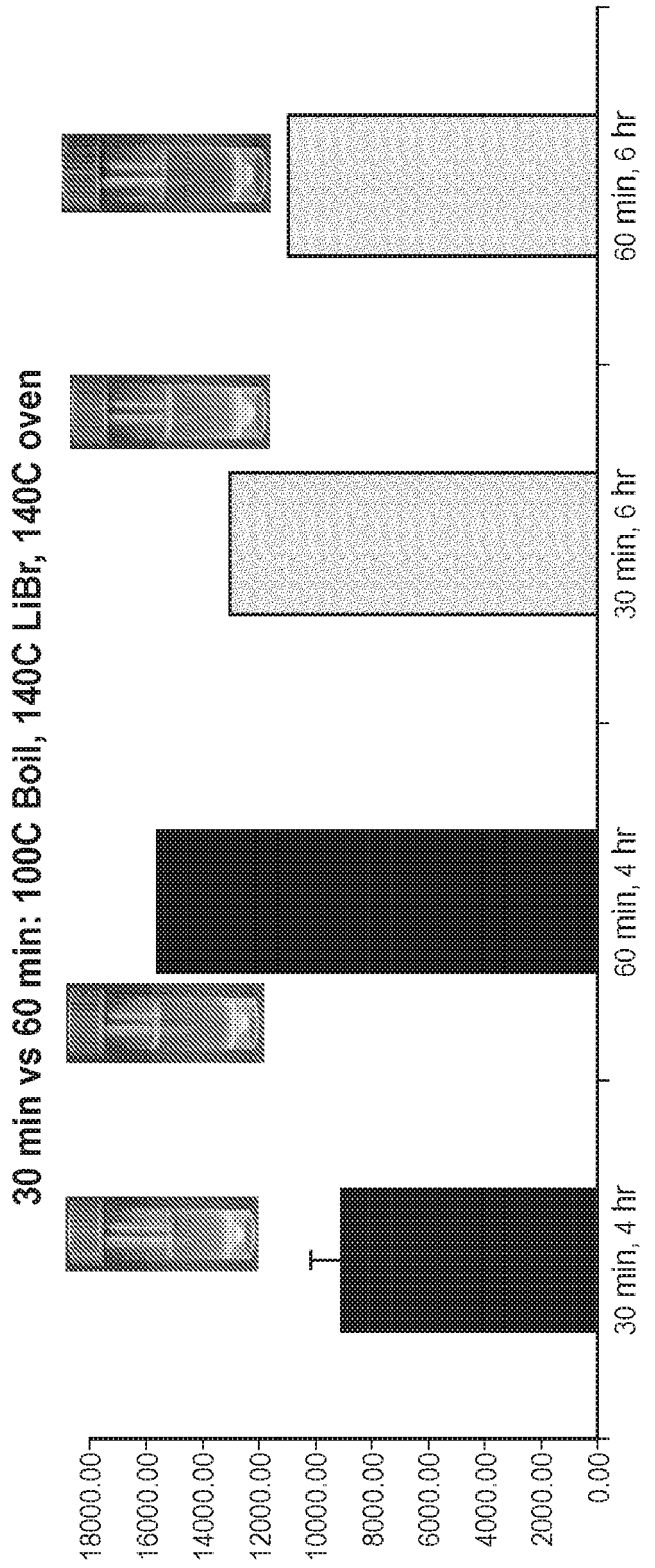

30 min vs 60 min: 100C Boil, 140C LiBr, 140C oven
18000.00
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
30 min, 4 hr
60 min, 4 hr
30 min, 6 hr
60 min, 6 hr

FIG. 46

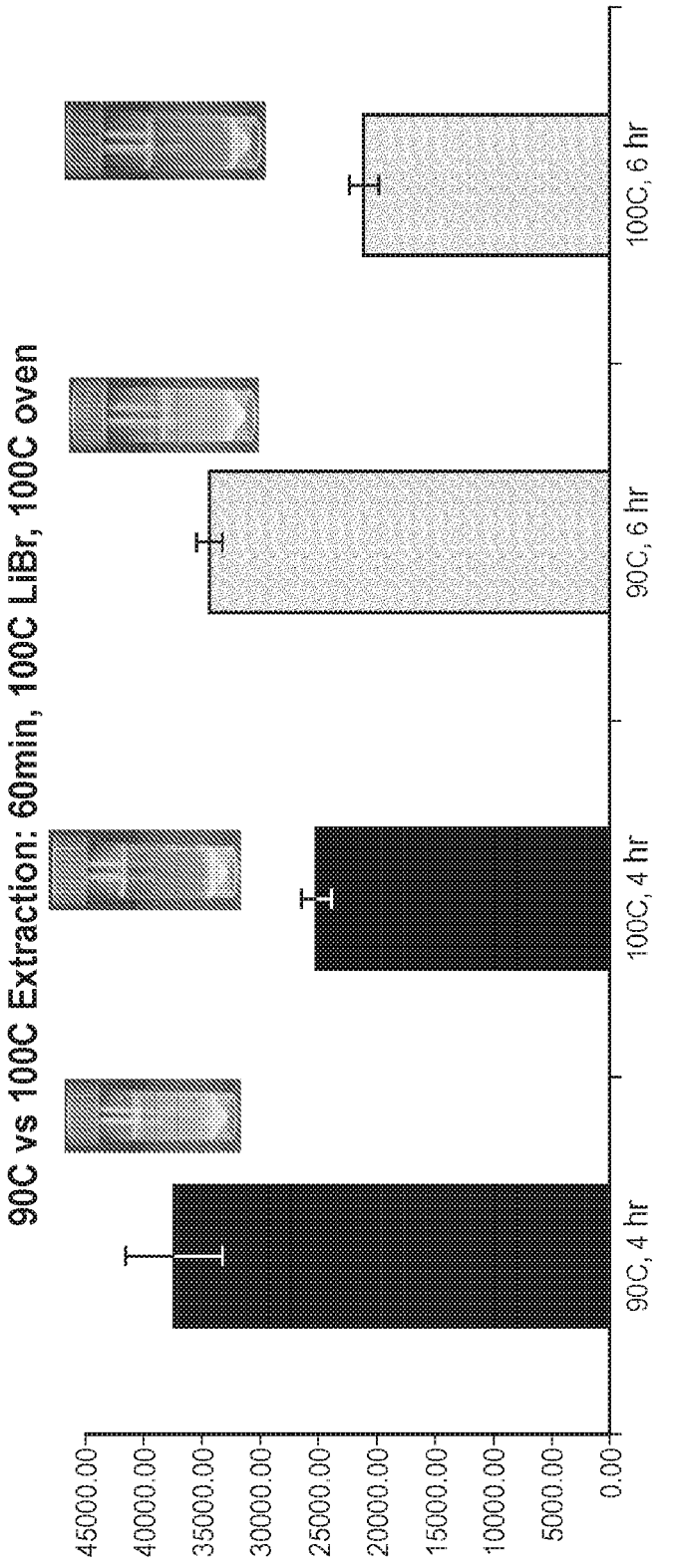

90C vs 100C Extraction: 60min, 100C LiBr, 100C oven
45000.00
40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
90C, 4 hr
100C, 4 hr
90C, 6 hr
100C, 6 hr

FIG. 47

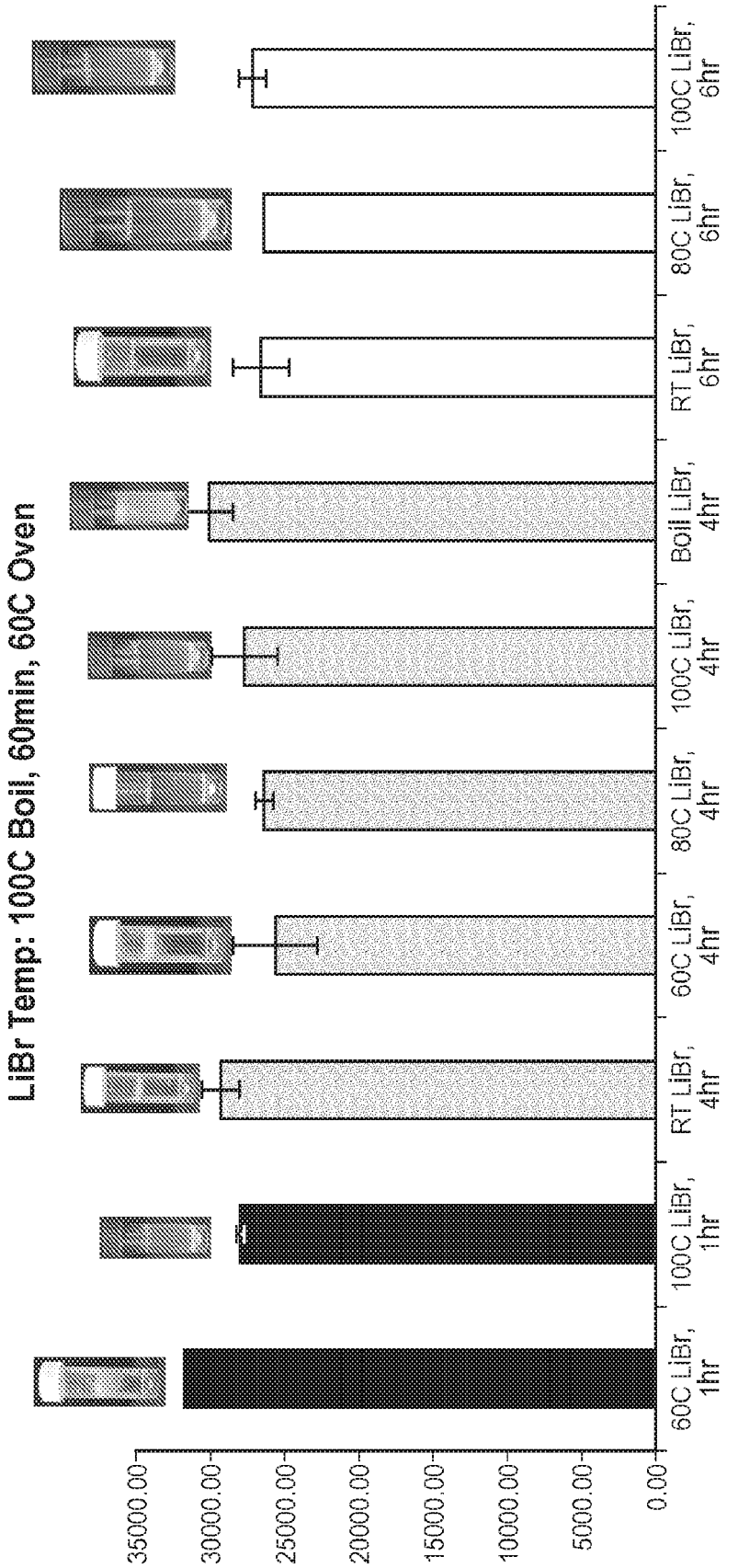

LiBr Temp: 100C Boil, 60min, 60C Oven
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
60C LiBr, 1hr
100C LiBr, 1hr
RT LiBr, 4hr
60C LiBr, 4hr
80C LiBr, 4hr
100C LiBr, 4hr
Boil LiBr, 4hr
RT LiBr, 6hr
80C LiBr, 6hr
100C LiBr, 6hr

FIG. 48

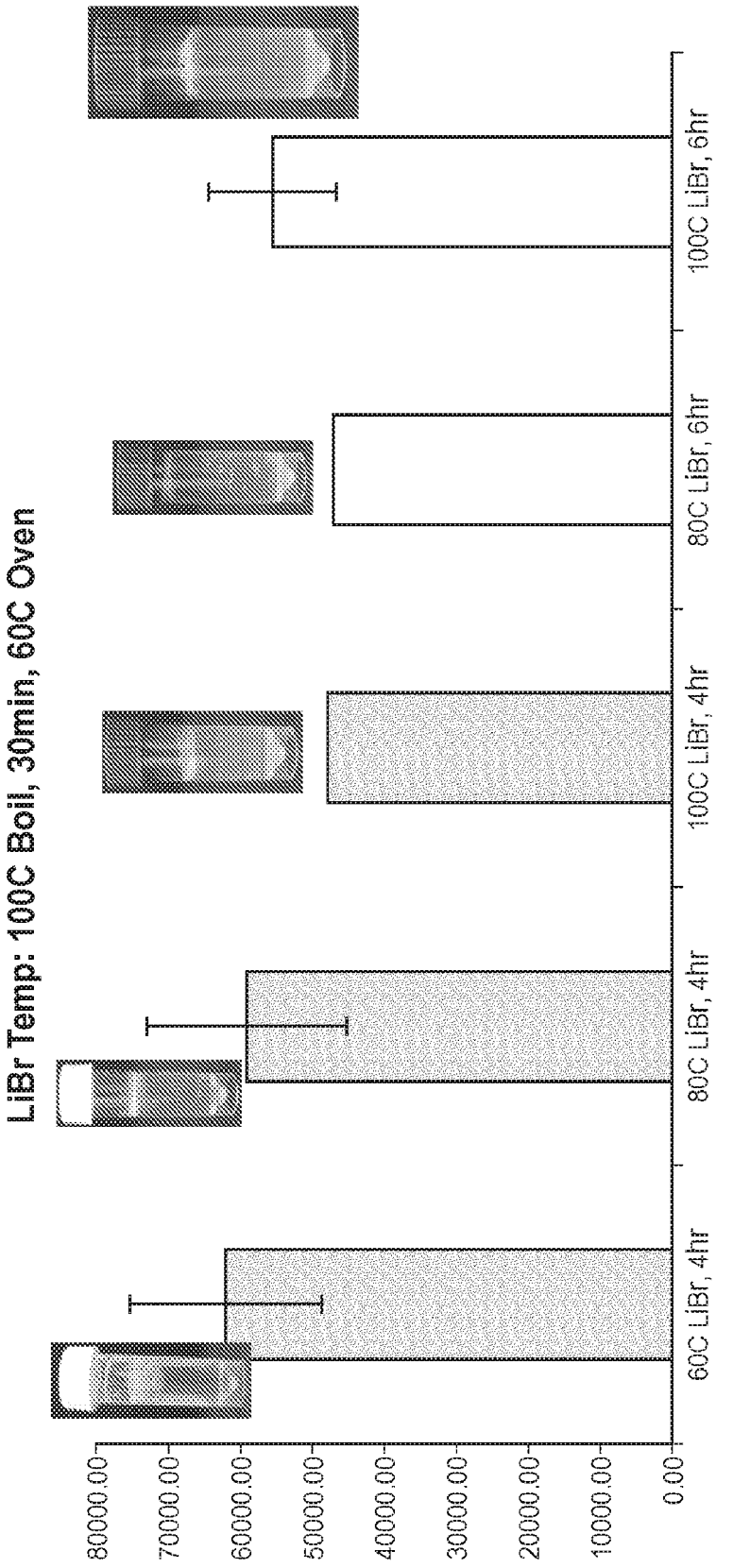

LiBr Temp: 100C Boil, 30min, 60C Oven
80000.00
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
60C LiBr, 4hr
80C LiBr, 4hr
100C LiBr, 4hr
80C LiBr, 6hr
100C LiBr, 6hr

FIG. 49

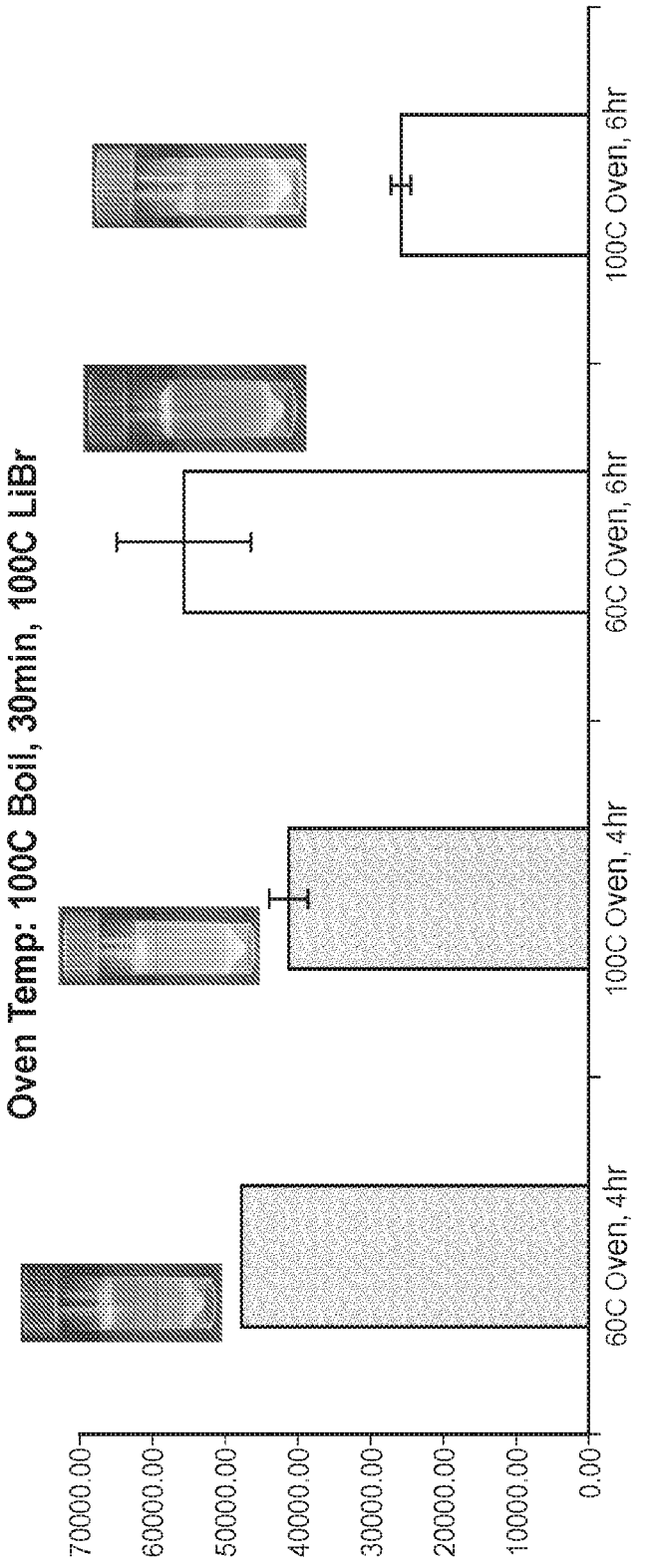

Oven Temp: 100C Boil, 30min, 100C LiBr
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
60C Oven, 4hr
100C Oven, 4hr
60C Oven, 6hr
100C Oven, 6hr

FIG. 50

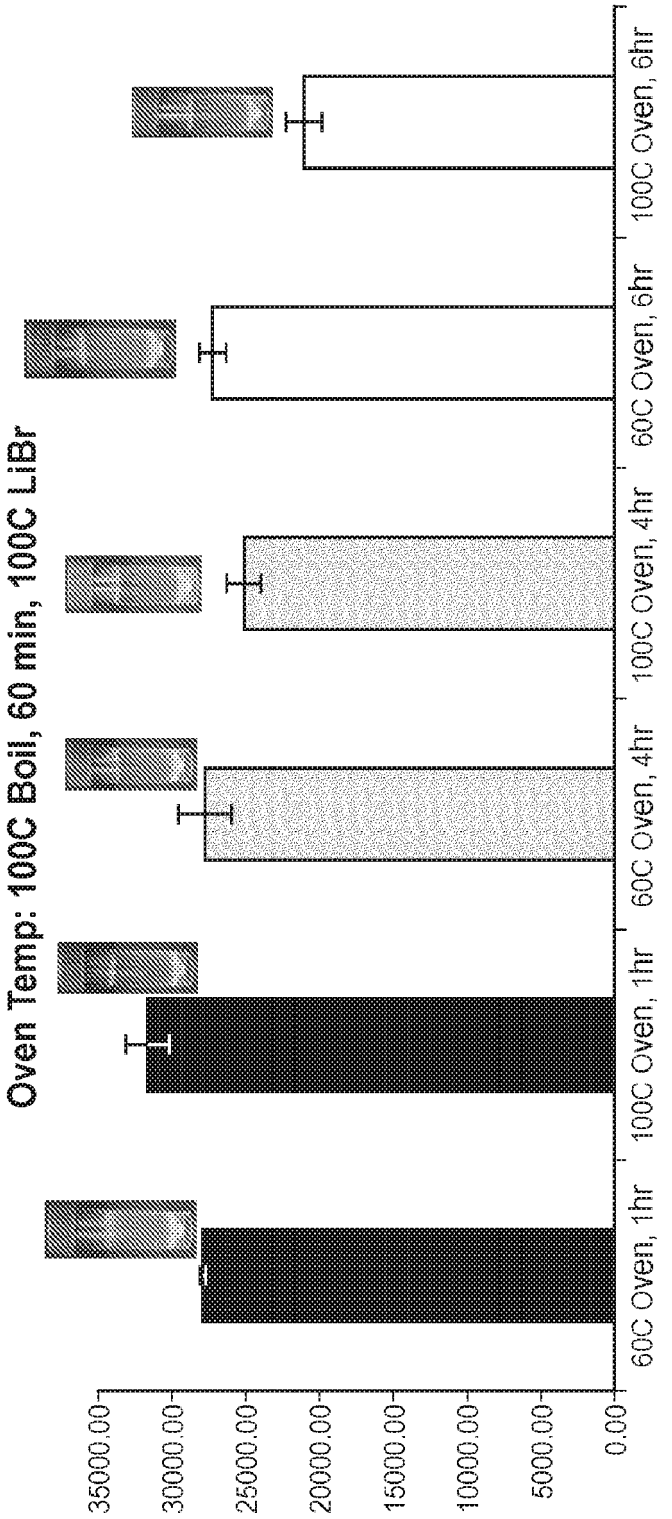

Oven Temp: 100C Boil, 60 min, 100C LiBr
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
60C Oven, 1hr
100C Oven, 1hr
60C Oven, 4hr
100C Oven, 4hr
60C Oven, 6hr
100C Oven, 6hr

FIG. 51

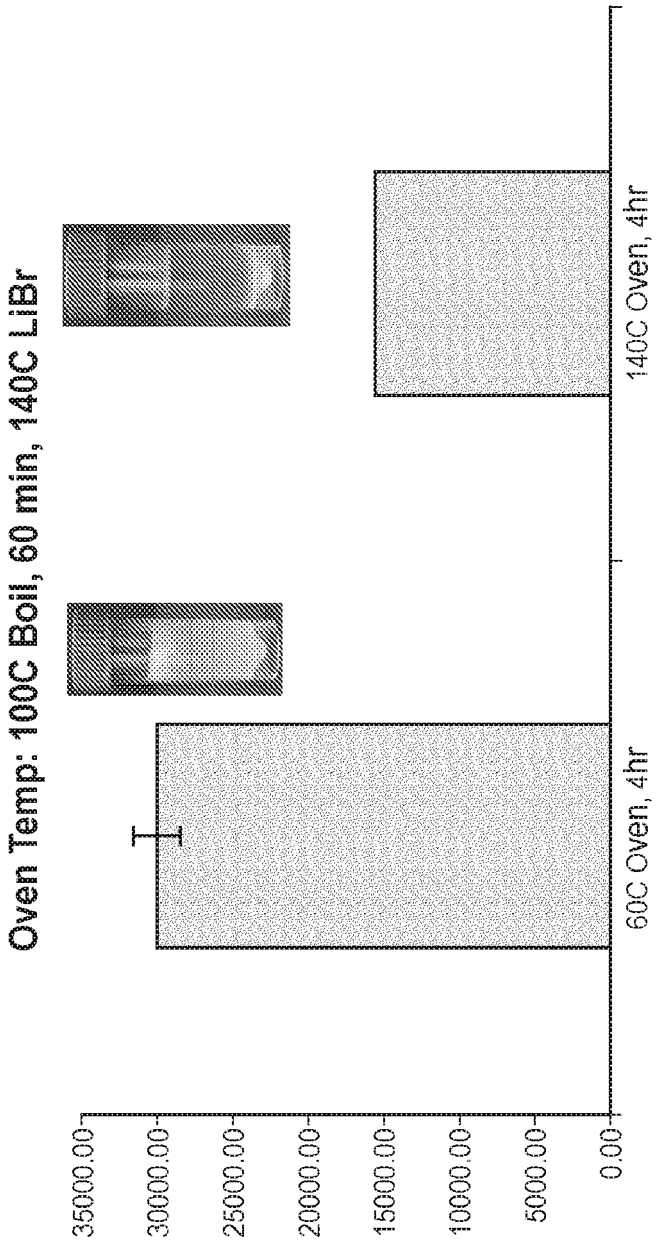

Oven Temp: 100C Boil, 60 min, 140C LiBr
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
60C Oven, 4hr
140C Oven, 4hr

FIG. 52

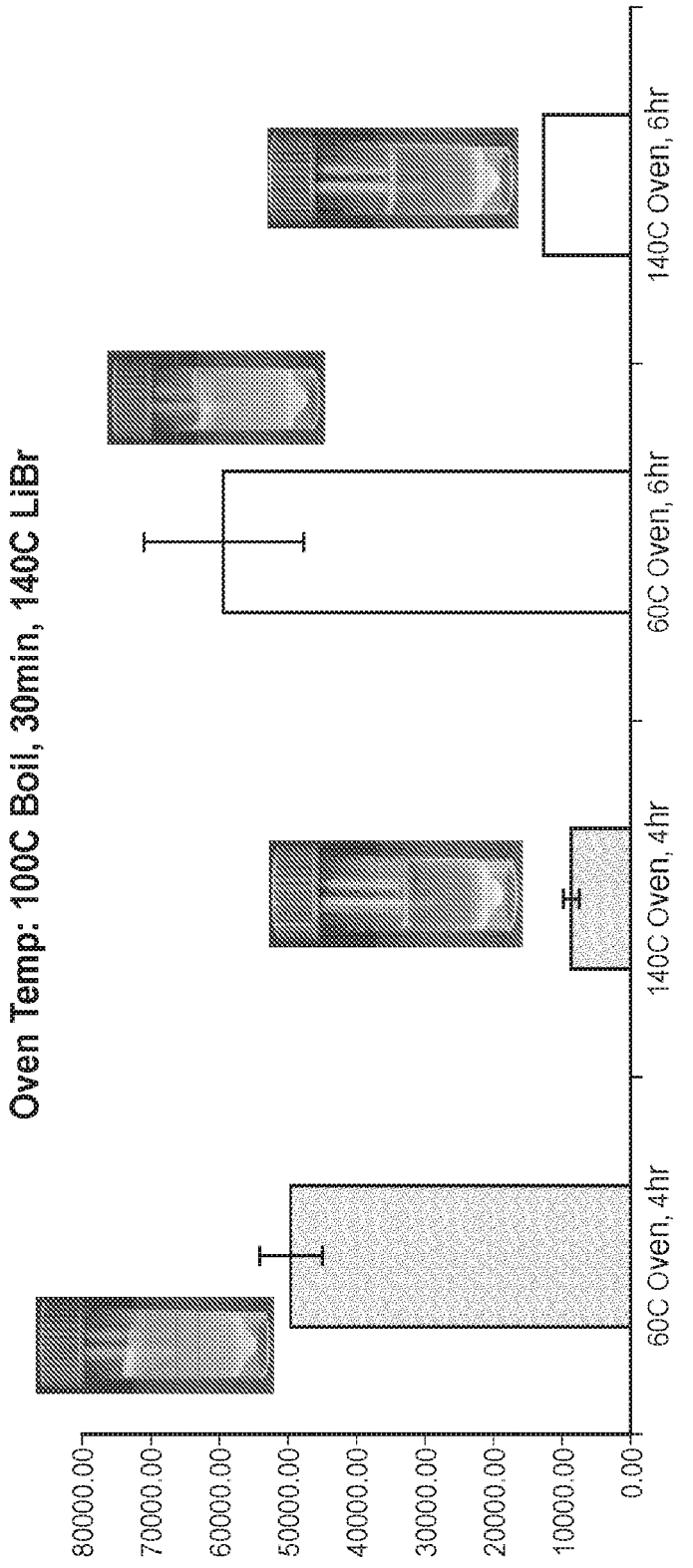

Oven Temp: 100C Boil, 30min, 140C LiBr
80000.00
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
60C Oven, 4hr
140C Oven, 4hr
60C Oven, 6hr
140C Oven, 6hr

FIG. 53

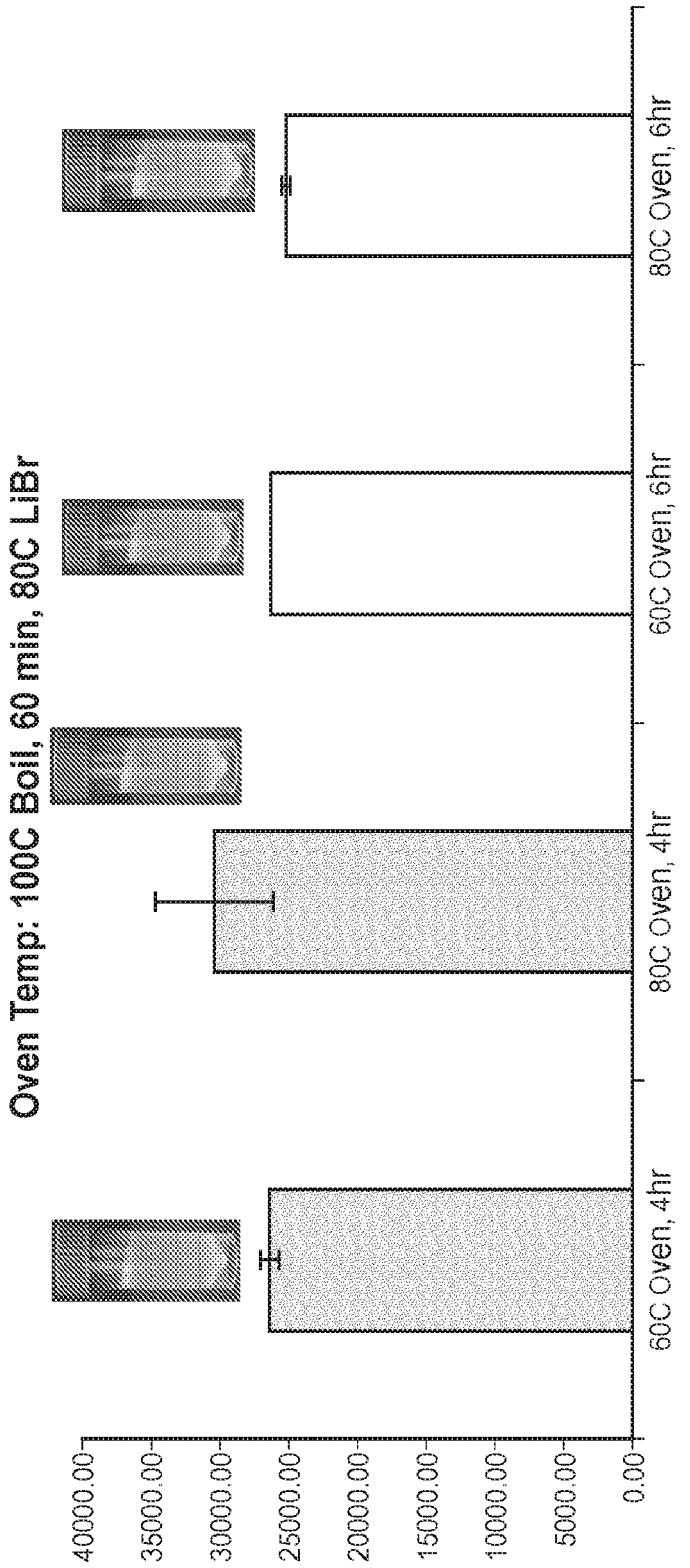

Oven Temp: 100C Boil, 60 min, 80C LiBr
40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
60C Oven, 4hr
80C Oven, 4hr
60C Oven, 6hr
80C Oven, 6hr

FIG. 54

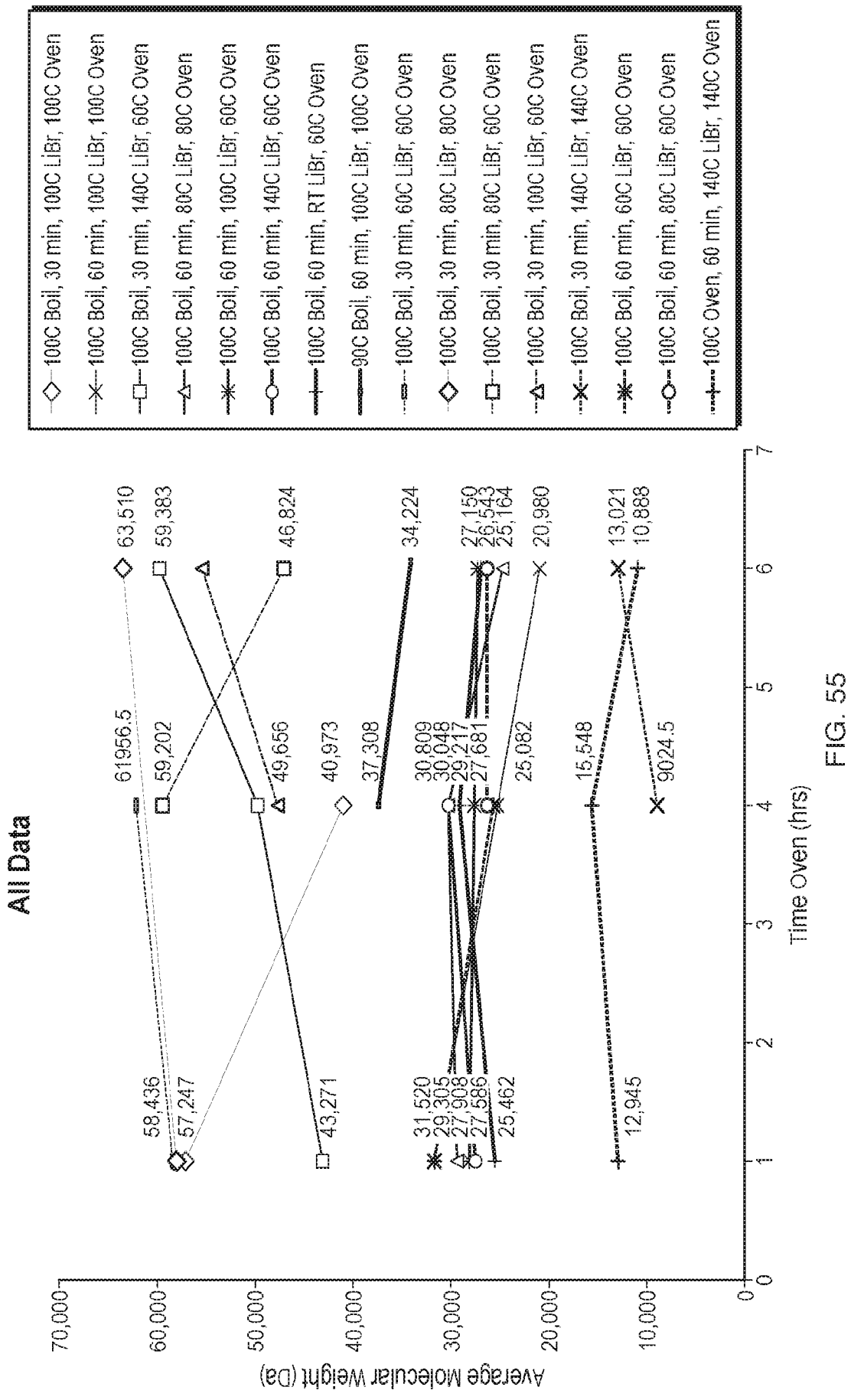

All Data
Average Molecular Weight (Da)
Time Oven (hrs)
100C Boil, 30 min, 100C LiBr, 100C Oven
100C Boil, 60 min, 100C LiBr, 100C Oven
100C Boil, 30 min, 140C LiBr, 60C Oven
100C Boil, 60 min, 80C LiBr, 80C Oven
100C Boil, 60 min, 100C LiBr, 60C Oven
100C Boil, 60 min, 140C LiBr, 60C Oven
100C Boil, 60 min, RT LiBr, 60C Oven
90C Boil, 60 min, 100C LiBr, 100C Oven
100C Boil, 30 min, 60C LiBr, 60C Oven
100C Boil, 30 min, 80C LiBr, 80C Oven
100C Boil, 30 min, 80C LiBr, 60C Oven
100C Boil, 30 min, 100C LiBr, 60C Oven
100C Boil, 30 min, 140C LiBr, 140C Oven
100C Boil, 60 min, 60C LiBr, 60C Oven
100C Boil, 60 min, 80C LiBr, 60C Oven
100C Oven, 60 min, 140C LiBr, 140C Oven
63,510
59,383
46,824
61956.5
59,202
49,656
40,973
37,308
34,224
58,436
57,247
43,271
30,809
30,048
29,217
27,681
27,150
26,543
25,164
25,082
20,980
31,520
29,305
27,908
27,586
25,462
15,548
13,021
10,888
12,945
9024.5

FIG. 55

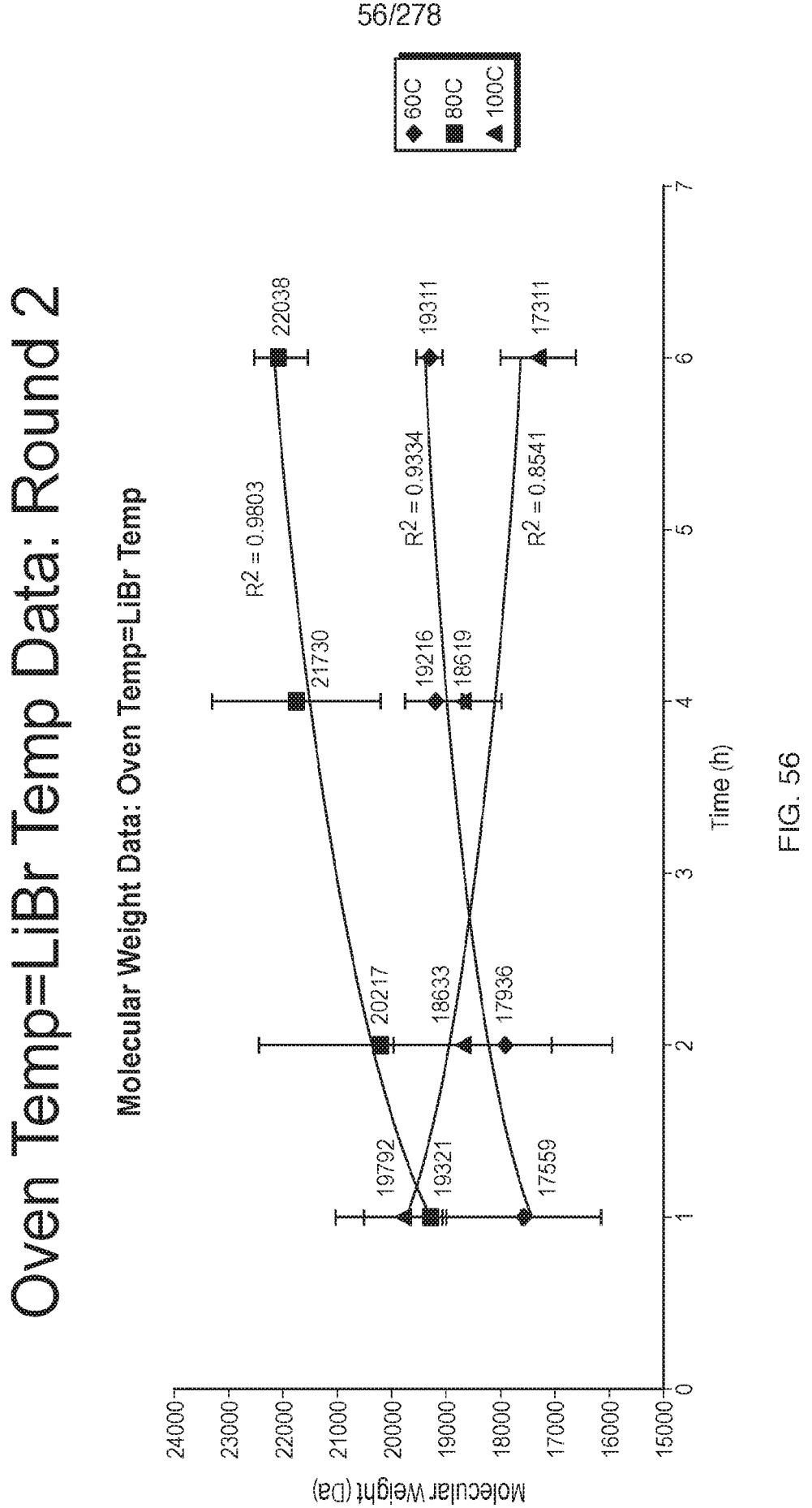

Oven Temp=LiBr Temp Data: Round 2
Molecular Weight Data: Oven Temp=LiBr Temp
60C
80C
100C
R2 = 0.9803
R2 = 0.9334
R2 = 0.8541
22038
21730
20217
19792
19321
19311
19216
18633
18619
17936
17559
17311
Molecular Weight (Da)
Time (h)
24000
23000
22000
21000
20000
19000
18000
17000
16000
15000
0
1
2
3
4
5
6
7

FIG. 56

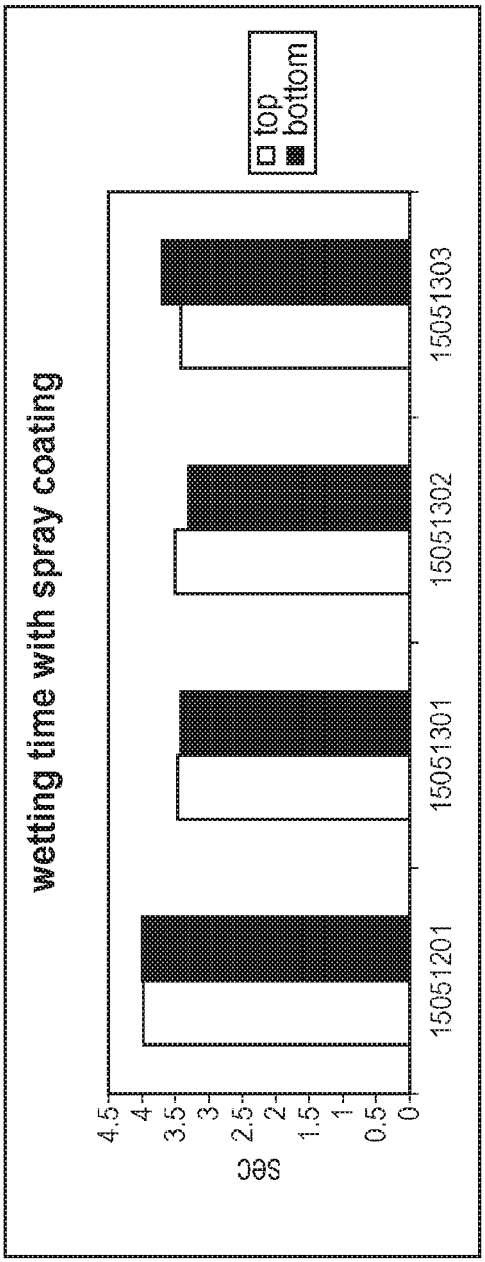


FIG. 57A

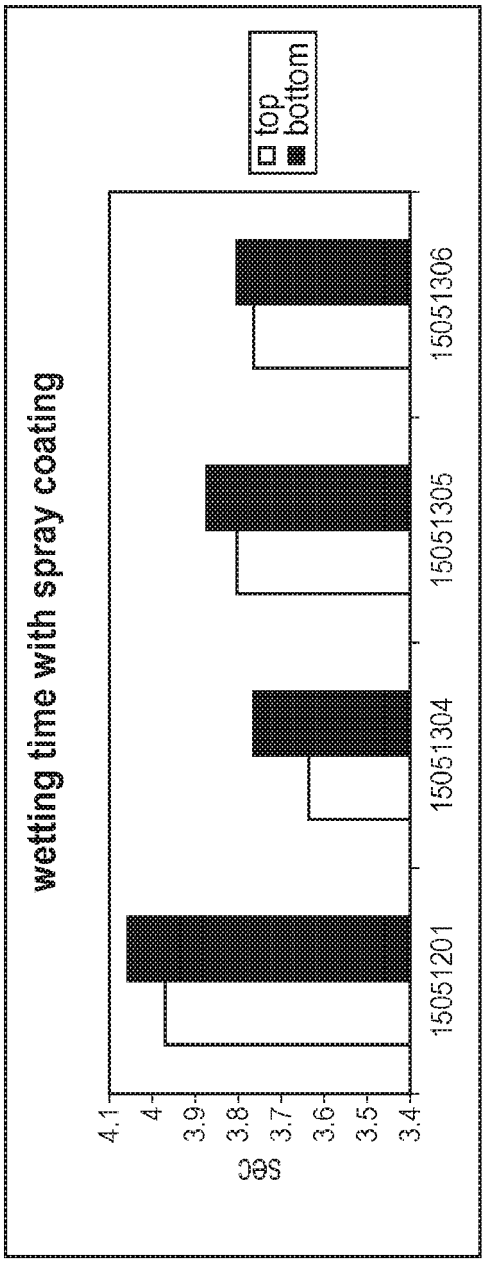


FIG. 57B

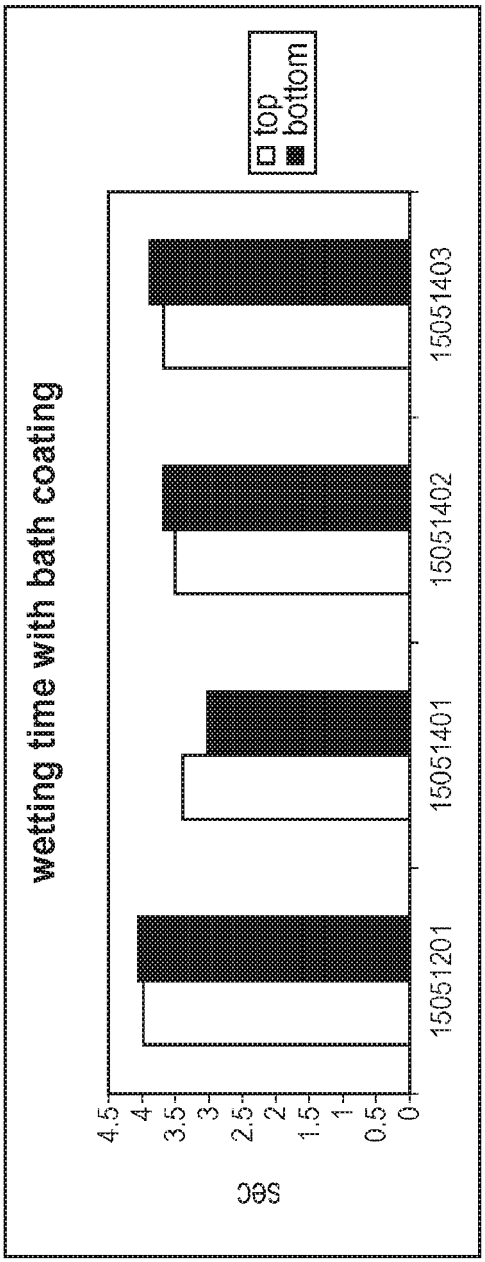


FIG. 57C

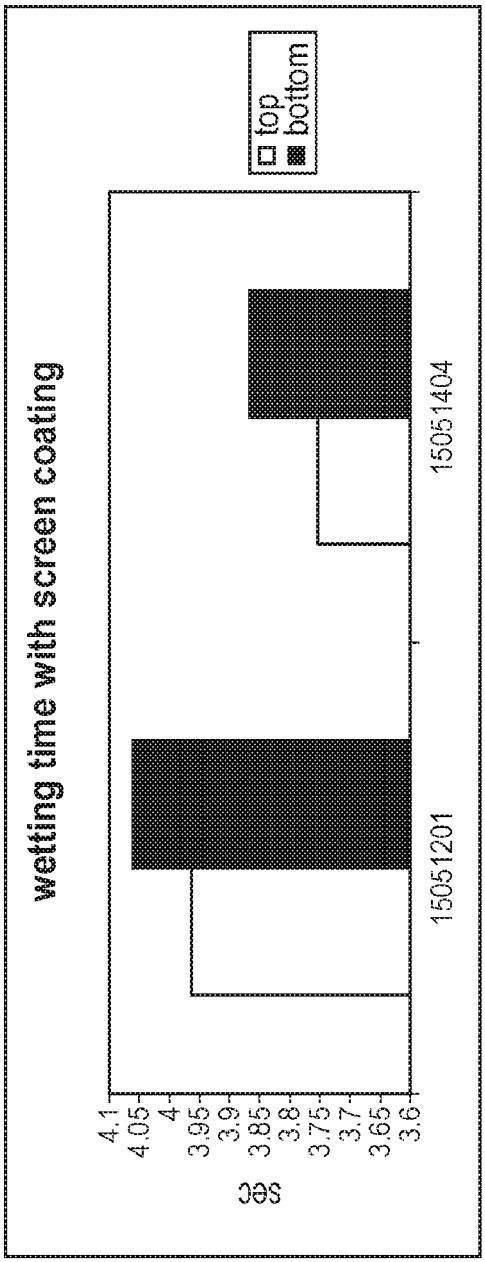


FIG. 57D

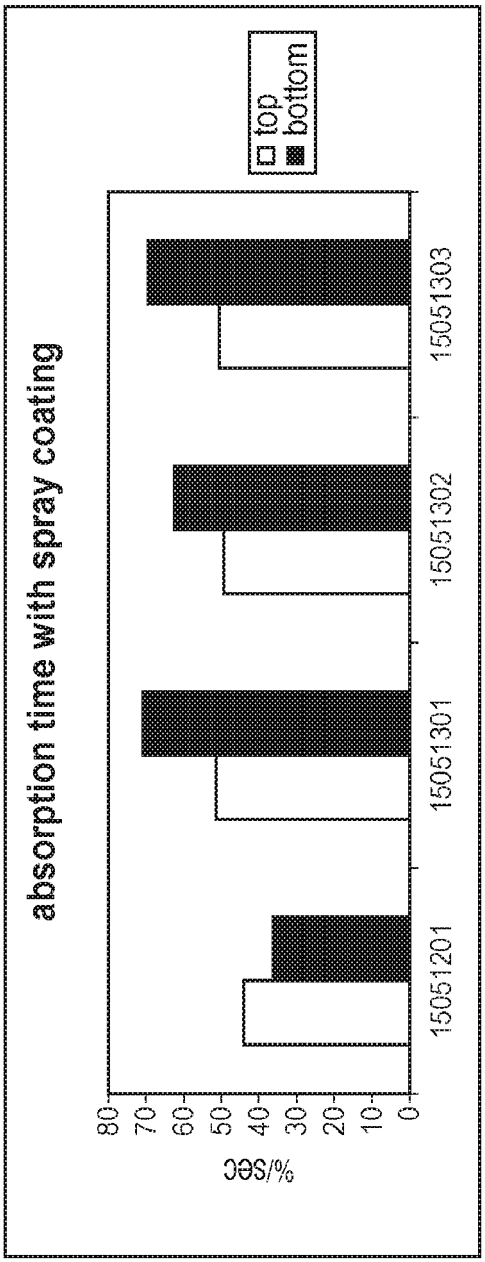


FIG. 58A

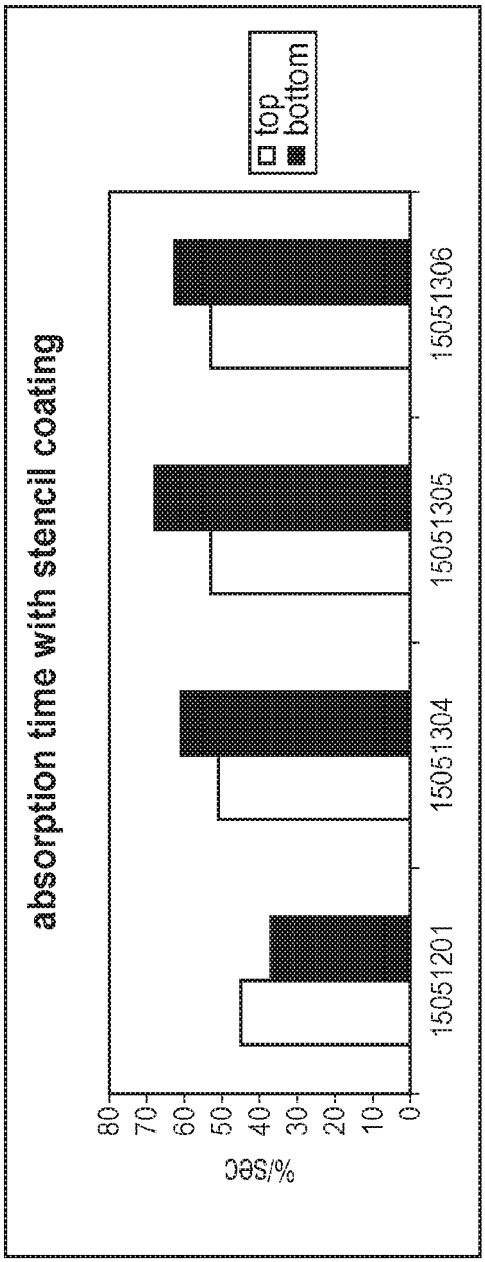


FIG. 58B

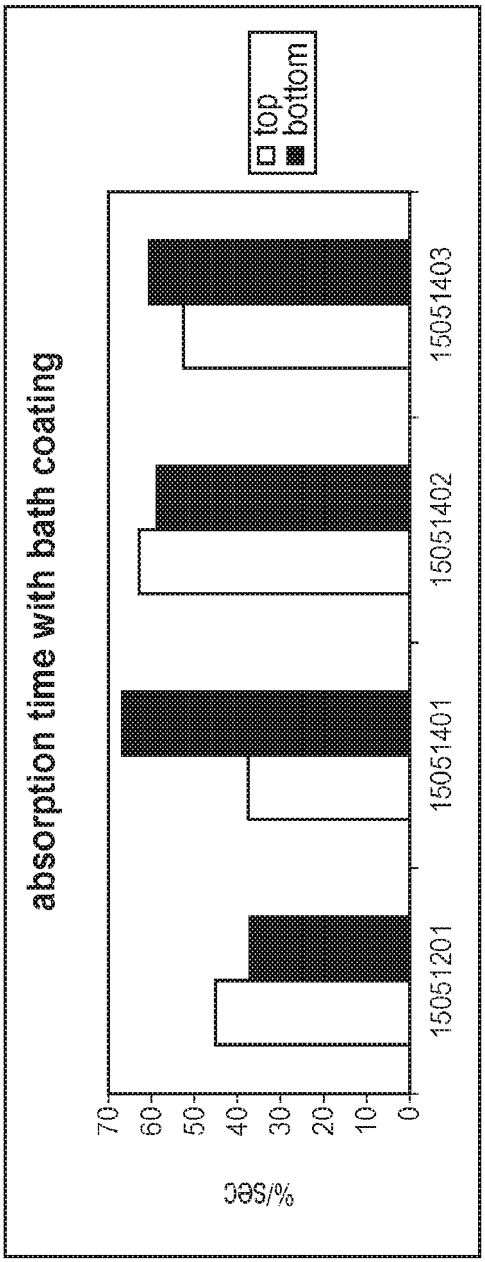


FIG. 58C

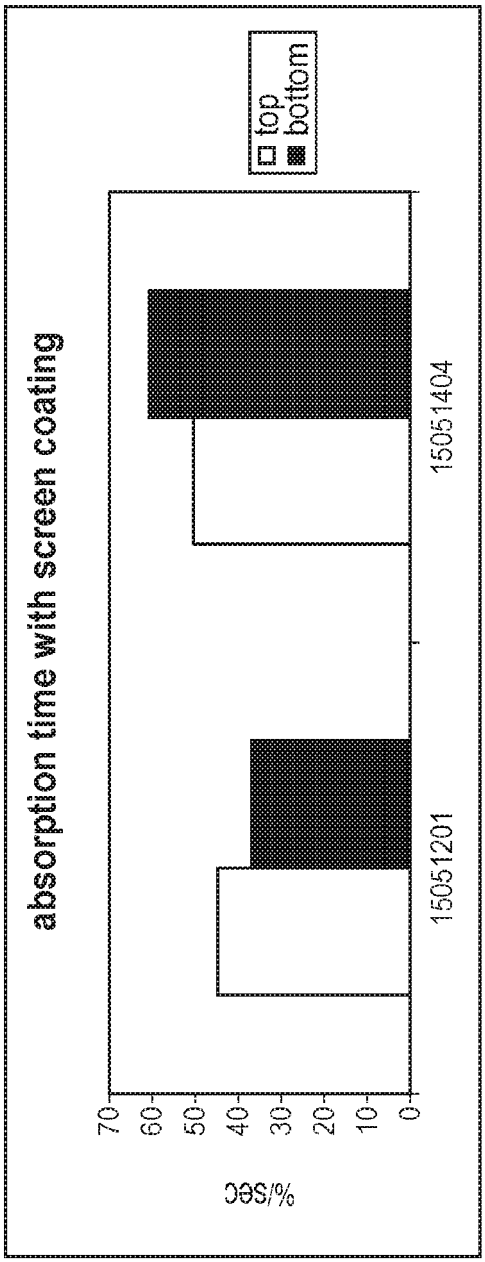


FIG. 58D

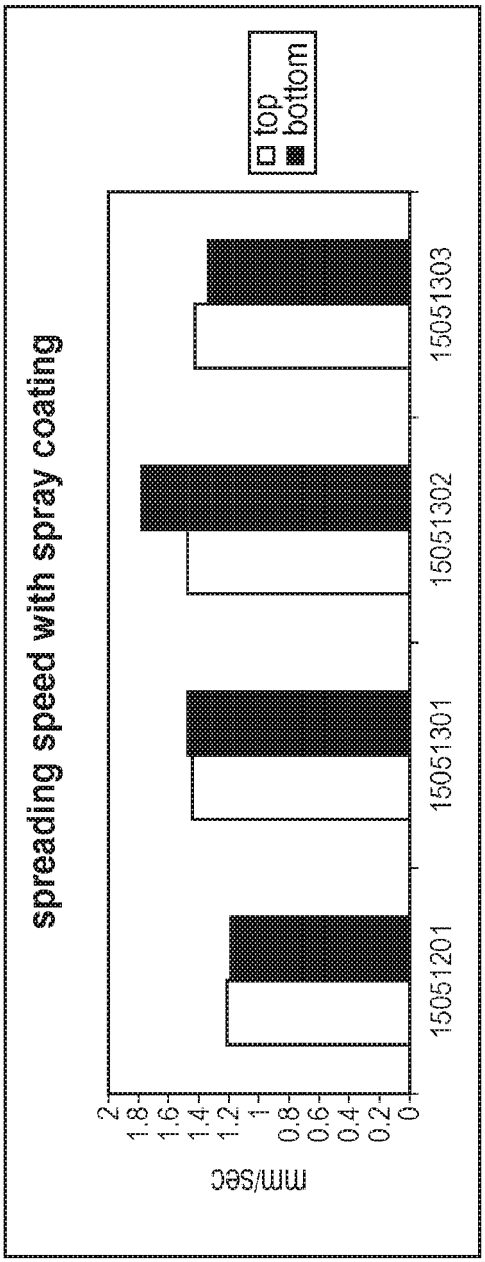


FIG. 59A

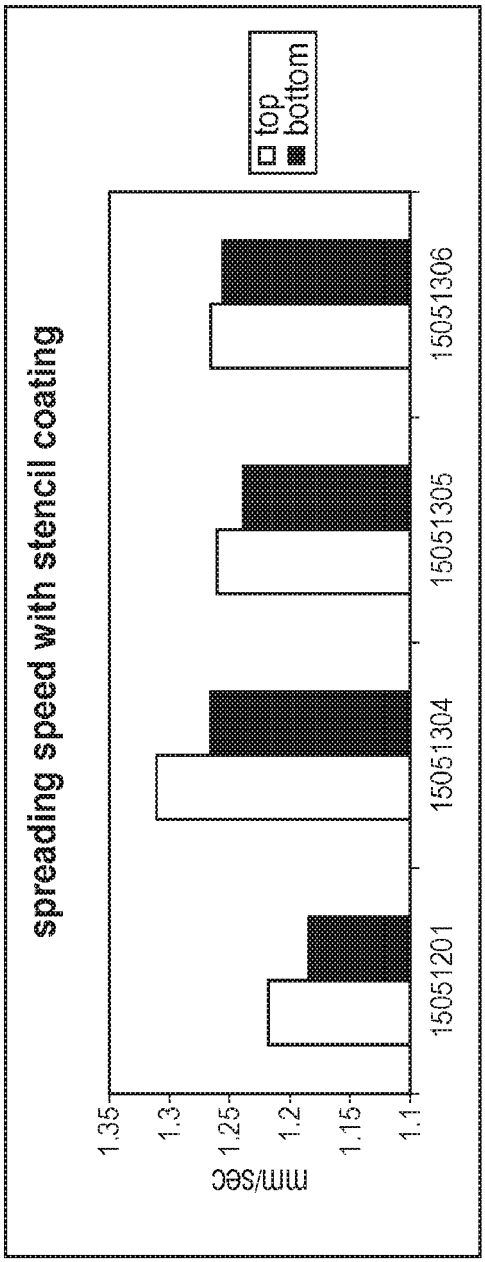


FIG. 59B

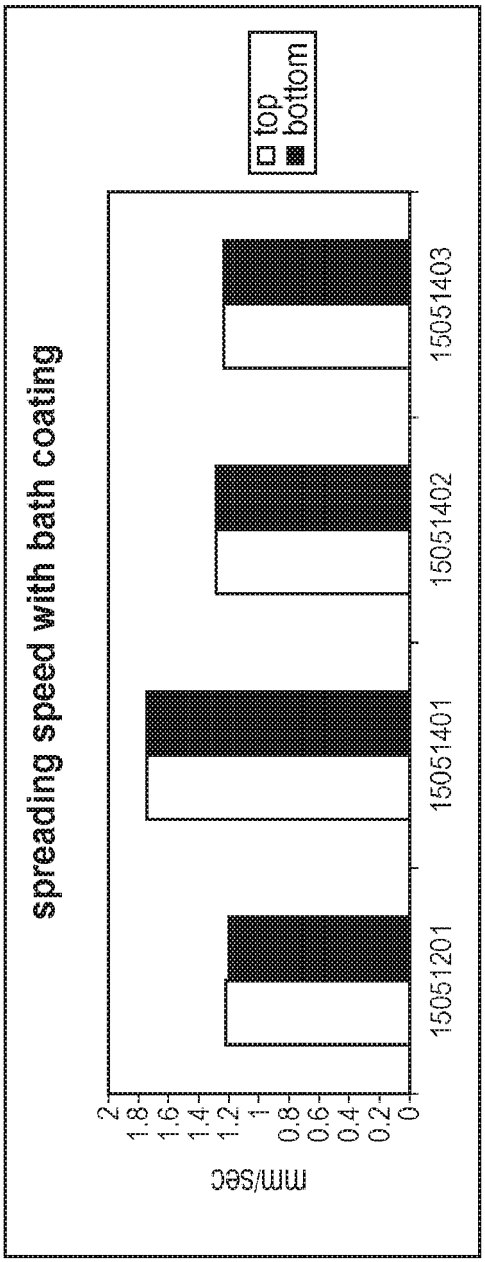


FIG. 59C

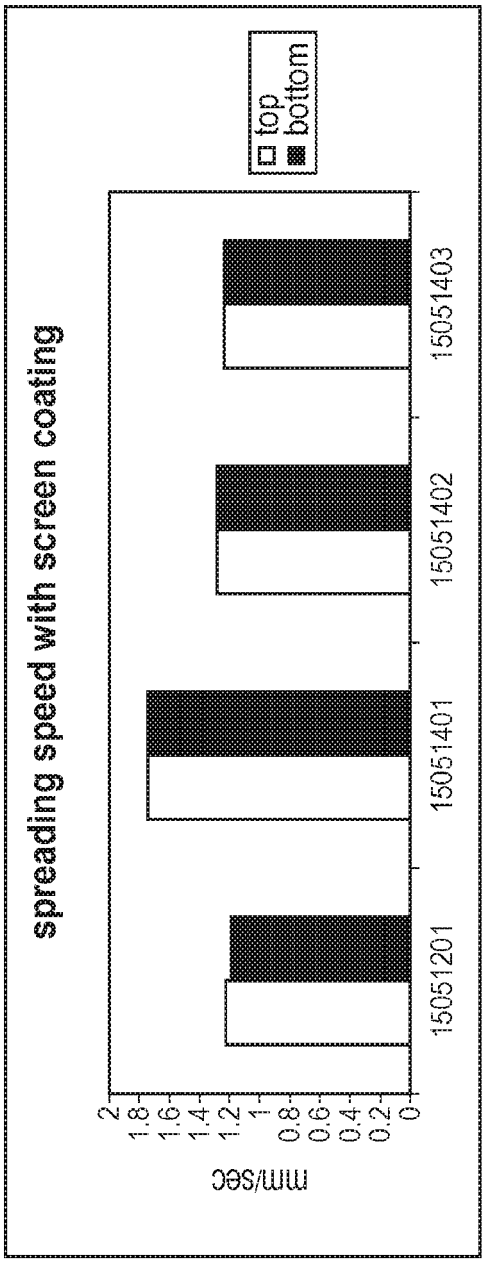


FIG. 59D

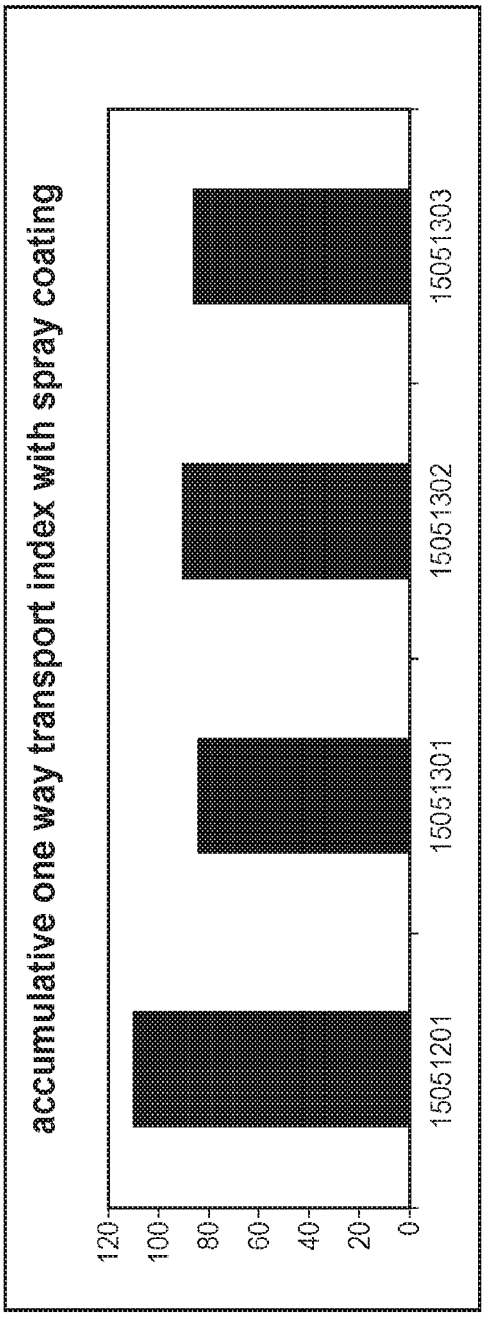


FIG. 60A

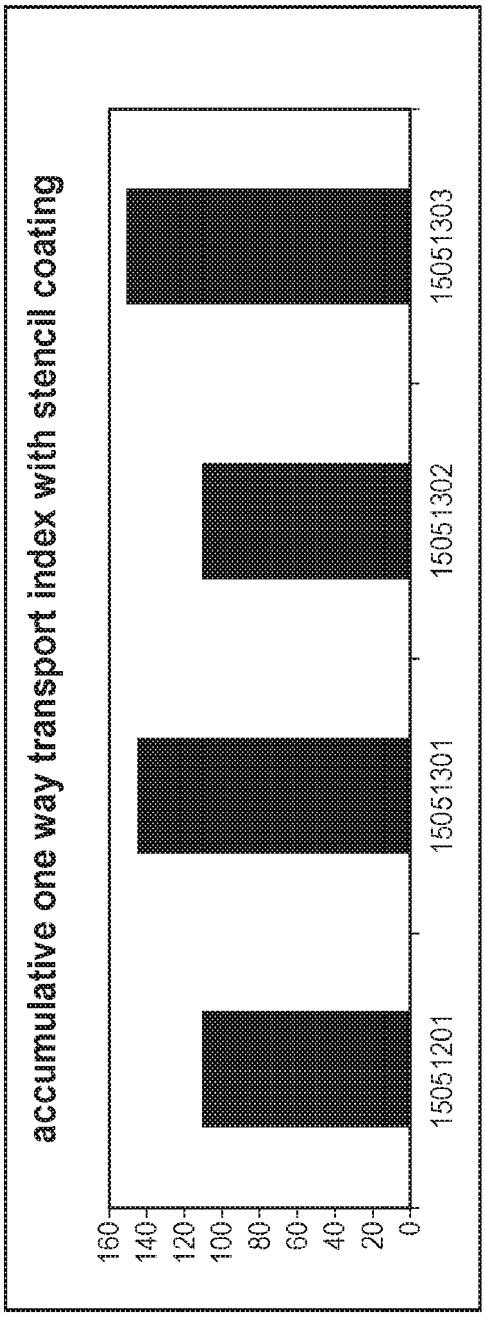


FIG. 60B

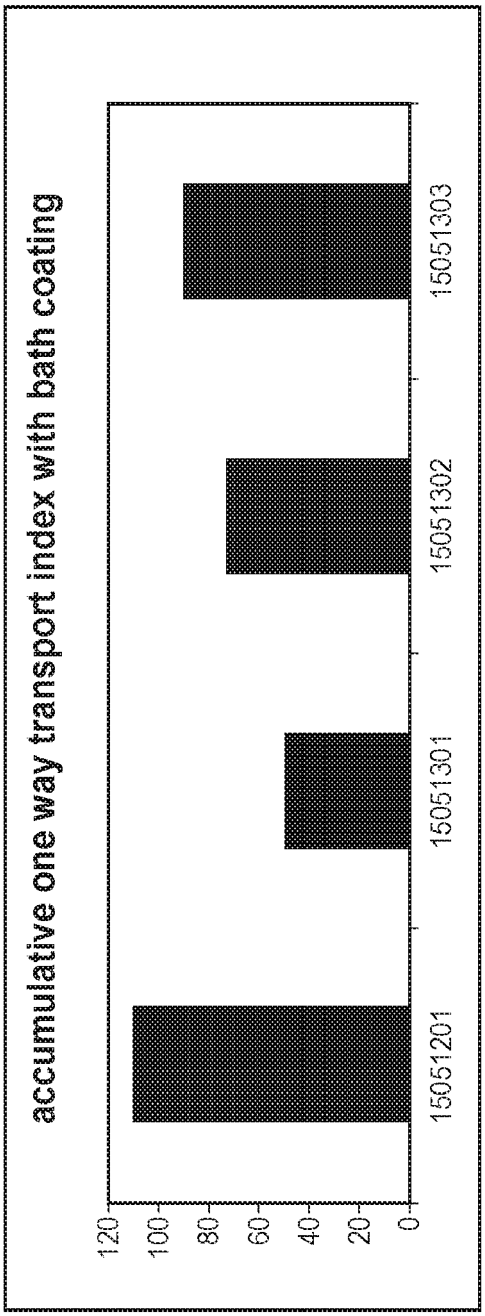


FIG. 60C

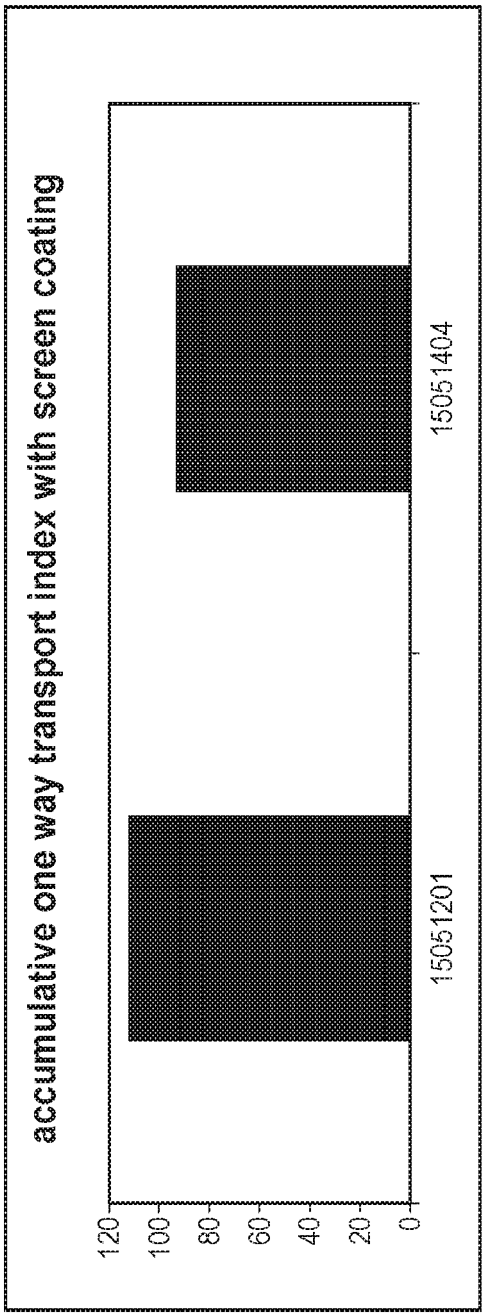


FIG. 60D

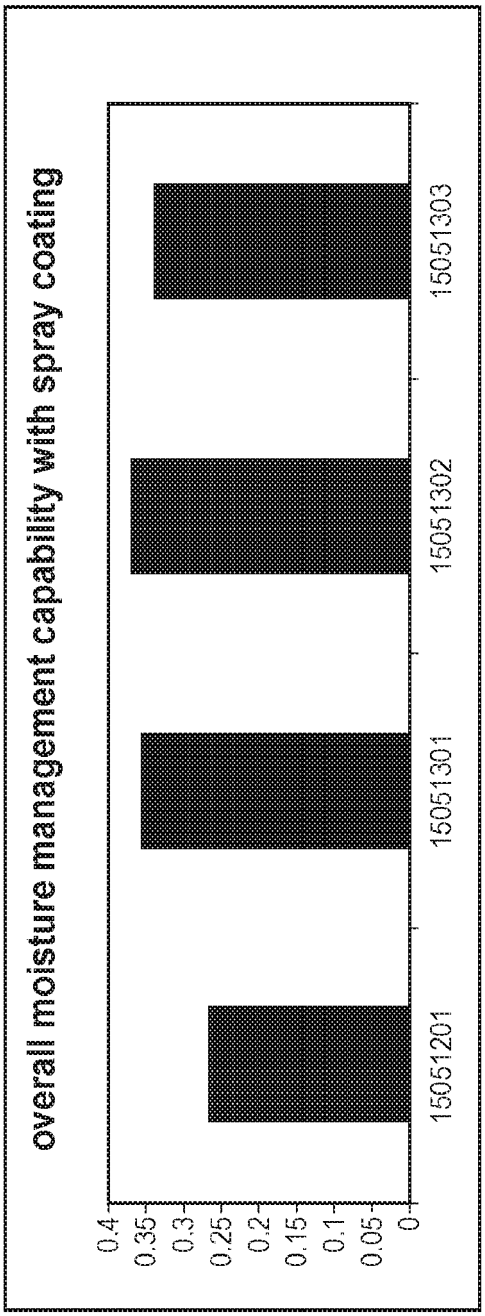


FIG. 61A

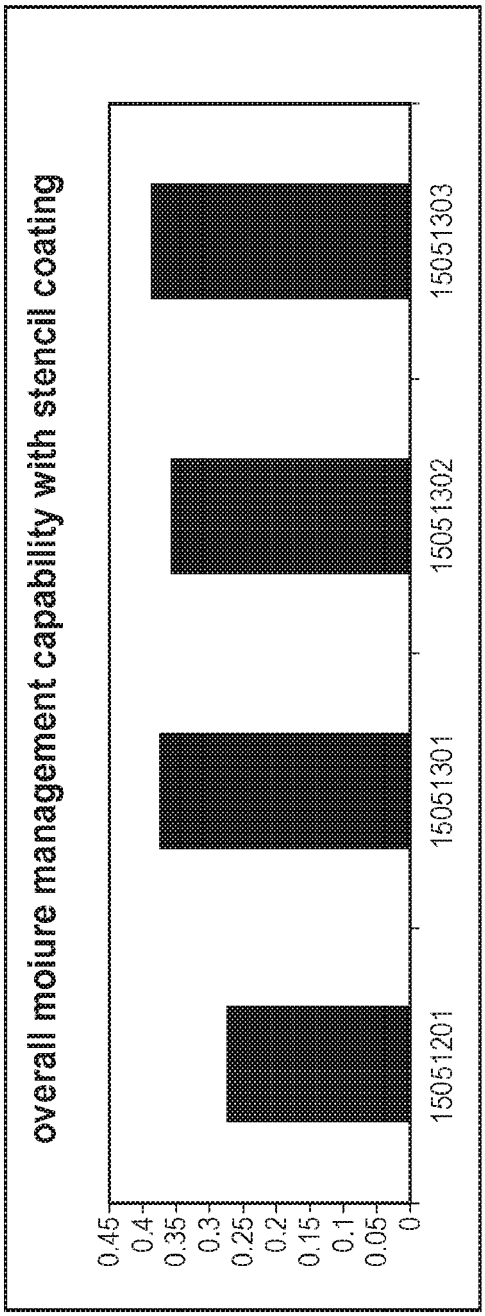


FIG. 61B

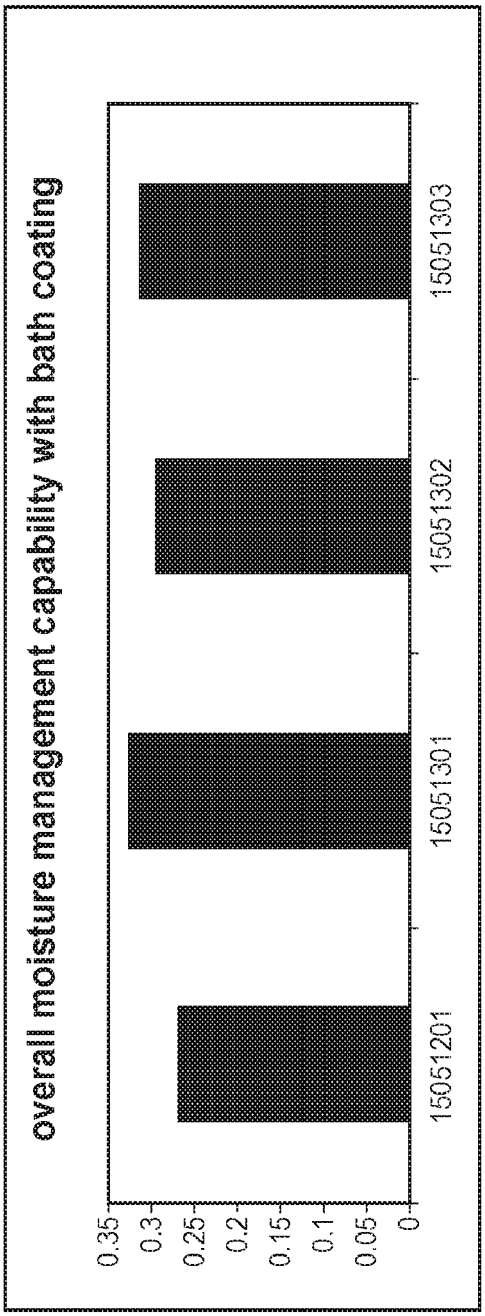


FIG. 61C

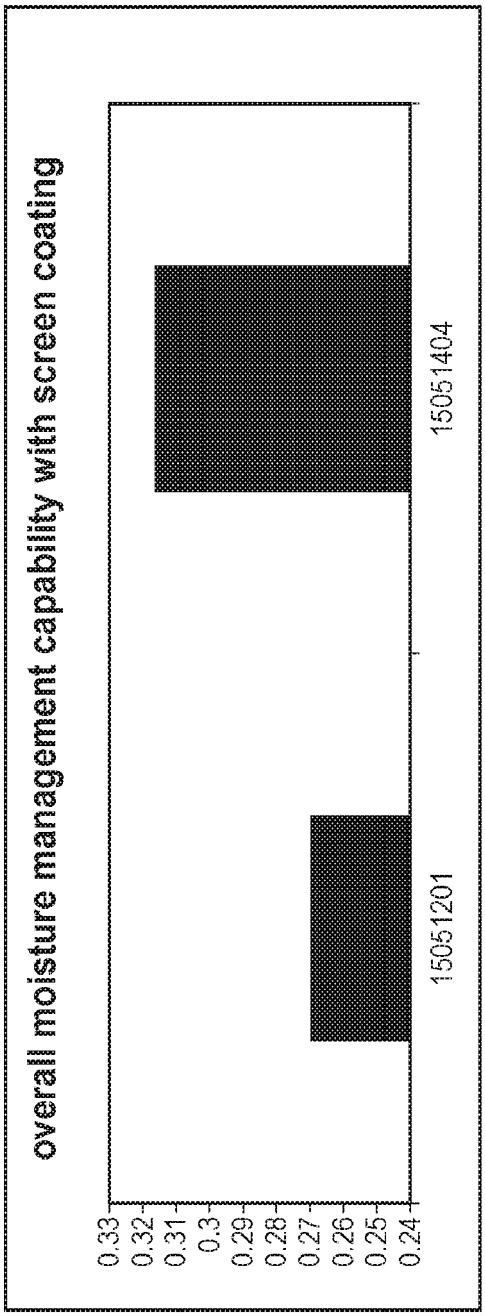


FIG. 61D

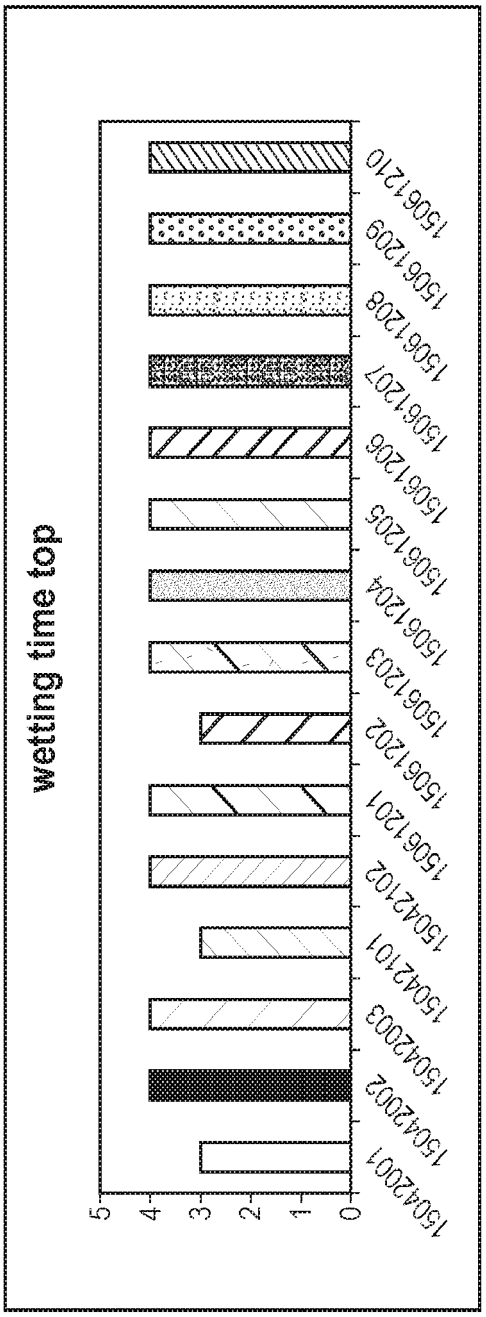


FIG. 62A

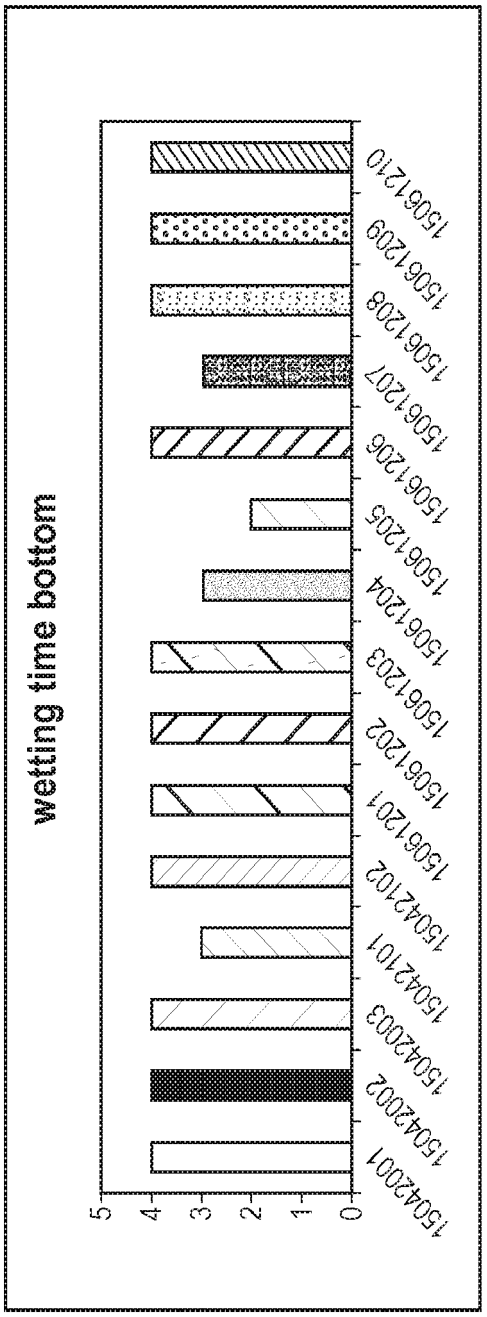


FIG. 62B

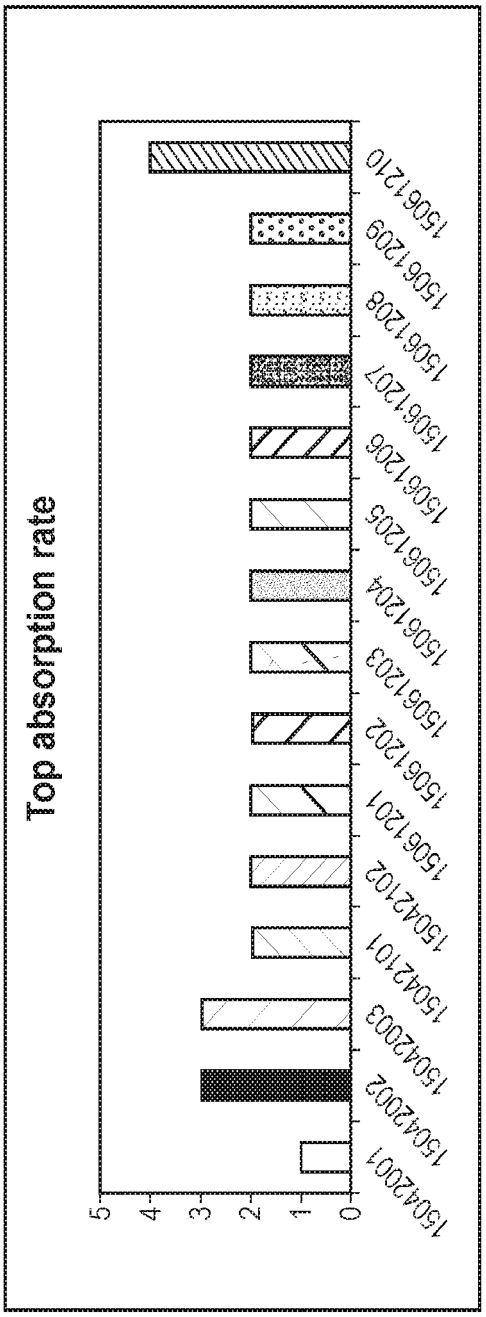


FIG. 63A

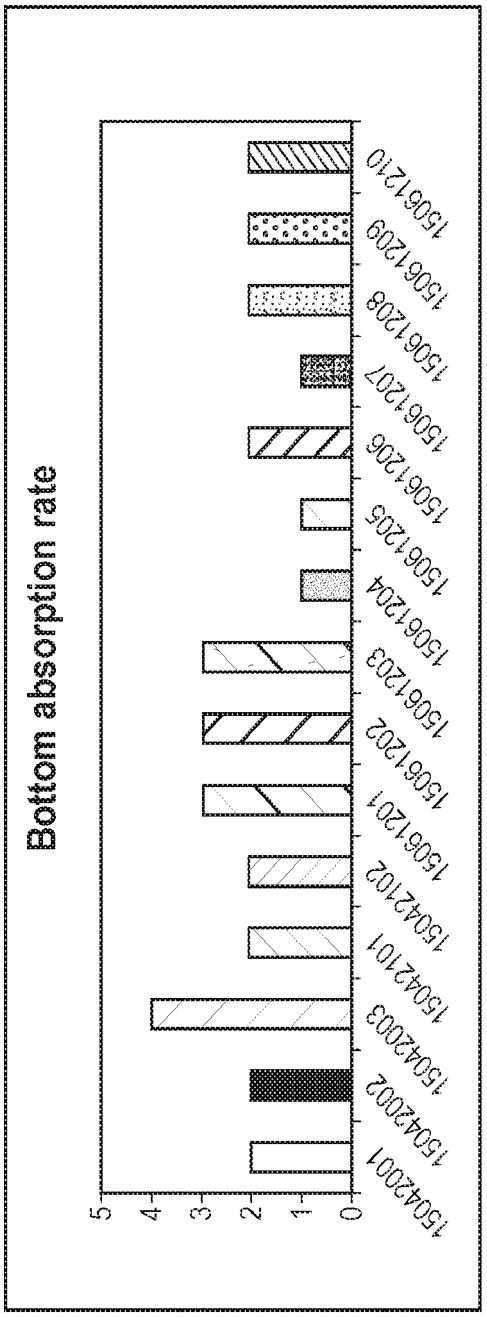


FIG. 63B

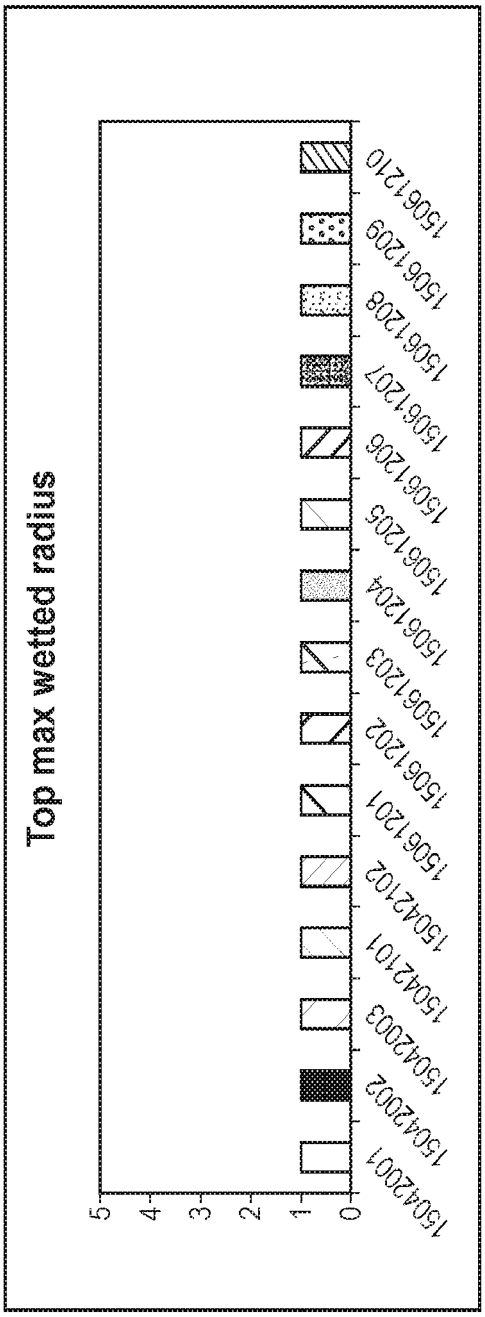


FIG. 64A

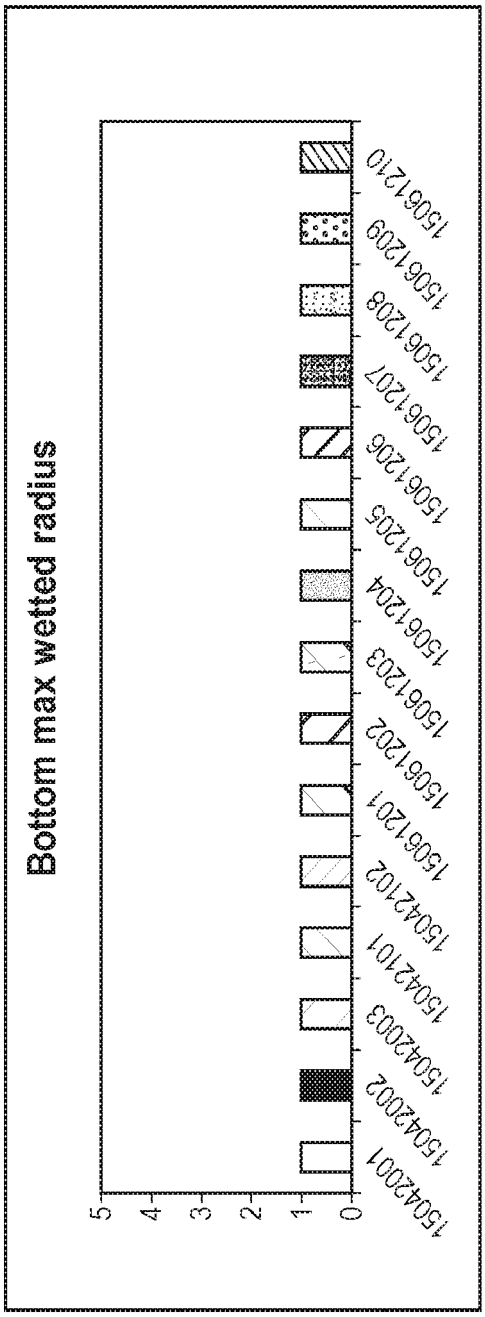


FIG. 64B

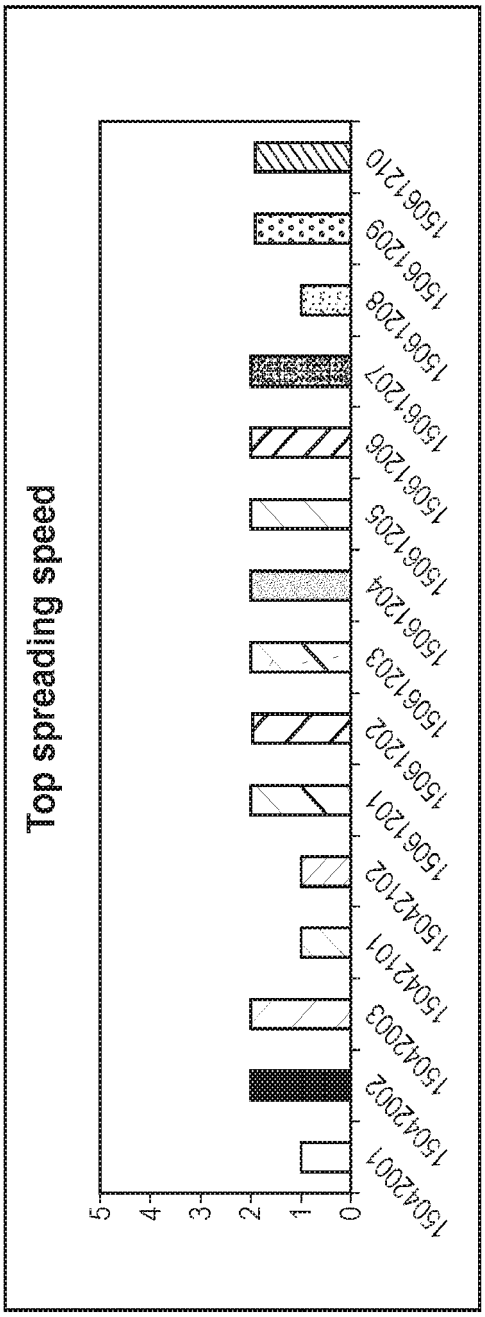


FIG. 65A

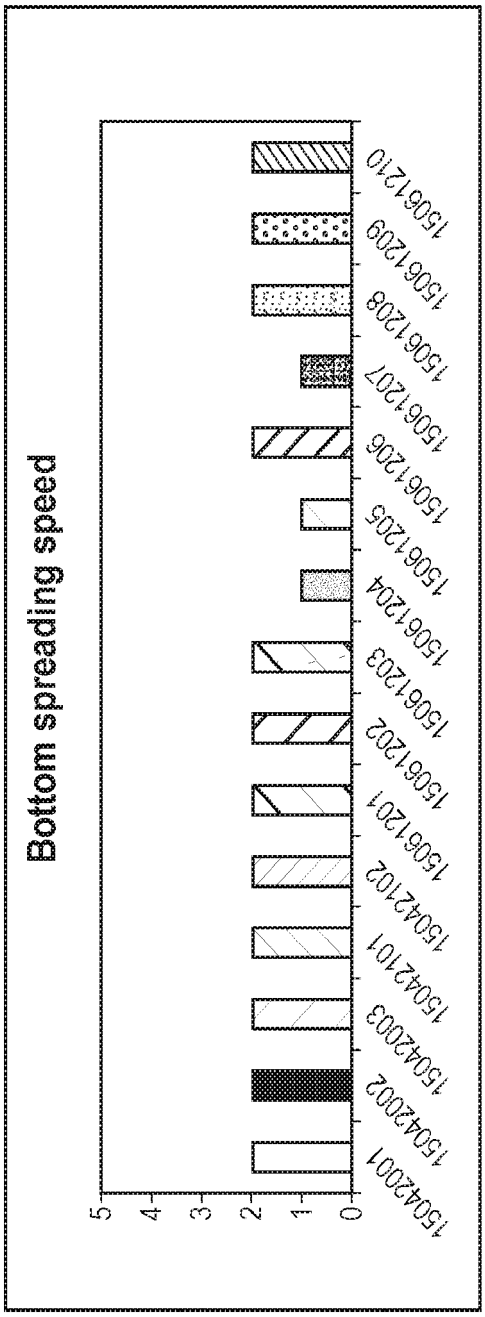


FIG. 65B

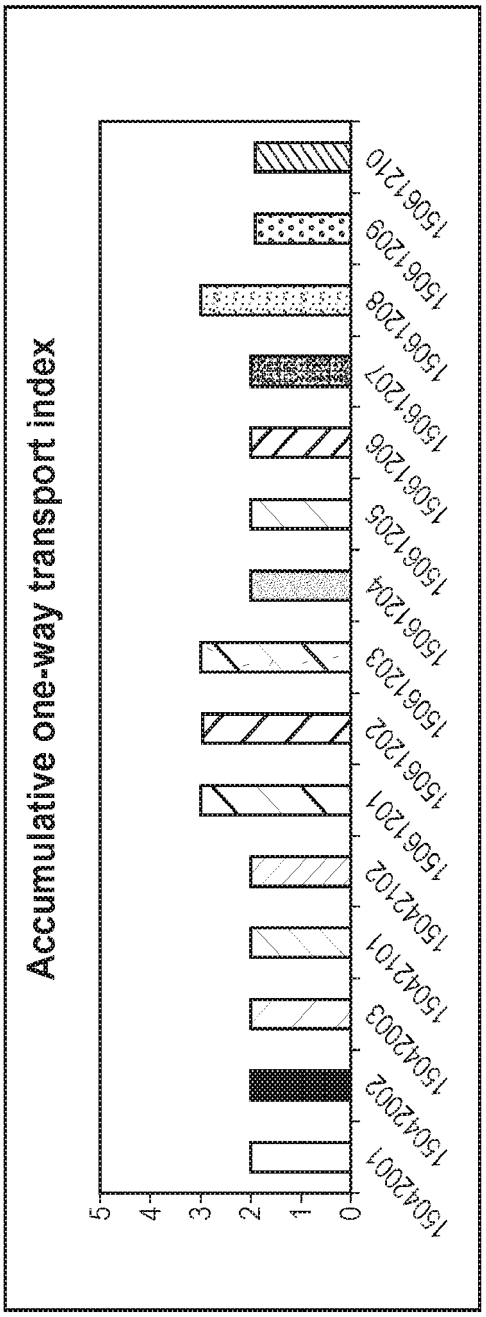


FIG. 66A

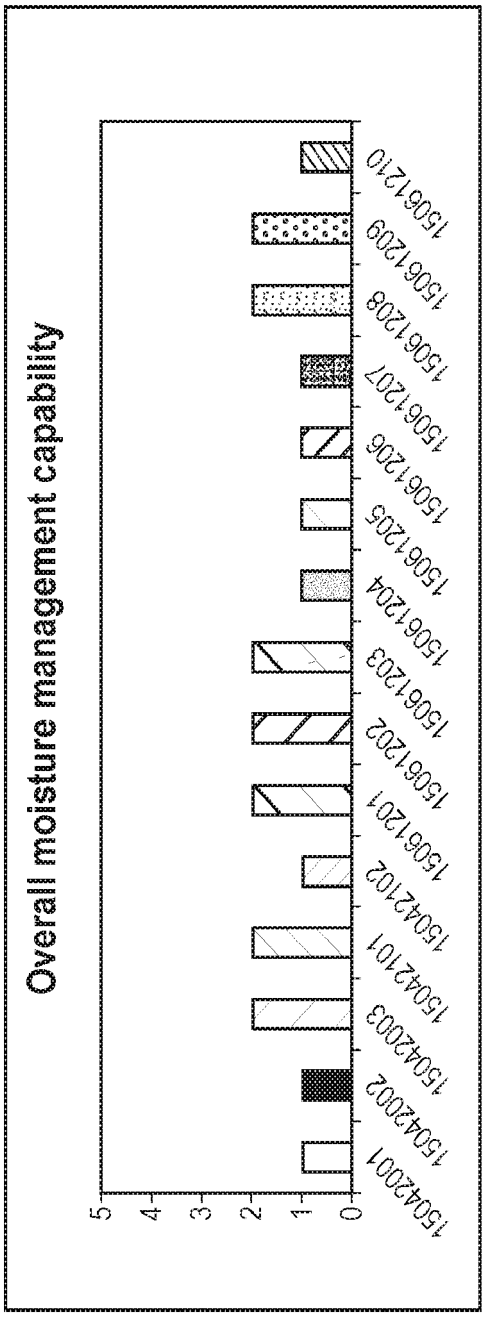


FIG. 66B

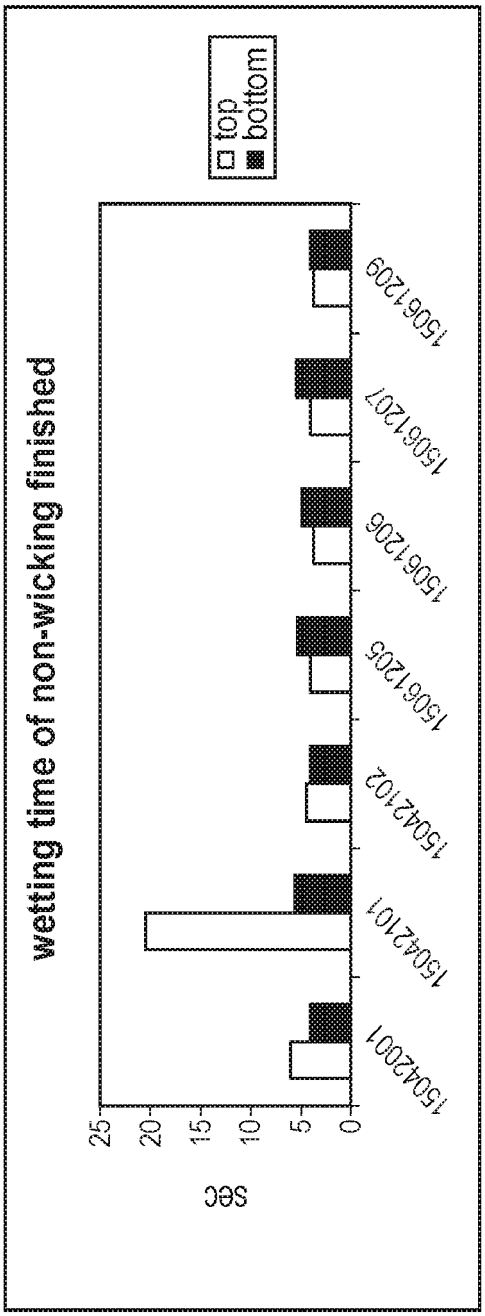


FIG. 67A

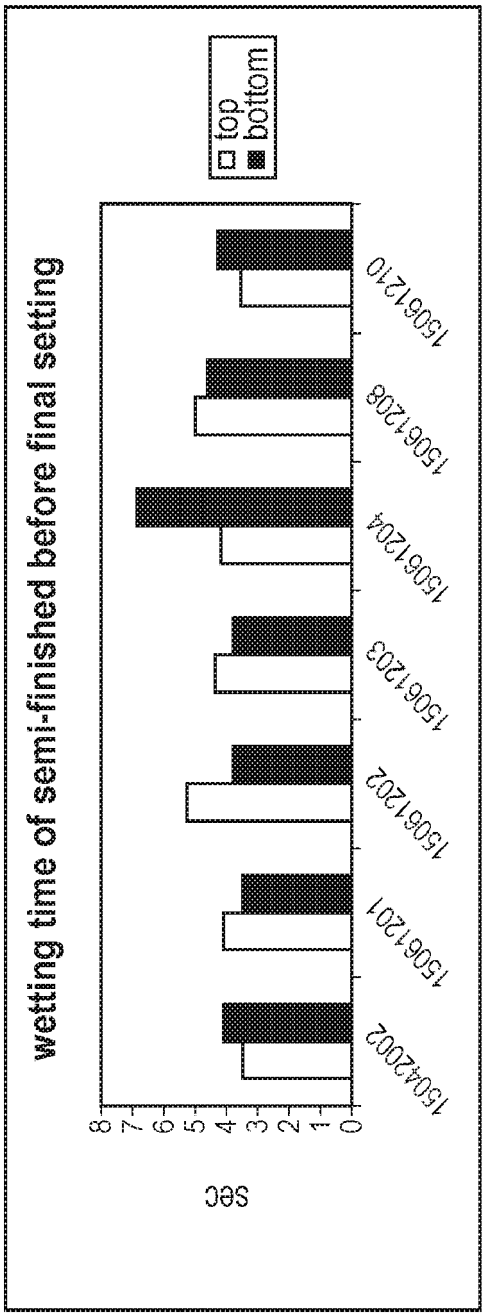


FIG. 67B

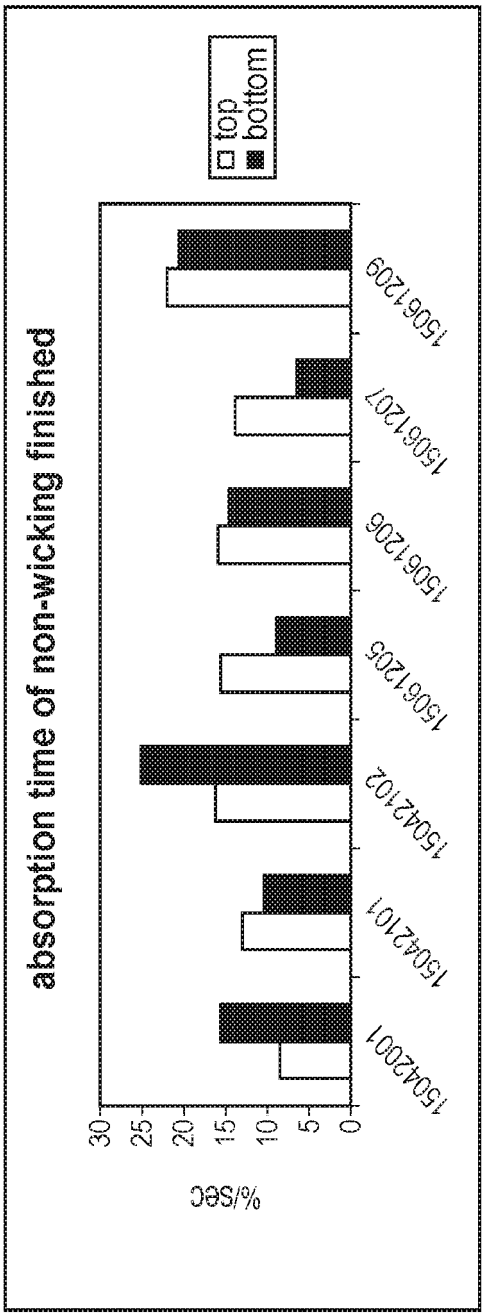


FIG. 68A

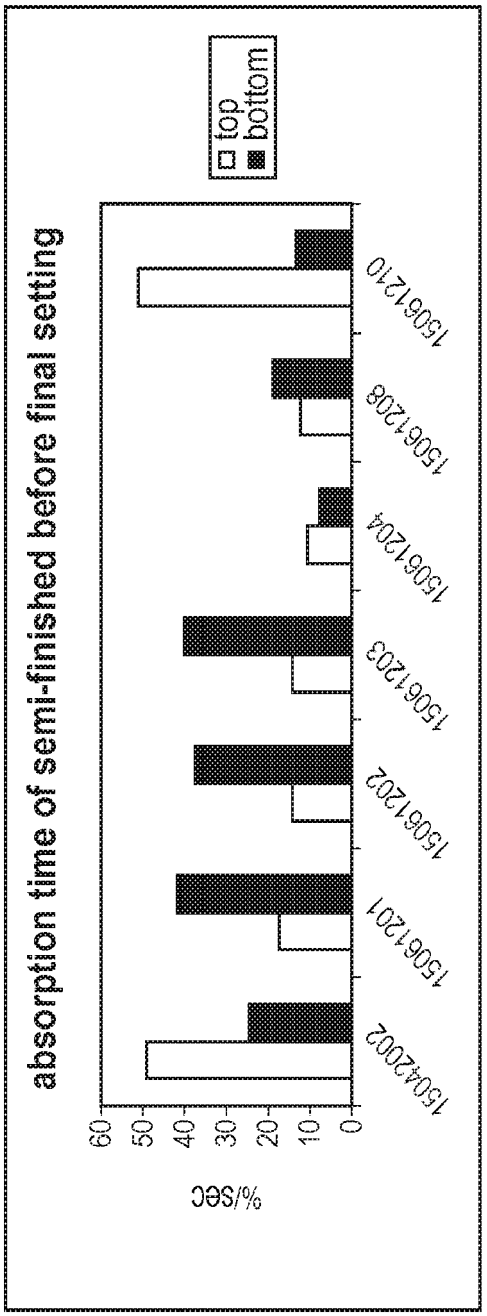


FIG. 68B

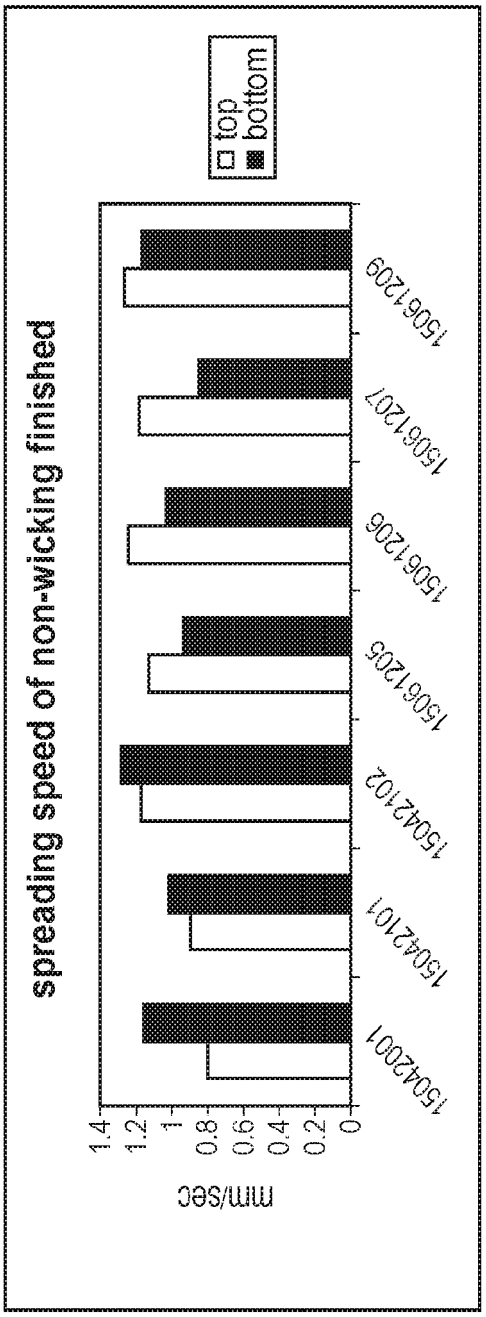


FIG. 69A

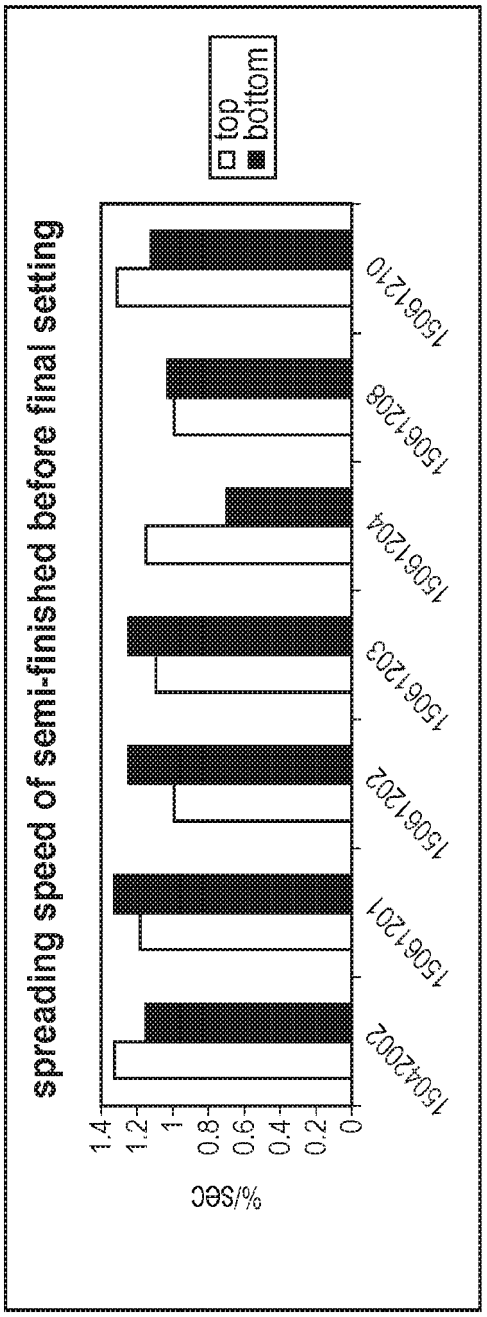


FIG. 69B

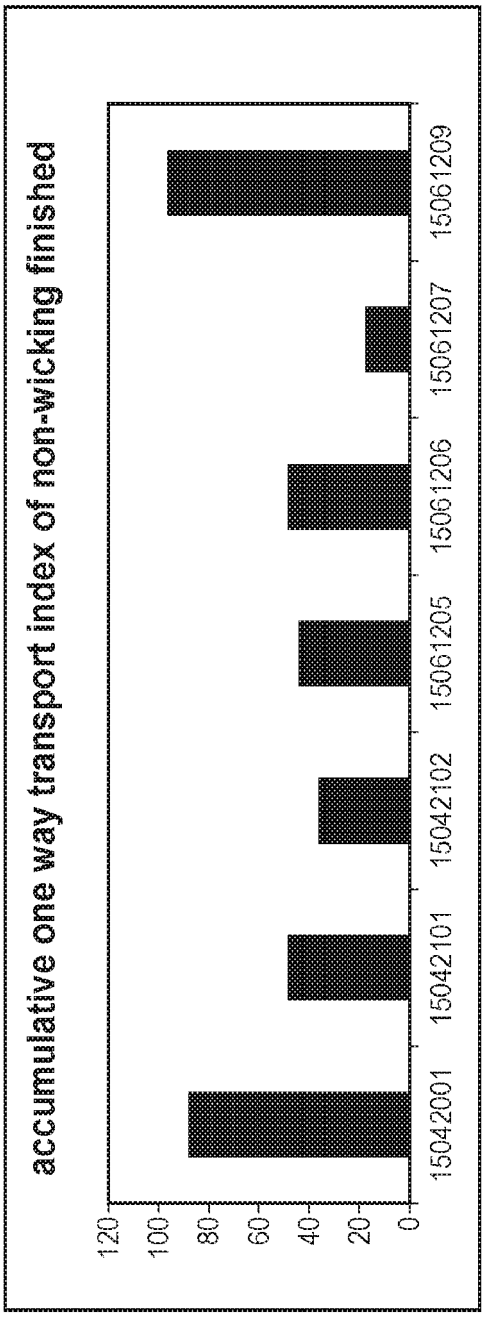


FIG. 70A

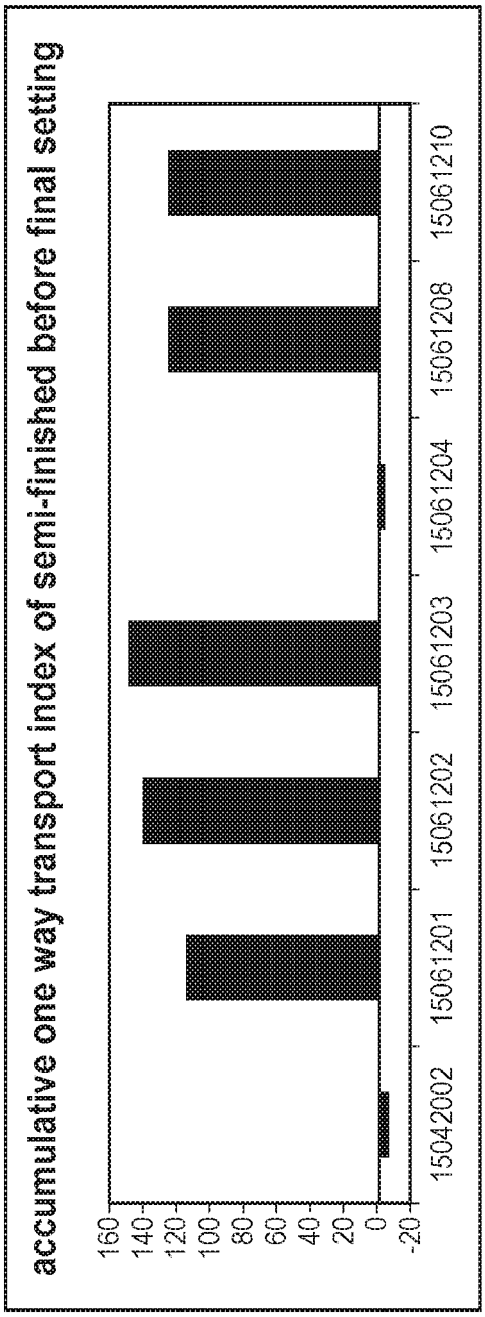


FIG. 70B

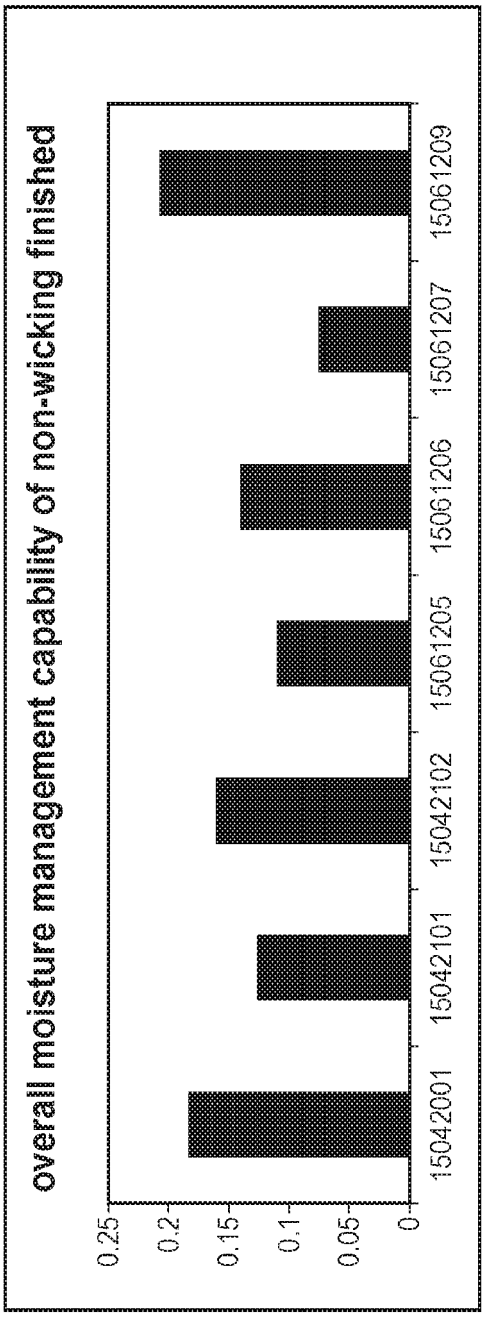


FIG. 71A

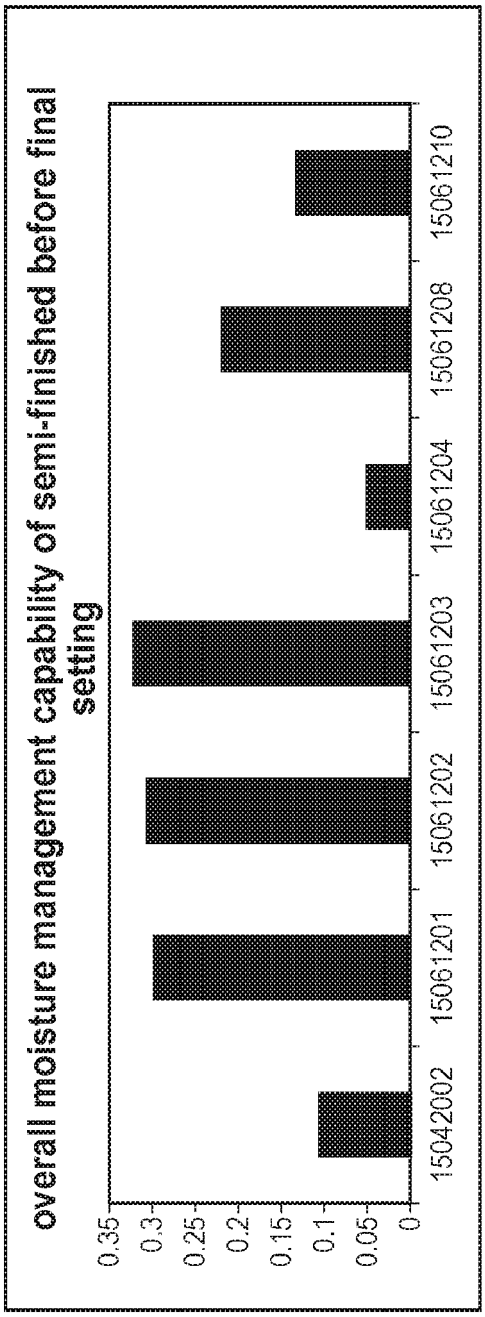


FIG. 71B

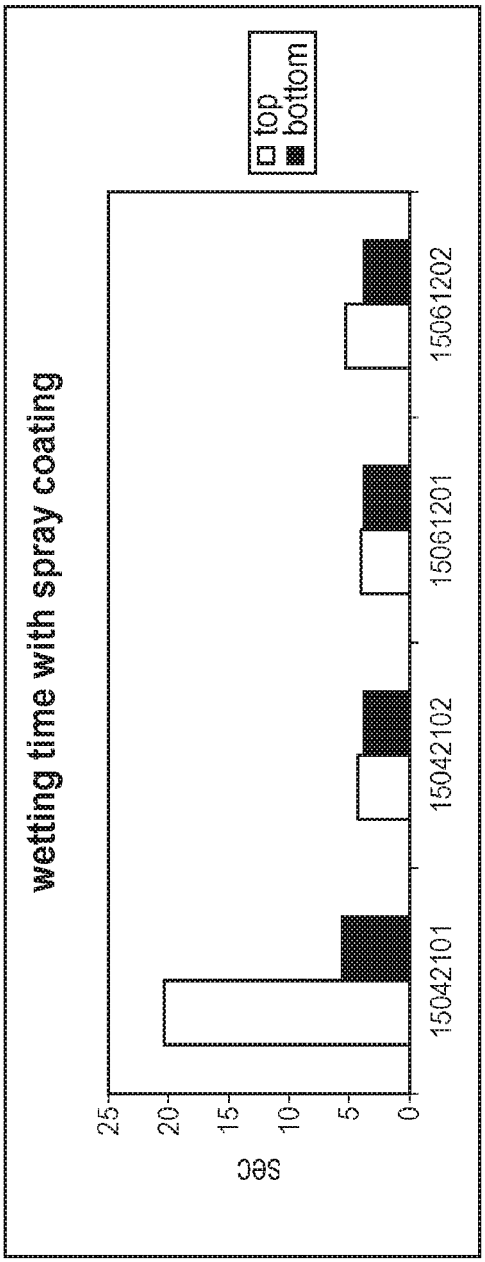


FIG. 72A

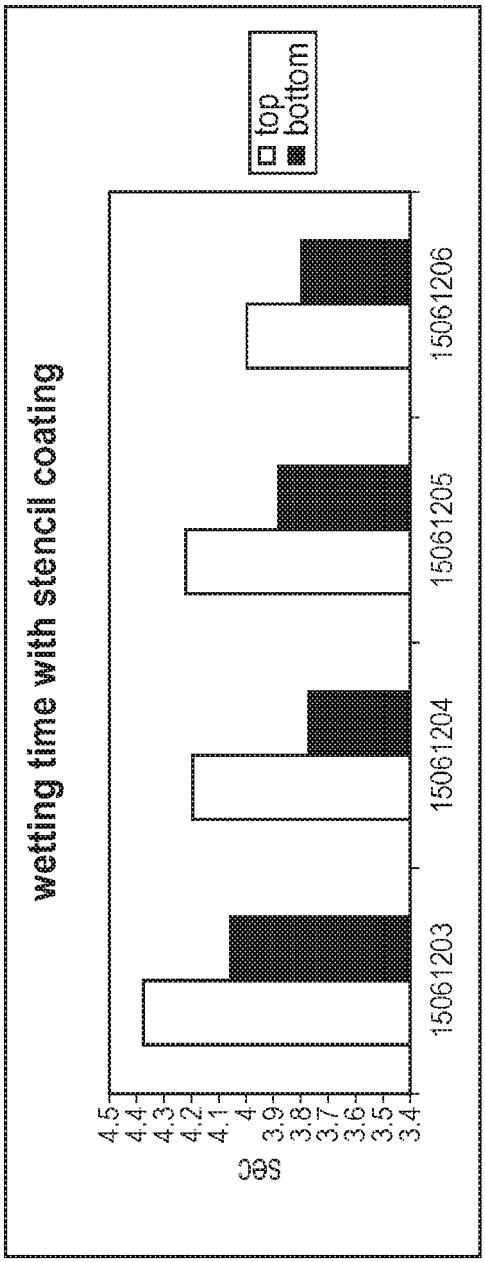


FIG. 72B

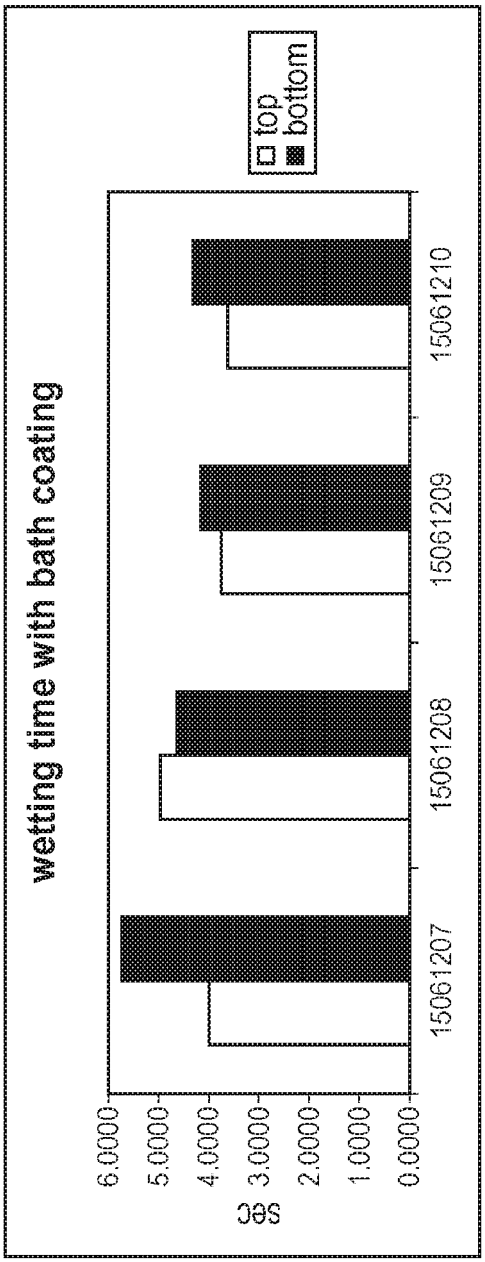


FIG. 72C

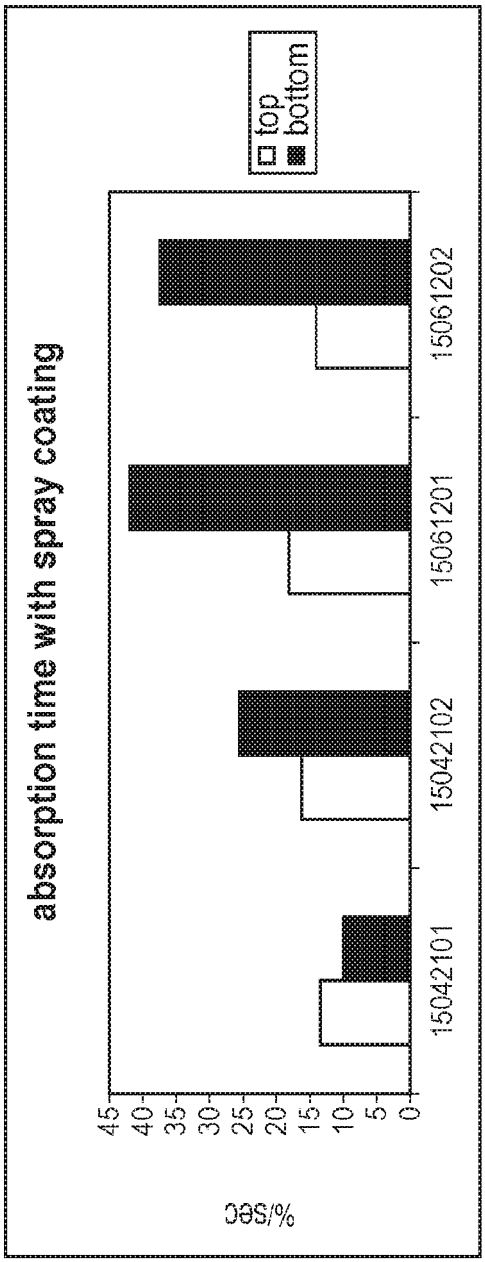


FIG. 73A

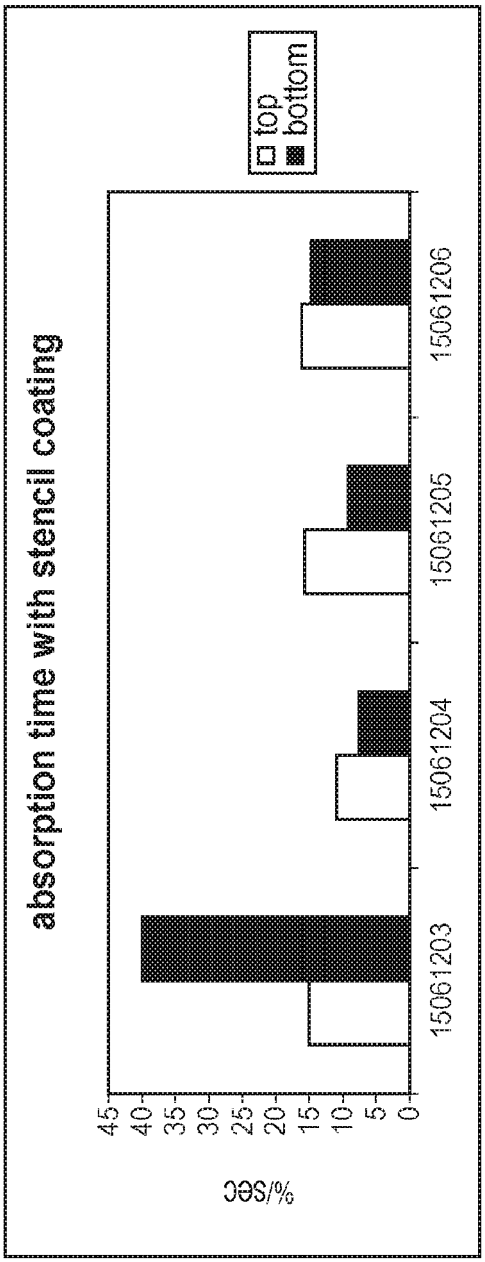


FIG. 73B

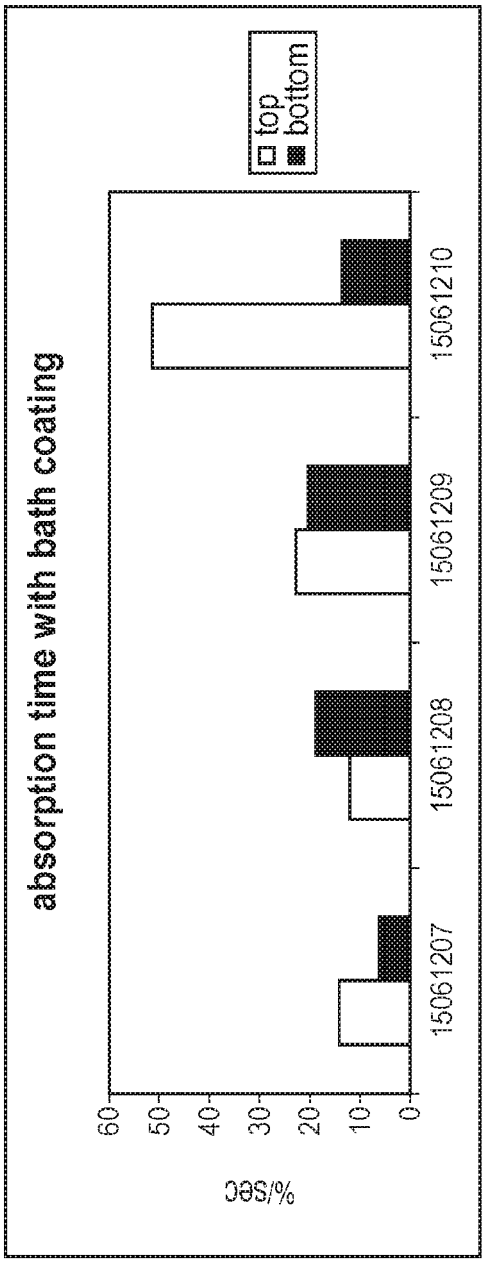


FIG. 73C

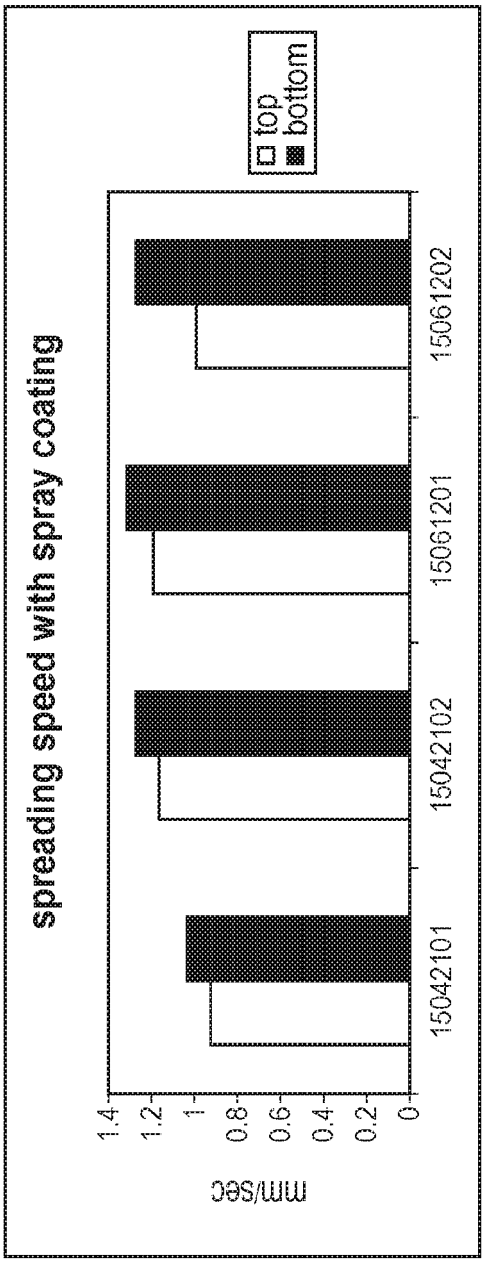


FIG. 74A

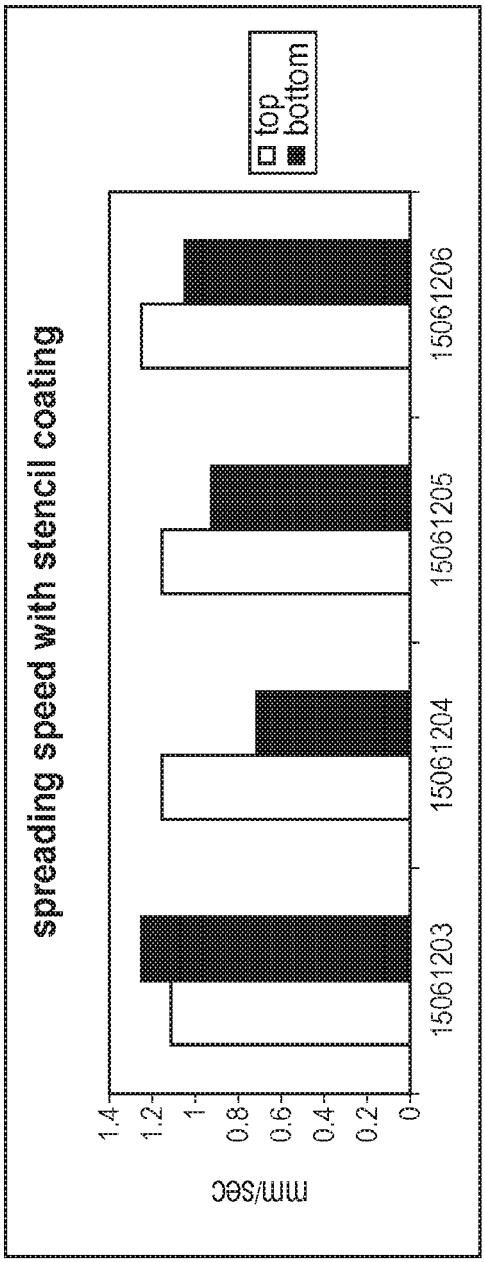


FIG. 74B

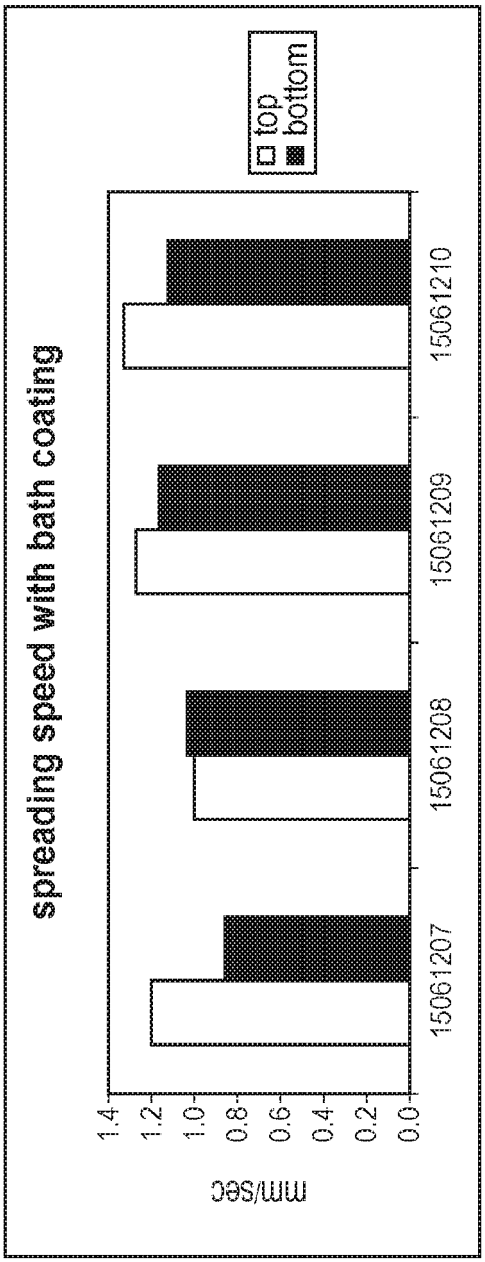


FIG. 74C

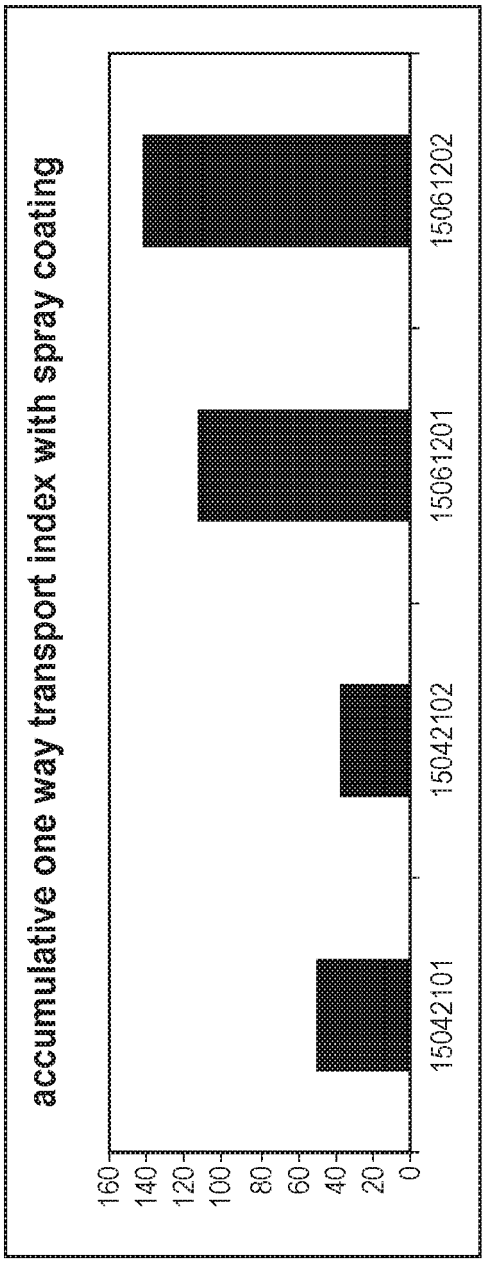


FIG. 75A

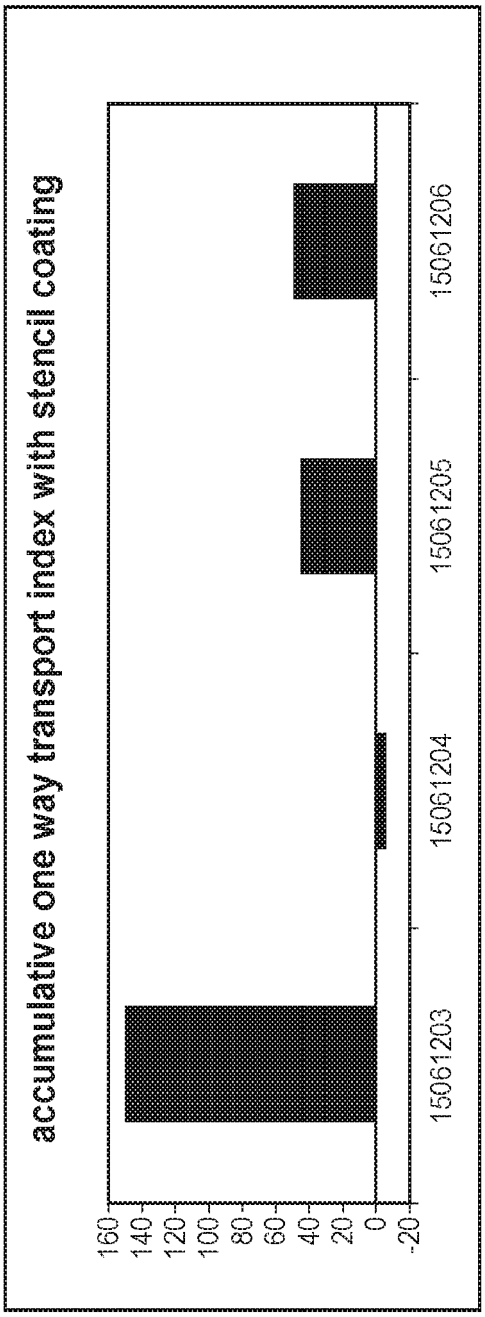


FIG. 75B

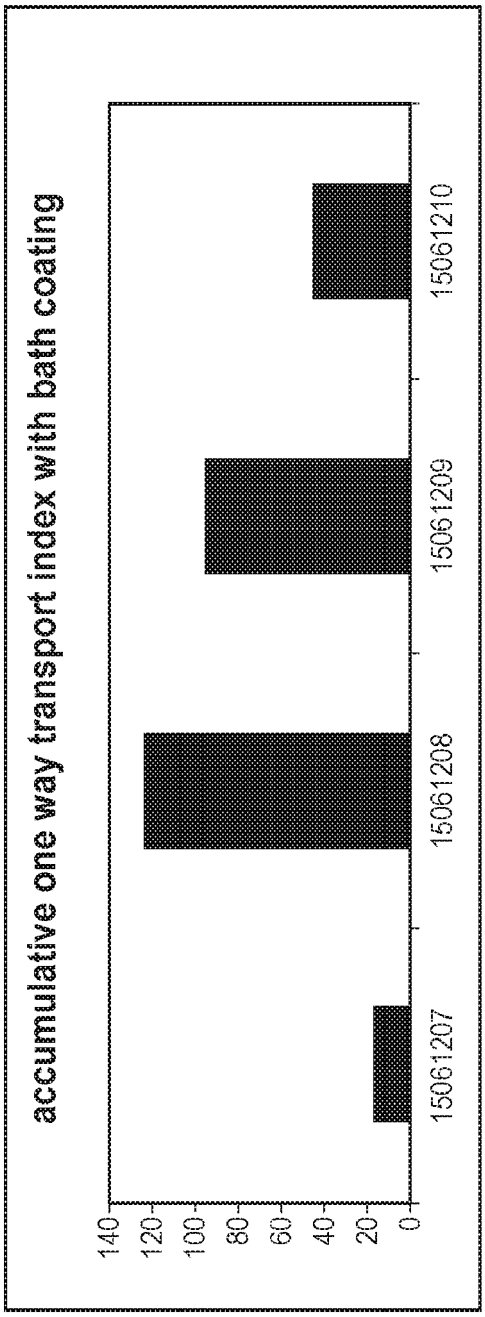


FIG. 75C

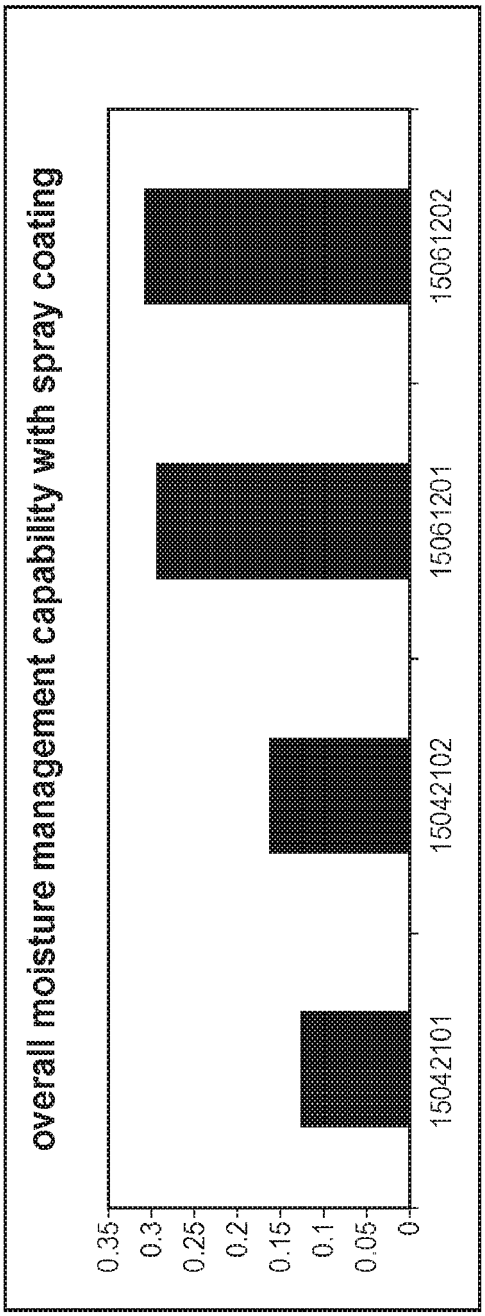


FIG. 76A

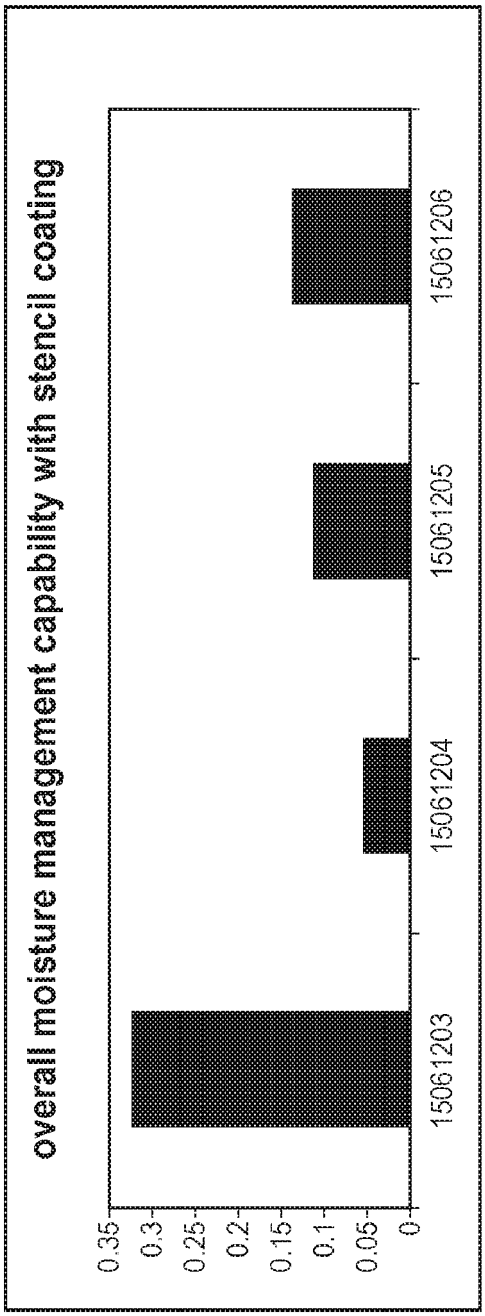


FIG. 76B

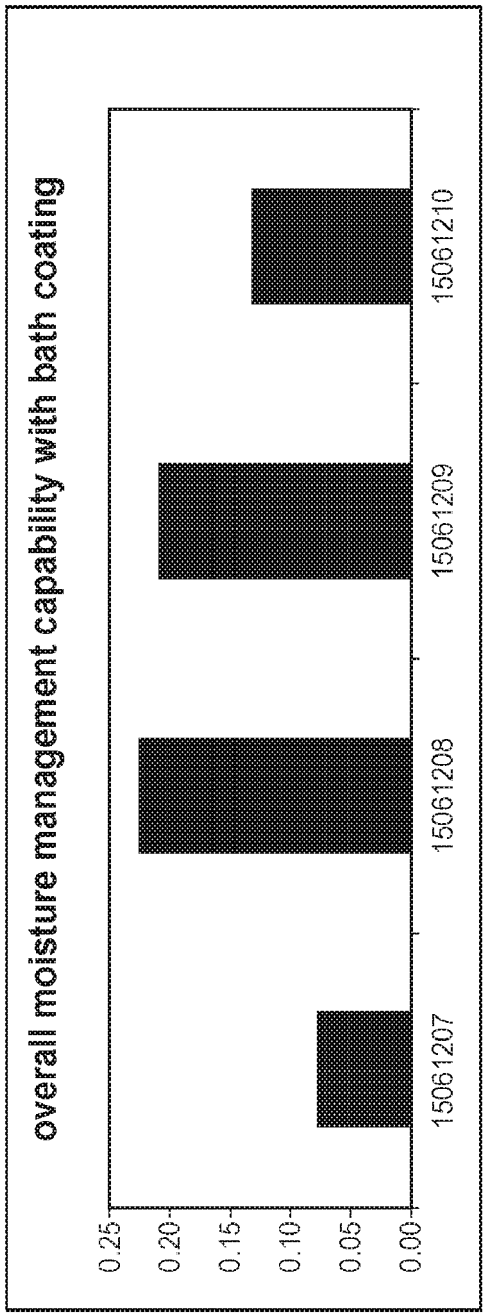

overall moisture management capability with bath coating
0.25
0.20
0.15
0.10
0.05
0.00
15061207
15061208
15061209
15061210

FIG. 76C

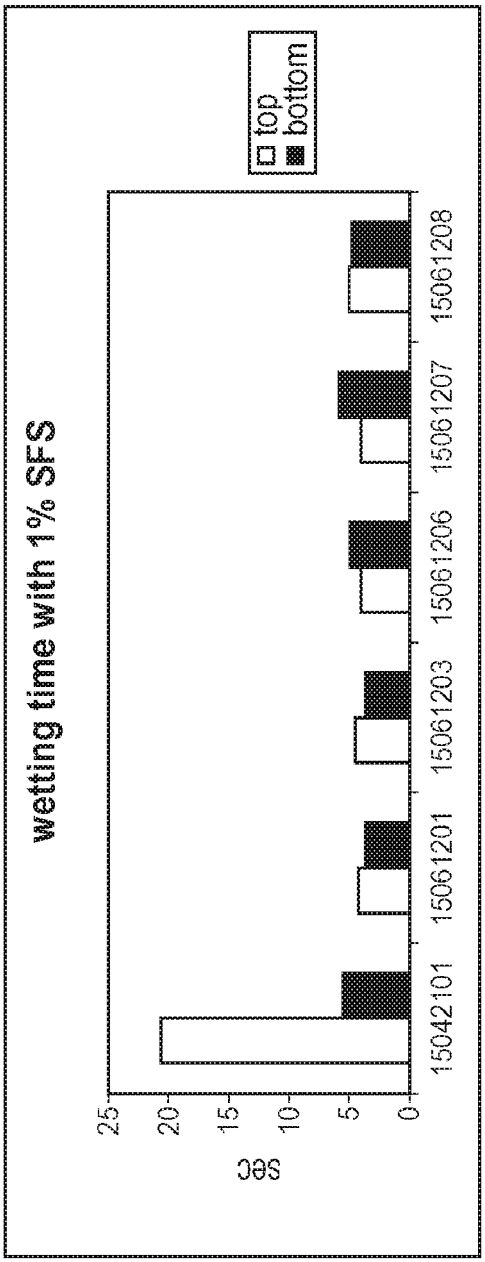


FIG. 77A

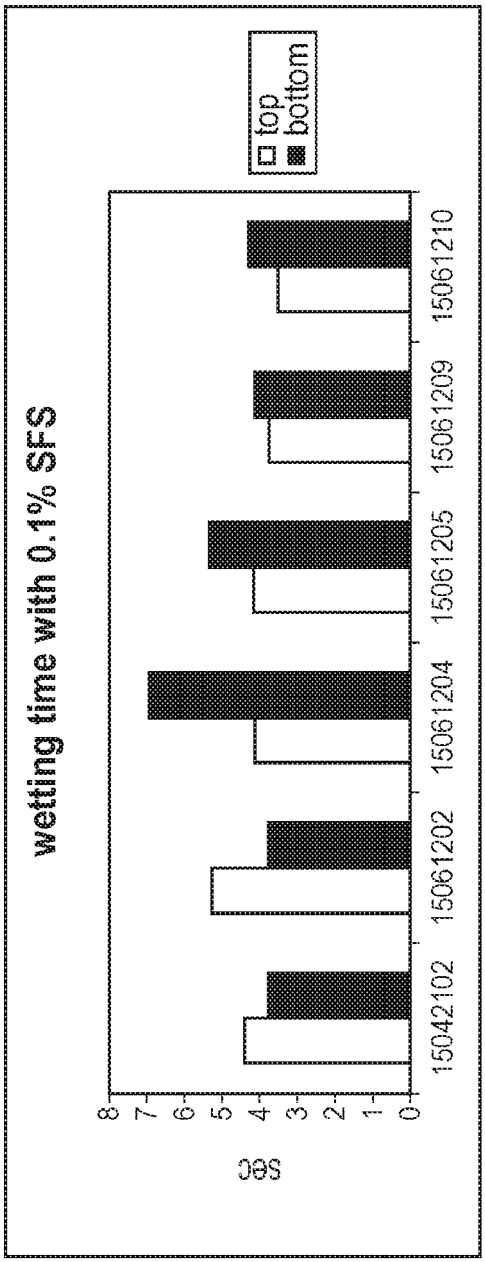


FIG. 77B

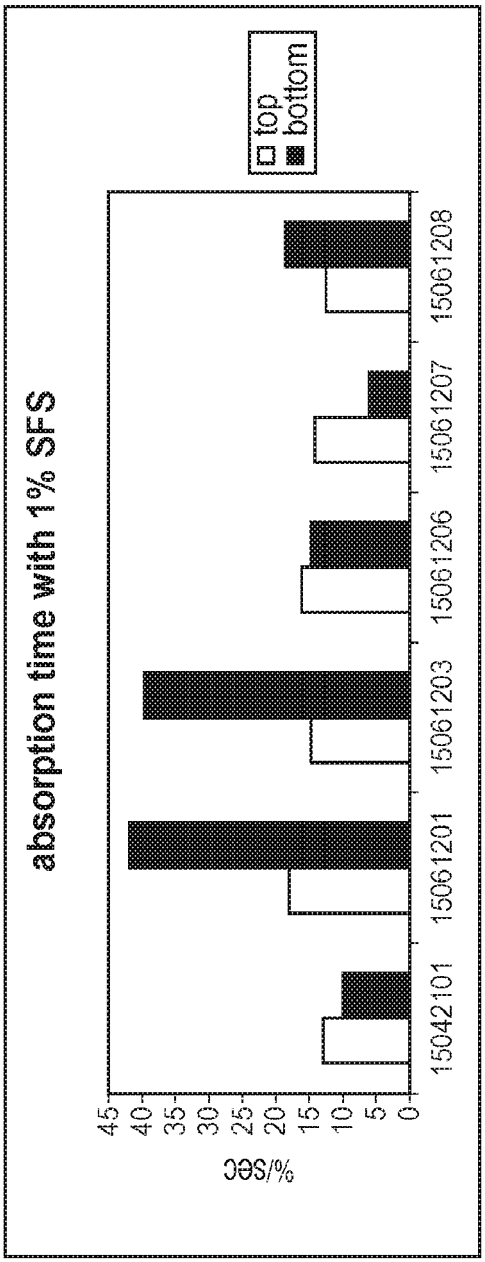


FIG. 78A

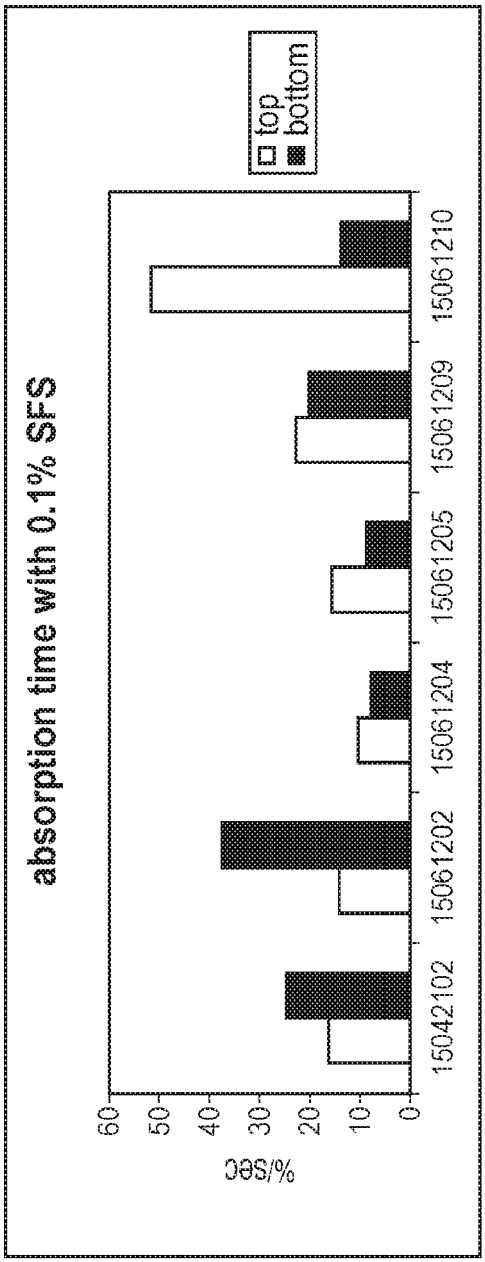


FIG. 78B

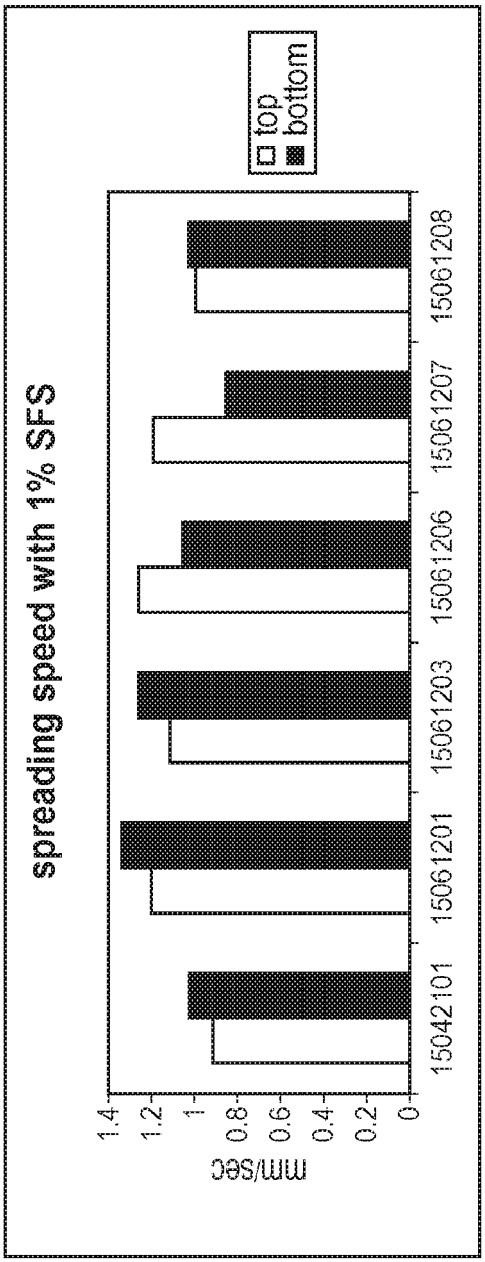


FIG. 79A

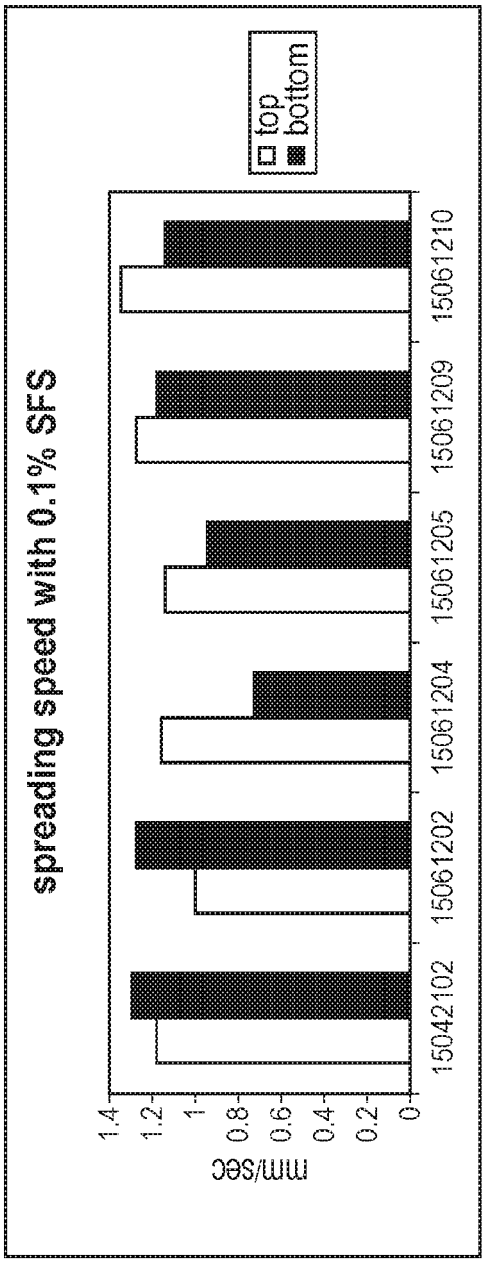


FIG. 79B

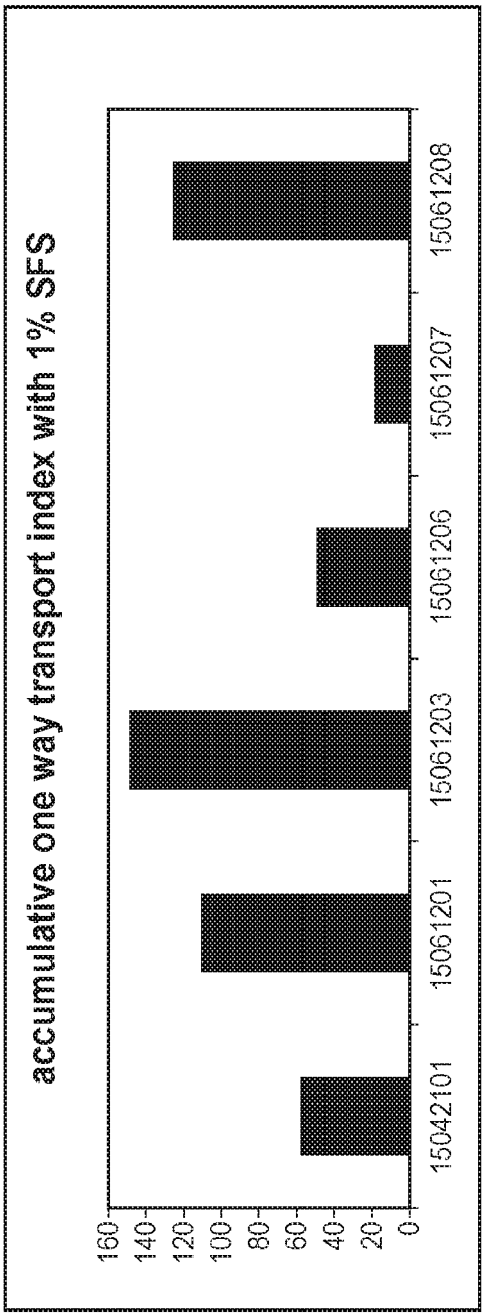


FIG. 80A

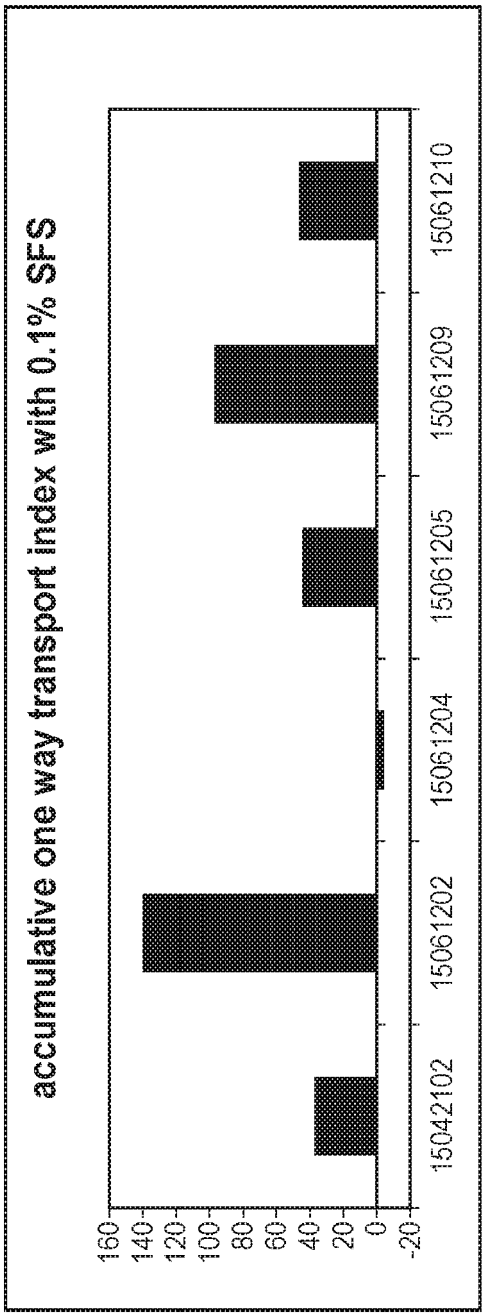


FIG. 80B

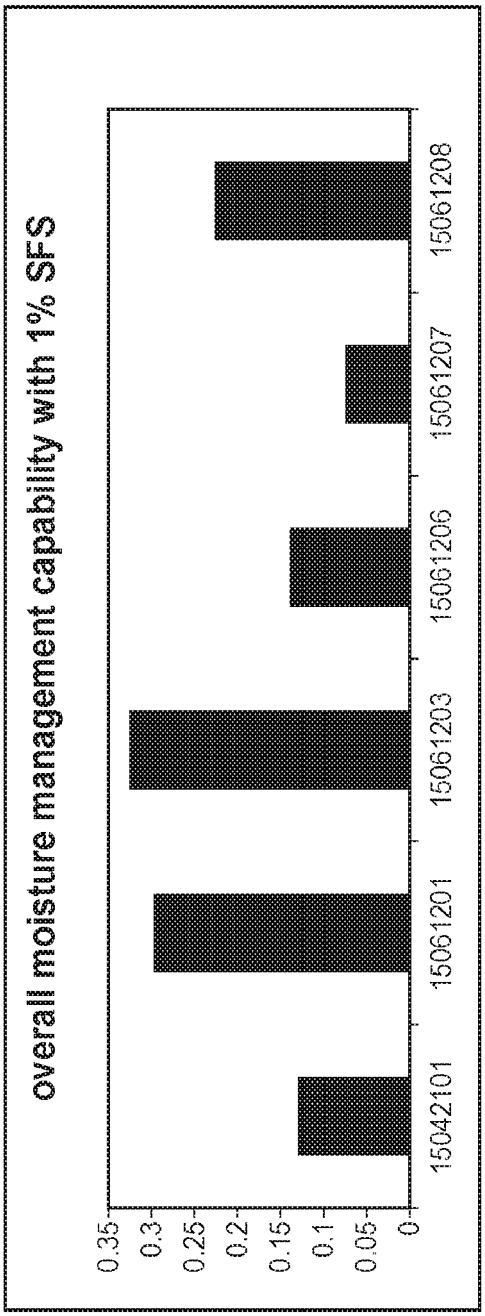


FIG. 81A

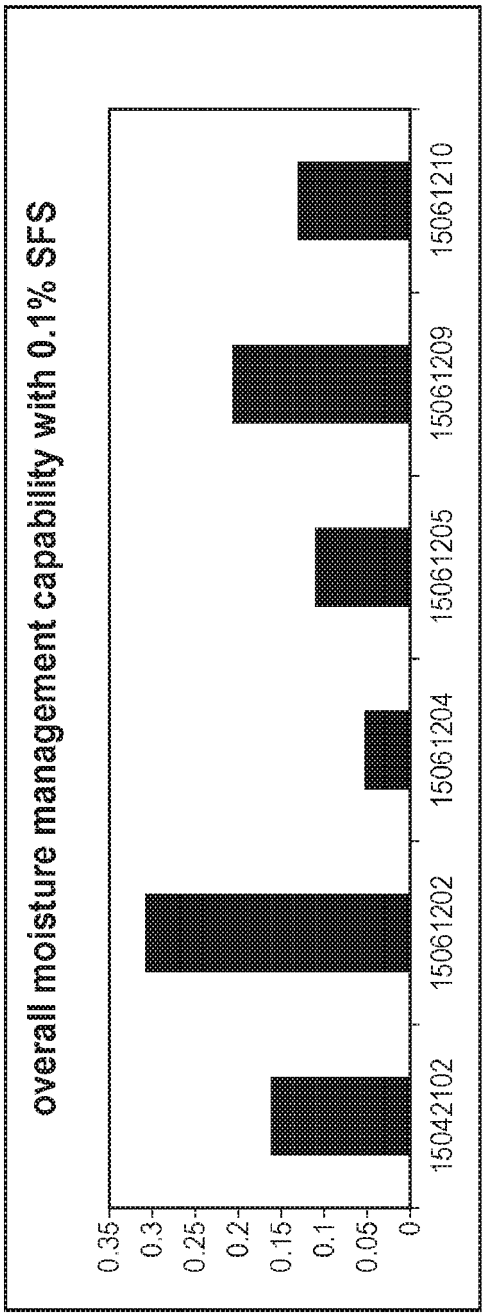


FIG. 81B

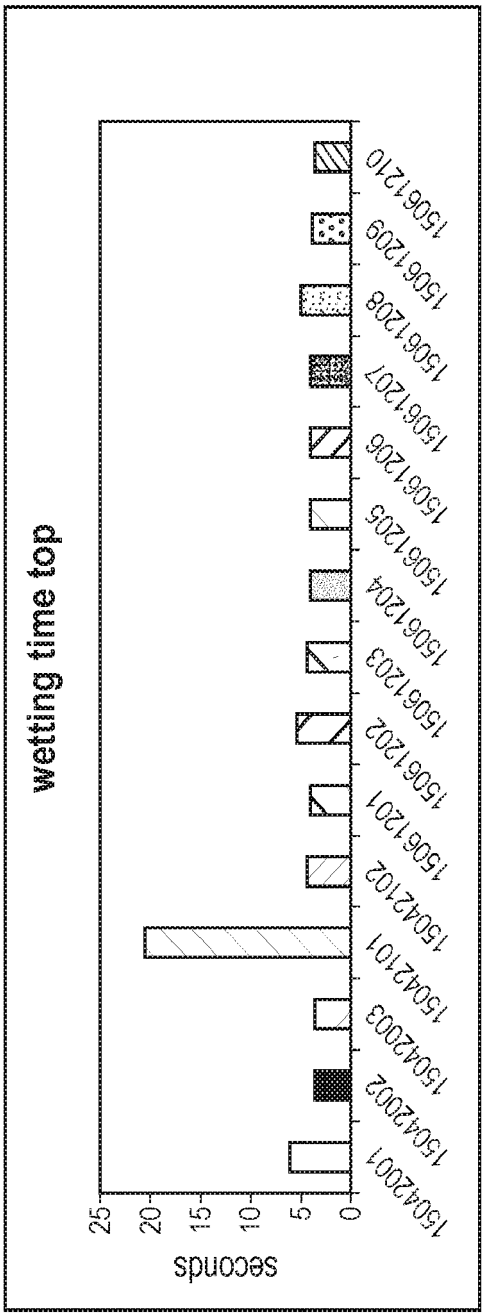


FIG. 82A

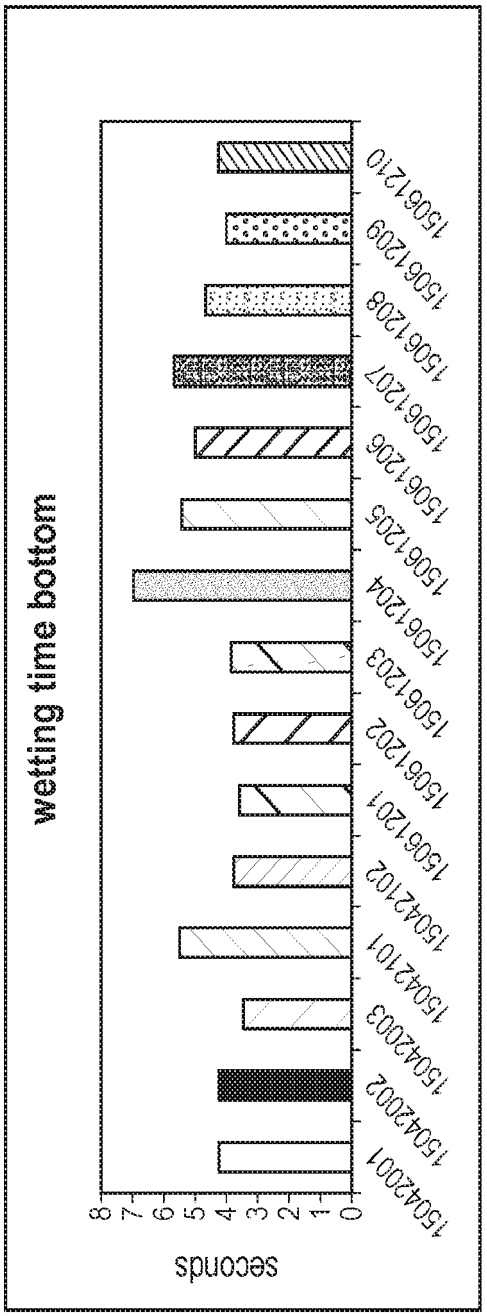


FIG. 82B

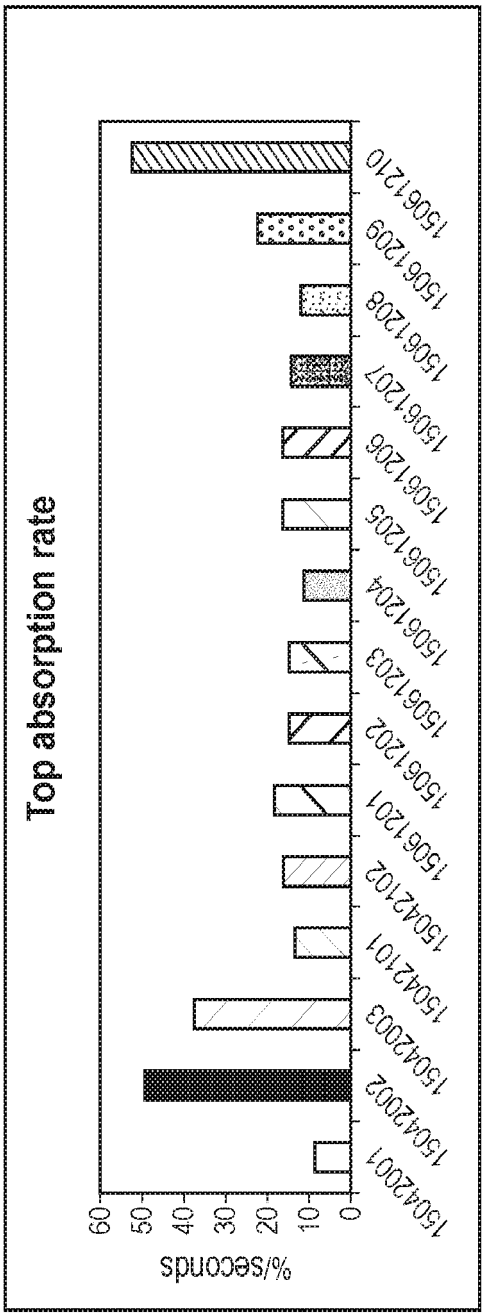


FIG. 83A

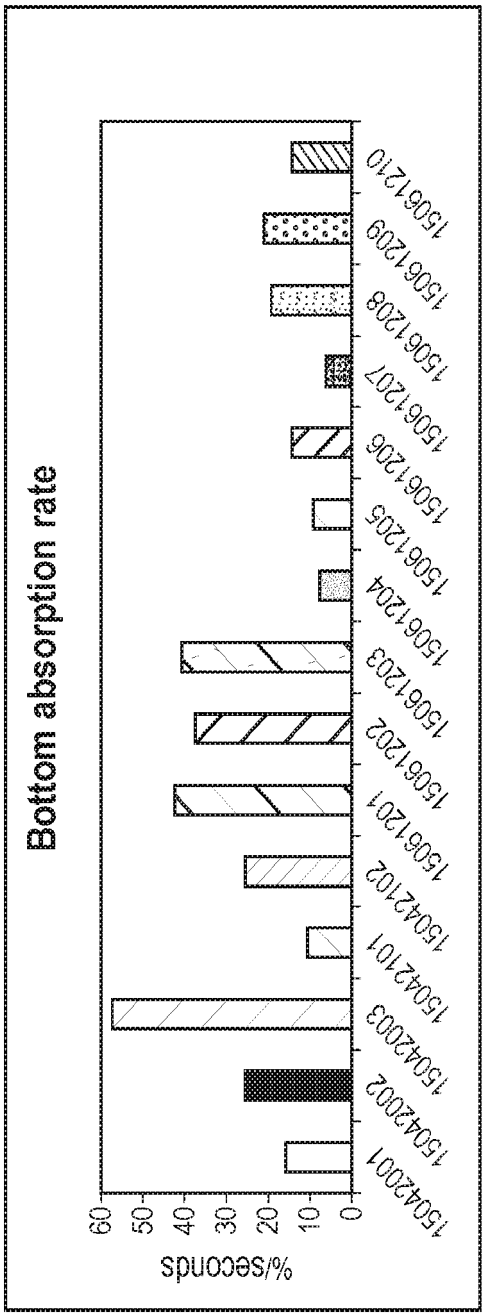


FIG. 83B

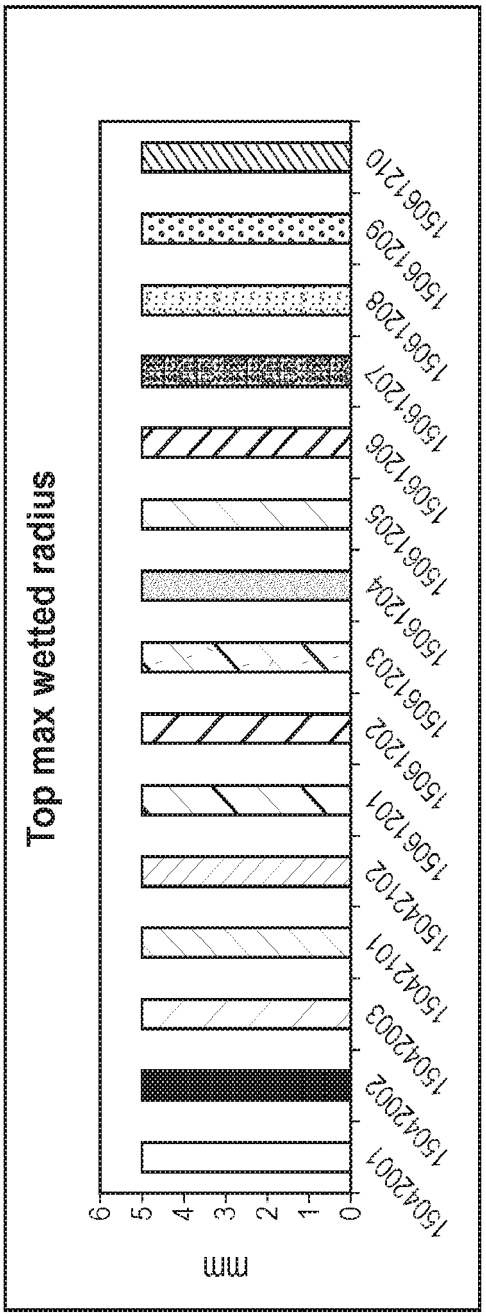


FIG. 84A

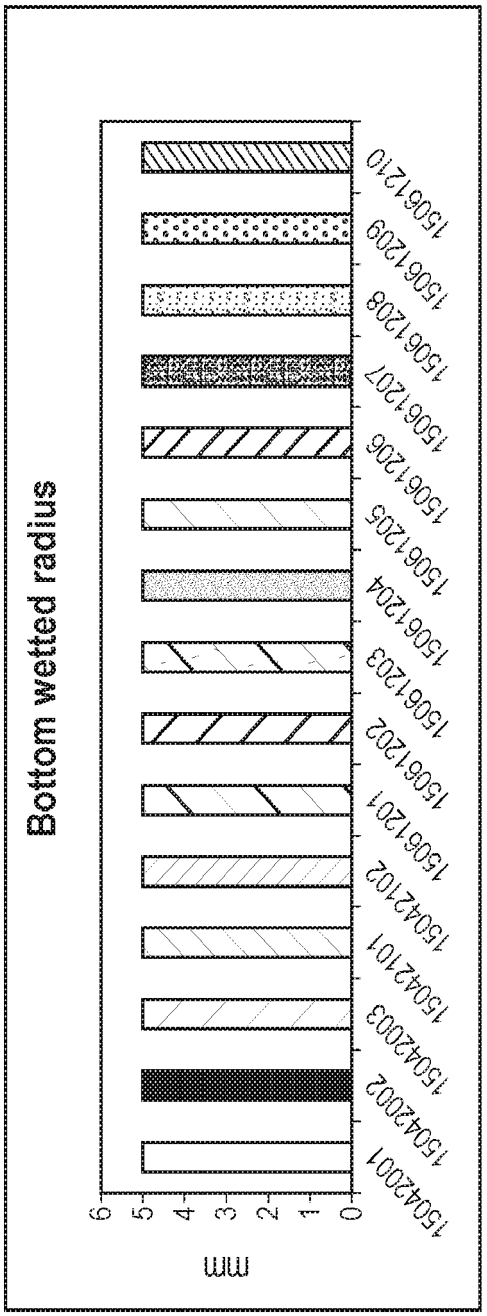


FIG. 84B

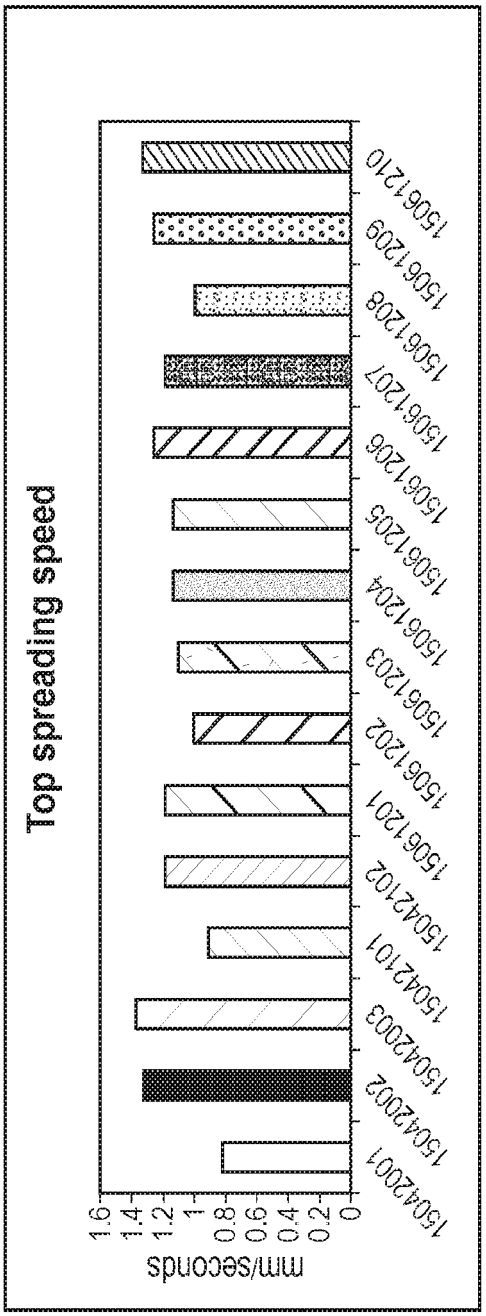


FIG. 85A

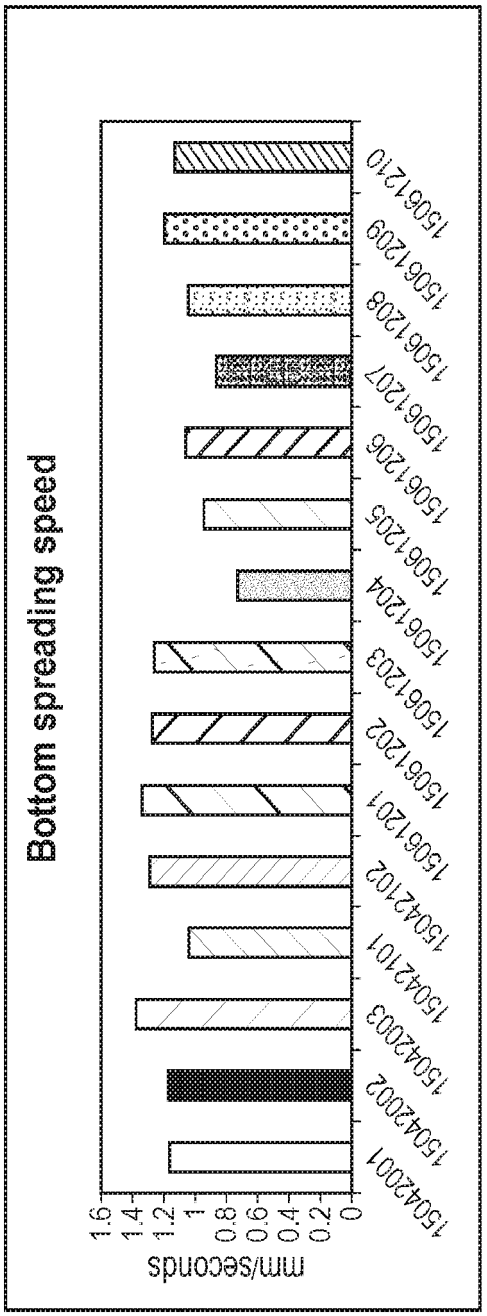


FIG. 85B

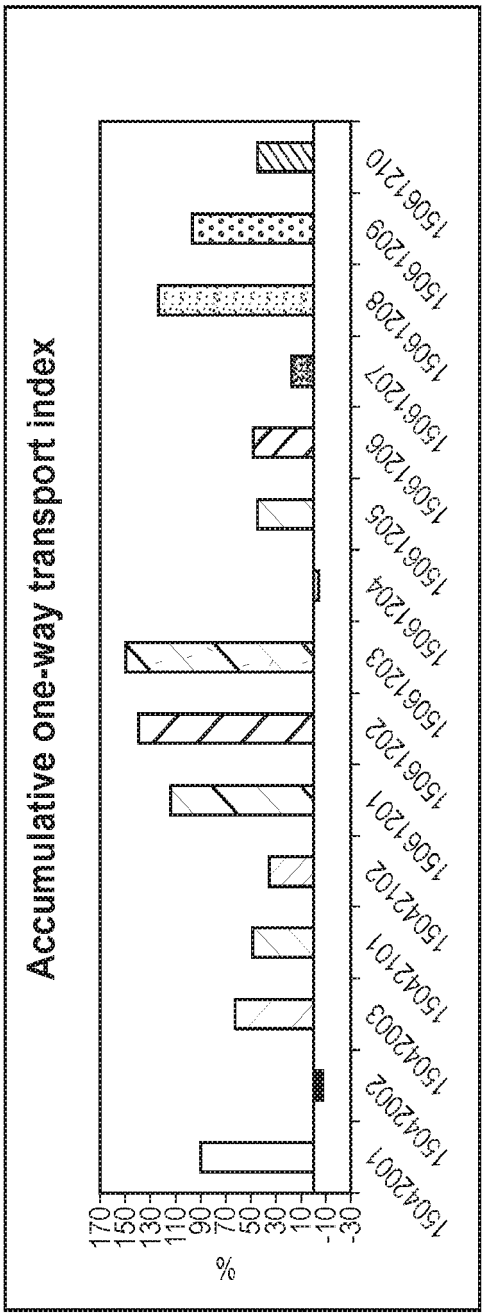


FIG. 86A

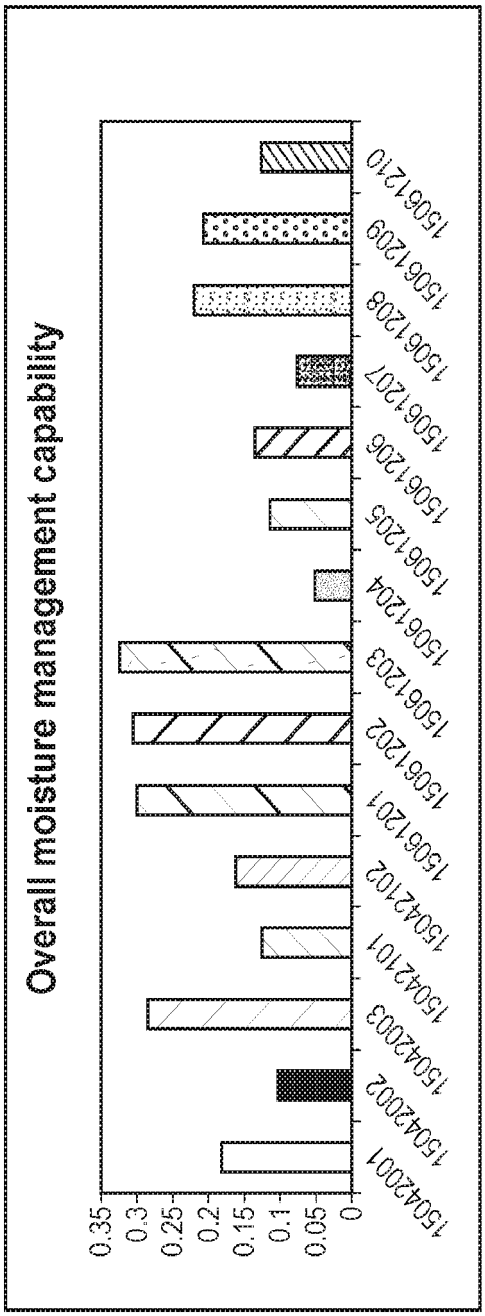


FIG. 86B

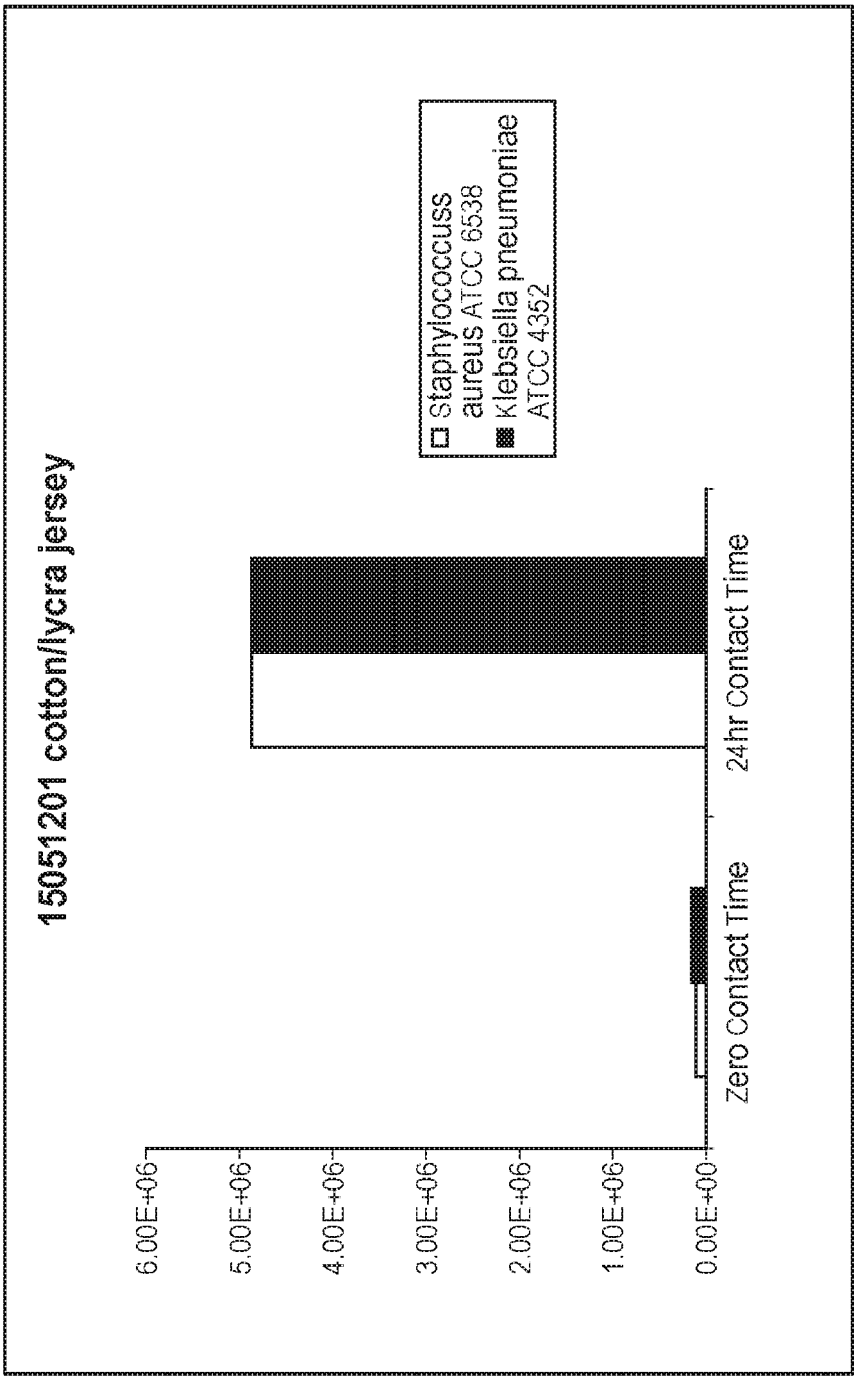

15051201 cotton/lycra jersey
Staphylococcuss aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
6.00E+06
5.00E+06
4.00E+06
3.00E+06
2.00E+06
1.00E+06
0.00E+00
Zero Contact Time
24hr Contact Time

FIG. 87

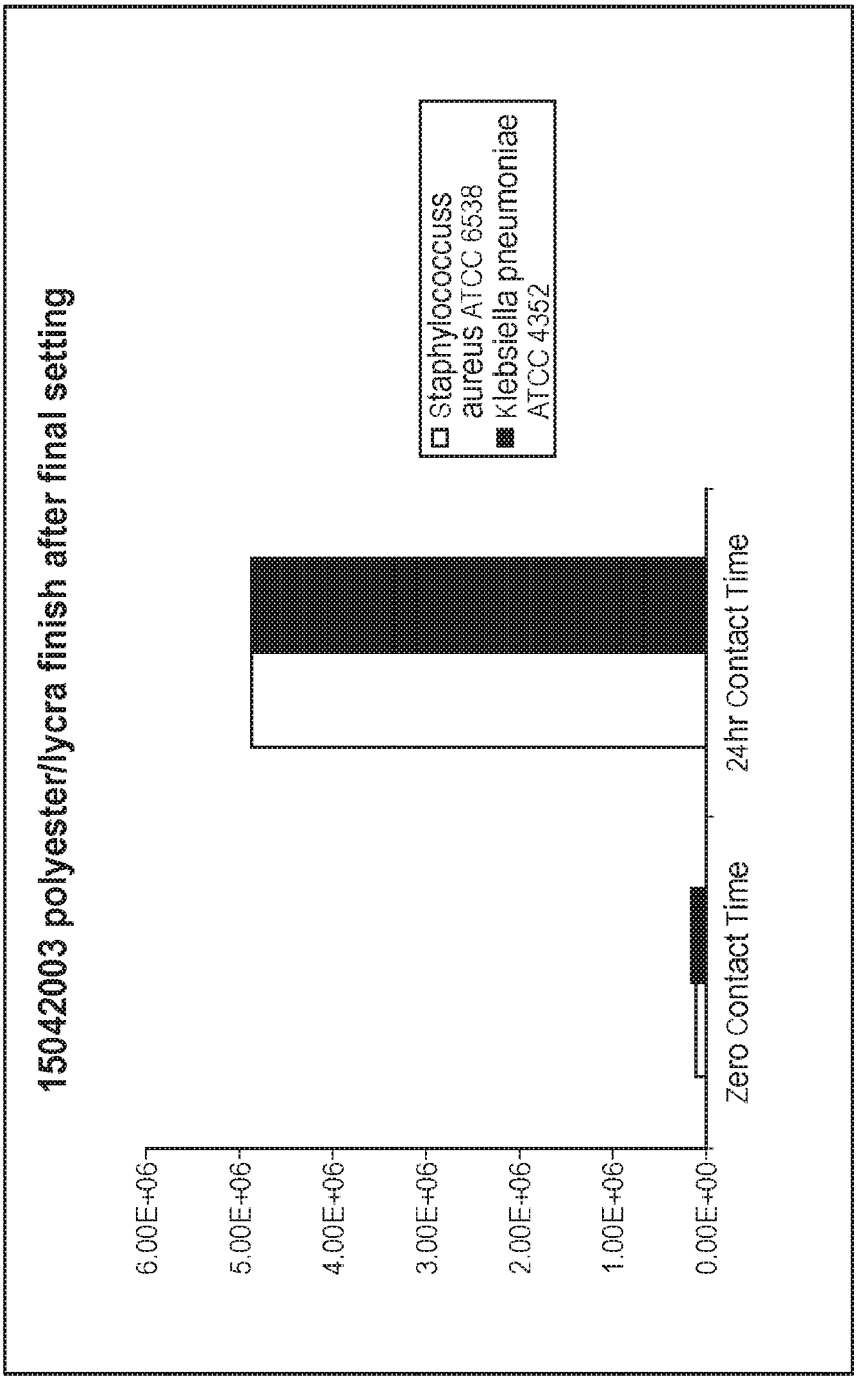

15042003 polyester/lycra finish after final setting
Staphylococcuss aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
6.00E+06
5.00E+06
4.00E+06
3.00E+06
2.00E+06
1.00E+06
0.00E+00
Zero Contact Time
24hr Contact Time

FIG. 88

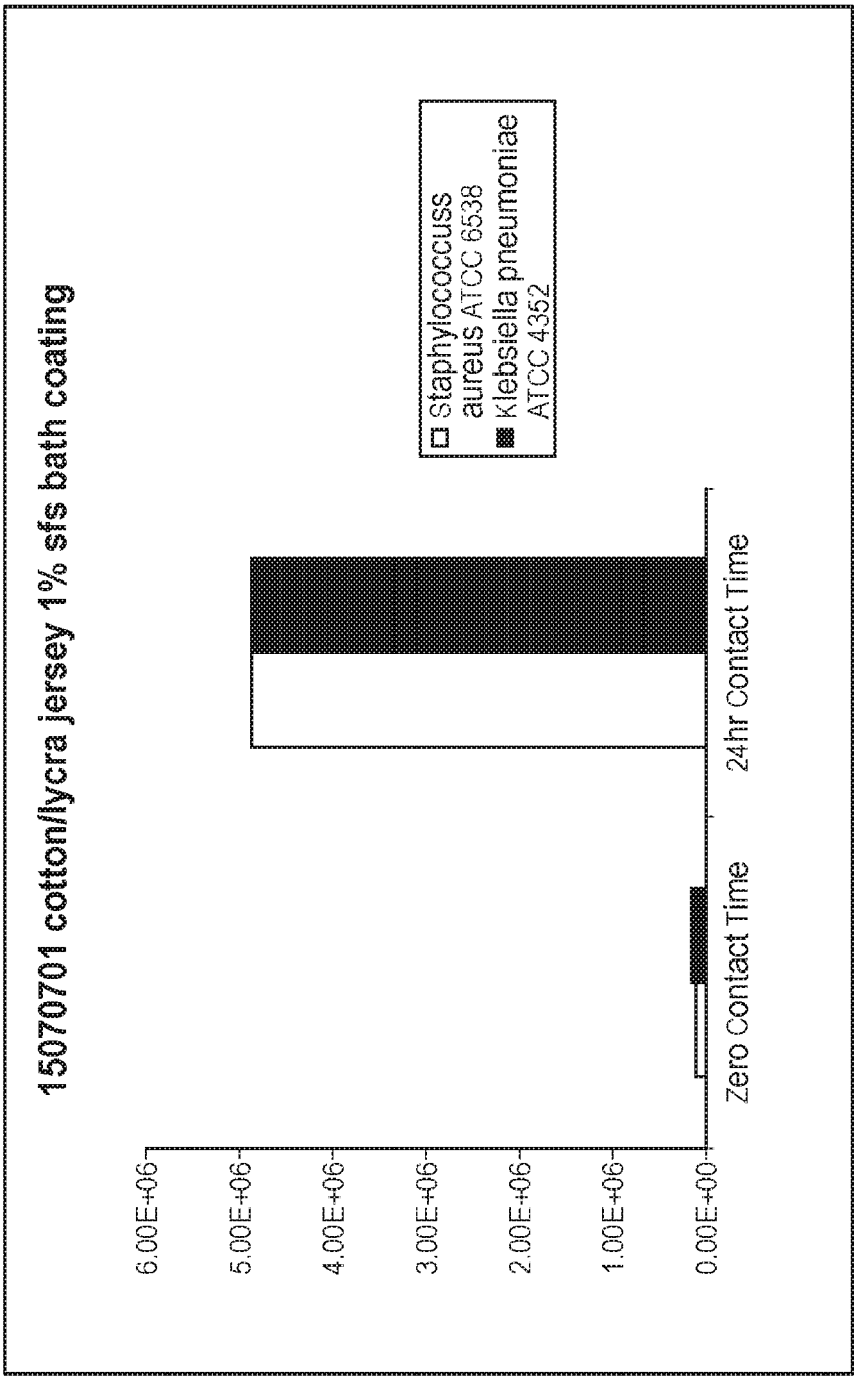

15070701 cotton/lycra jersey 1% sfs bath coating
Staphylococcuss aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
6.00E+06
5.00E+06
4.00E+06
3.00E+06
2.00E+06
1.00E+06
0.00E+00
Zero Contact Time
24hr Contact Time

FIG. 89

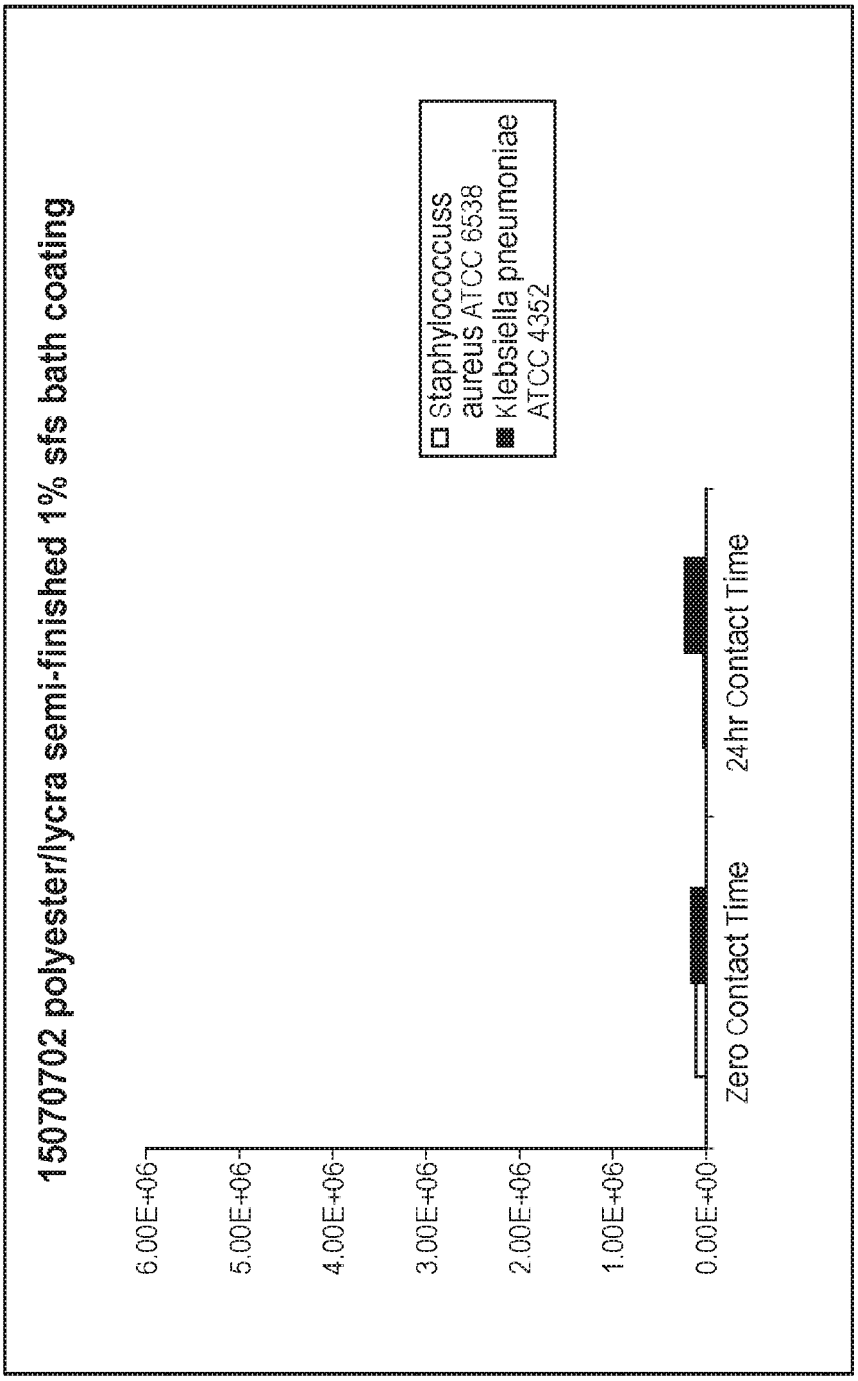

15070702 polyester/lycra semi-finished 1% sfs bath coating
Staphylococcuss aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
6.00E+06
5.00E+06
4.00E+06
3.00E+06
2.00E+06
1.00E+06
0.00E+00
Zero Contact Time
24hr Contact Time

FIG. 90

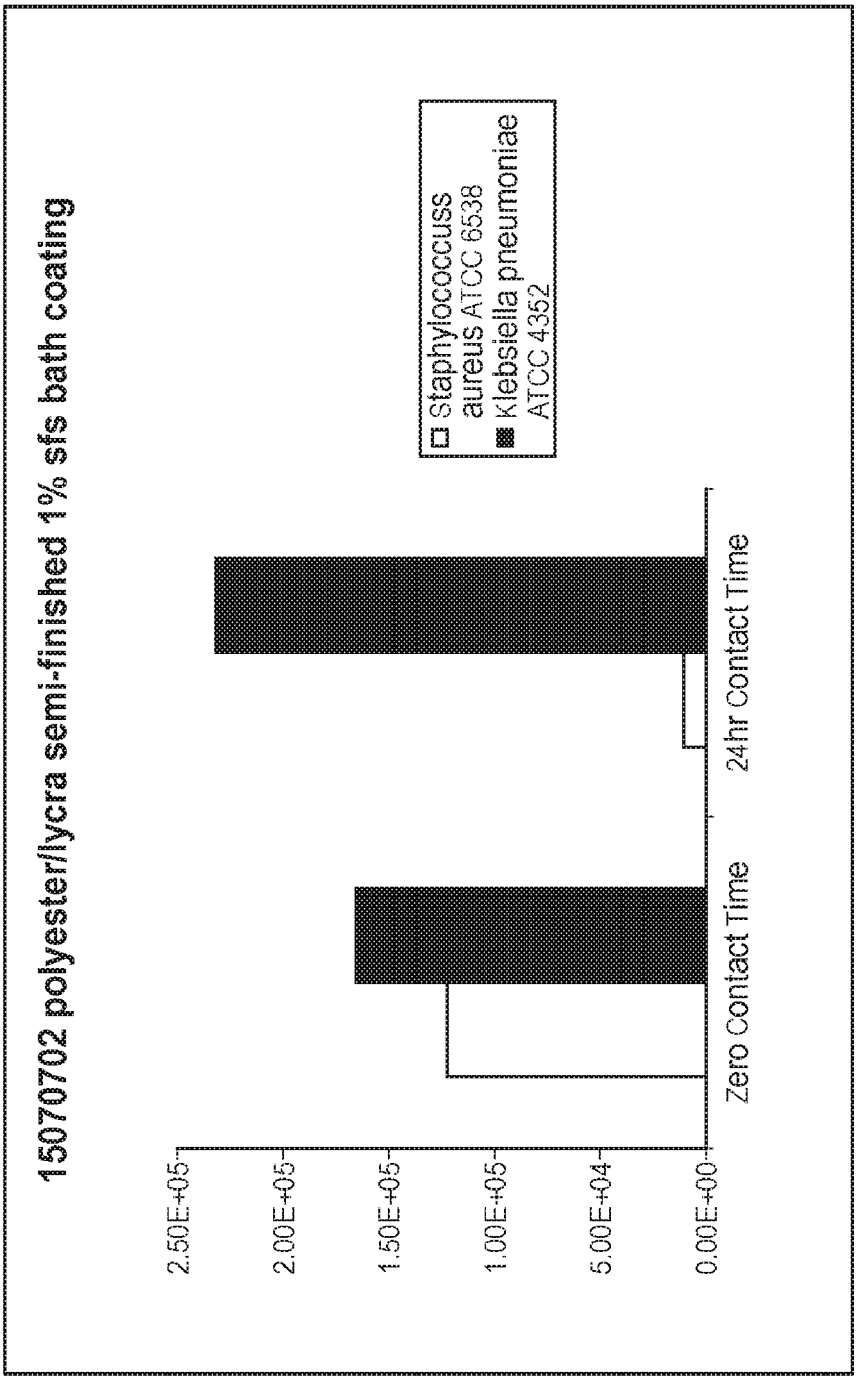

15070702 polyester/lycra semi-finished 1% sfs bath coating
Staphylococcuss aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Zero Contact Time
24hr Contact Time

FIG. 91

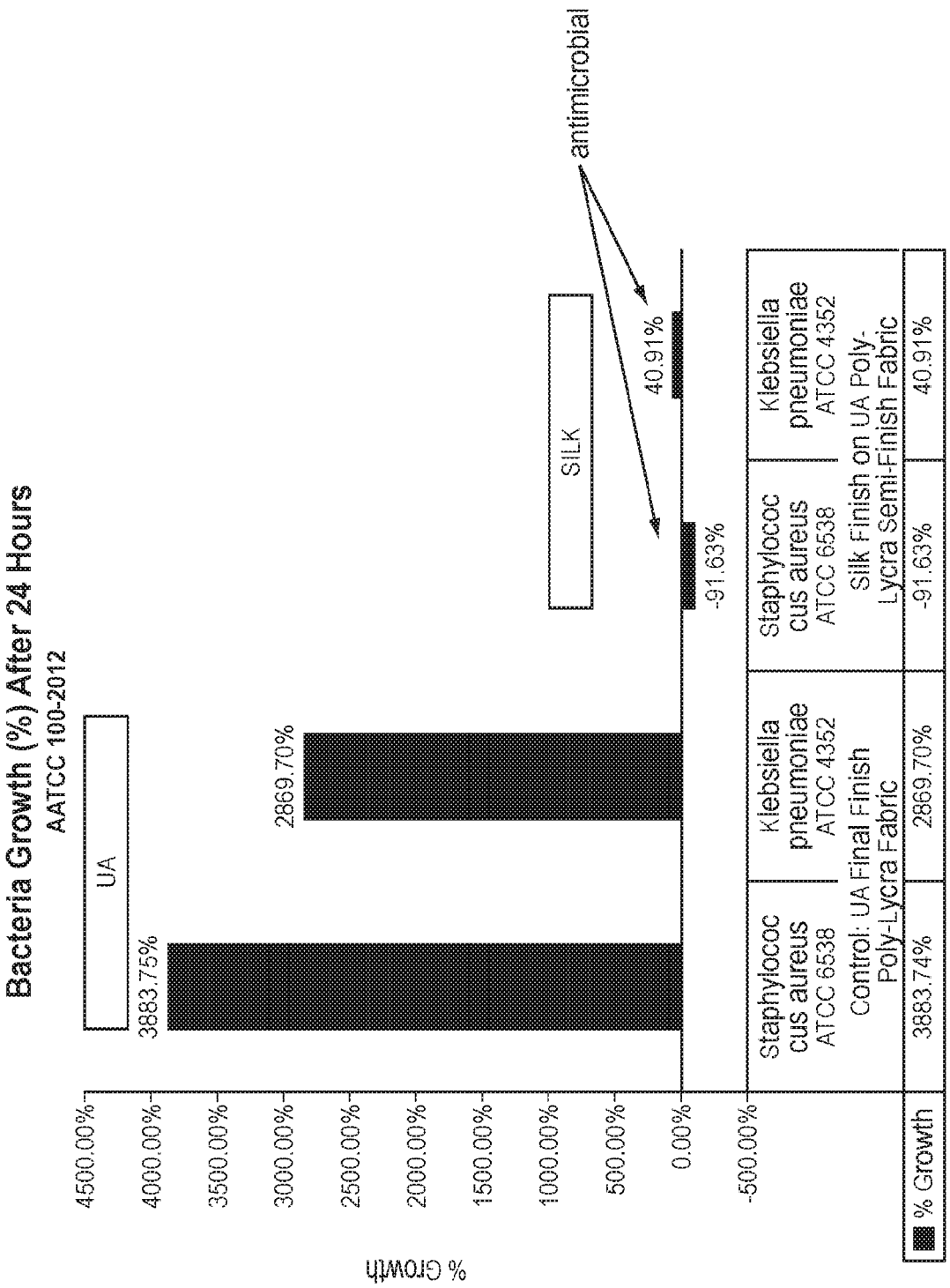

Bacteria Growth (%) After 24 Hours
AATCC 100-2012
UA
SILK
antimicrobial
3883.75%
2869.70%
-91.63%
40.91%
4500.00%
4000.00%
3500.00%
3000.00%
2500.00%
2000.00%
1500.00%
1000.00%
500.00%
0.00%
-500.00%
% Growth
Staphylococcus aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
Staphylococcus aureus ATCC 6538
Klebsiella pneumoniae ATCC 4352
Control: UA Final Finish Poly-Lycra Fabric
Silk Finish on UA Poly-Lycra Semi-Finish Fabric
% Growth
3883.74%
2869.70%
-91.63%
40.91%

FIG. 92

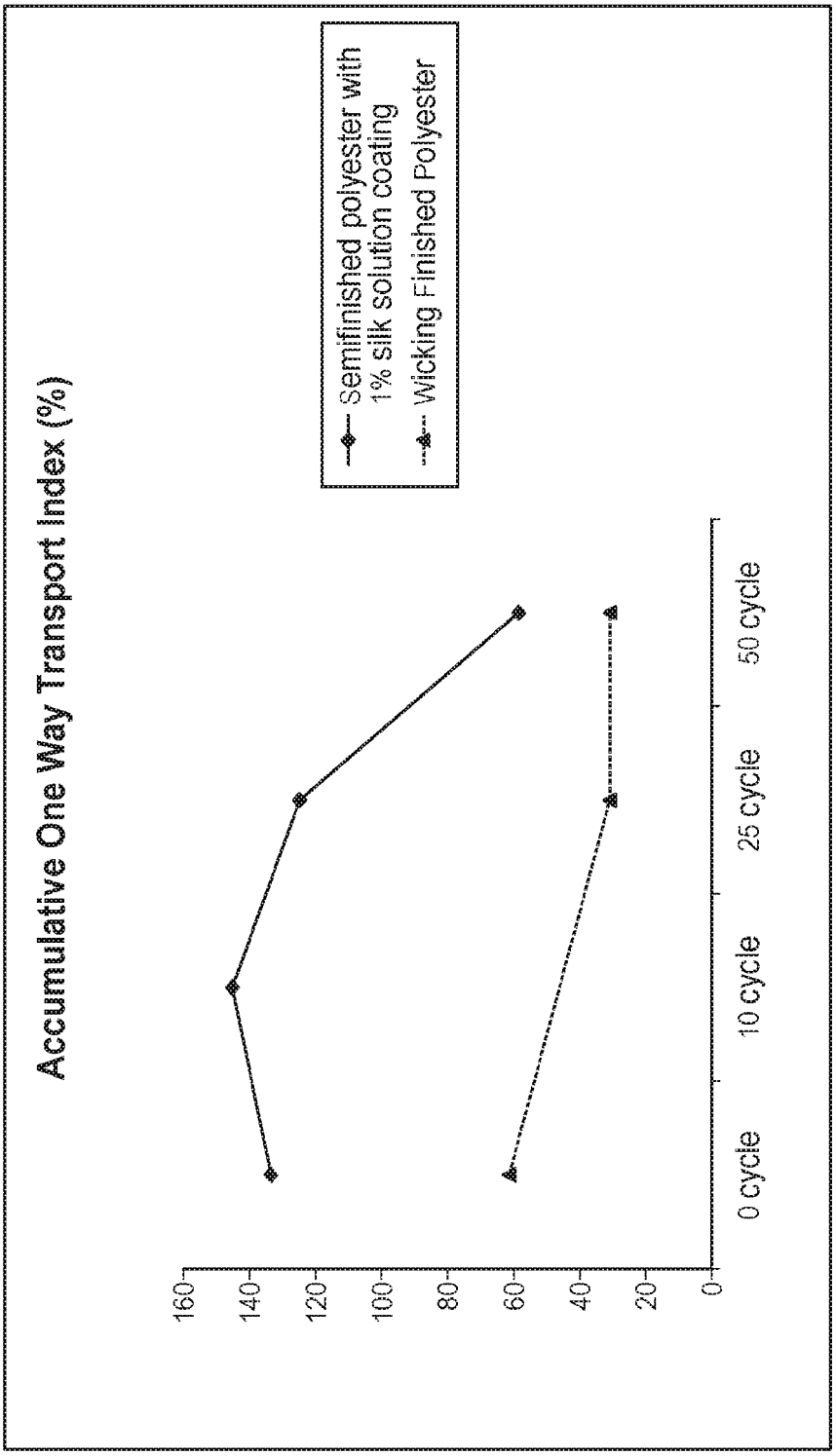

Accumulative One Way Transport Index (%)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
160
140
120
100
80
60
40
20
0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 93

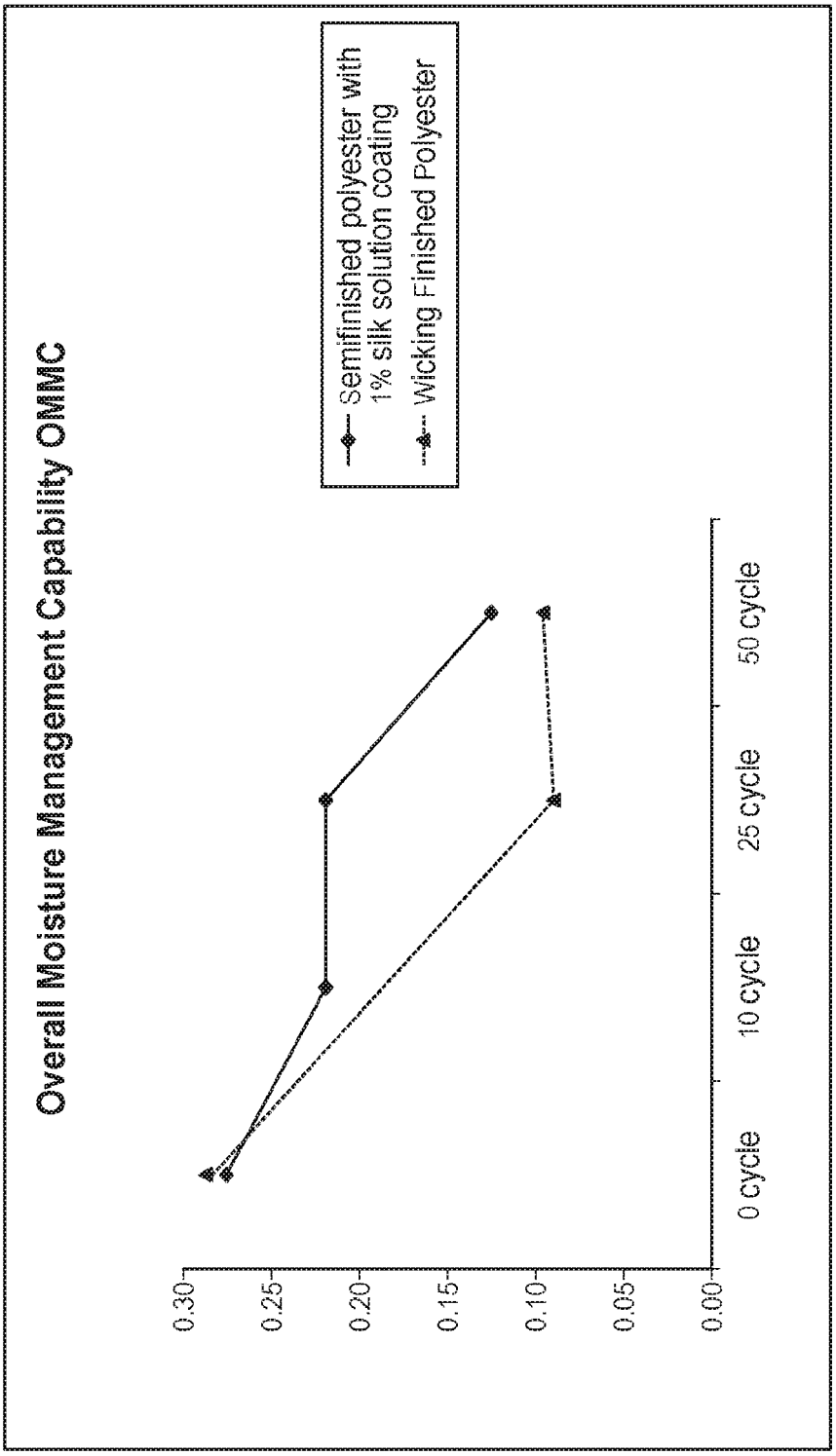

Overall Moisture Management Capability OMMC
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 94

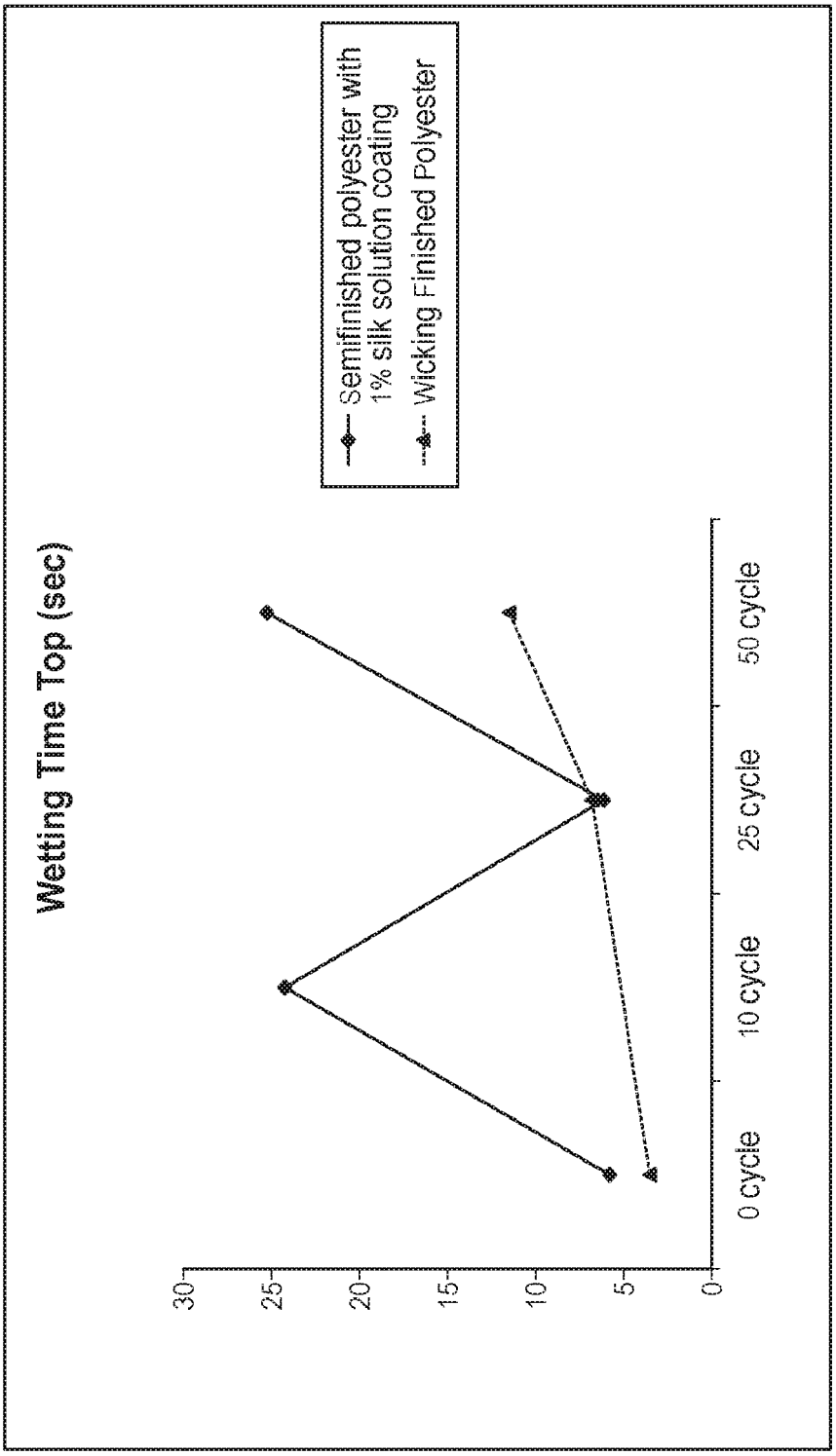

Wetting Time Top (sec)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
30
25
20
15
10
5
0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 95

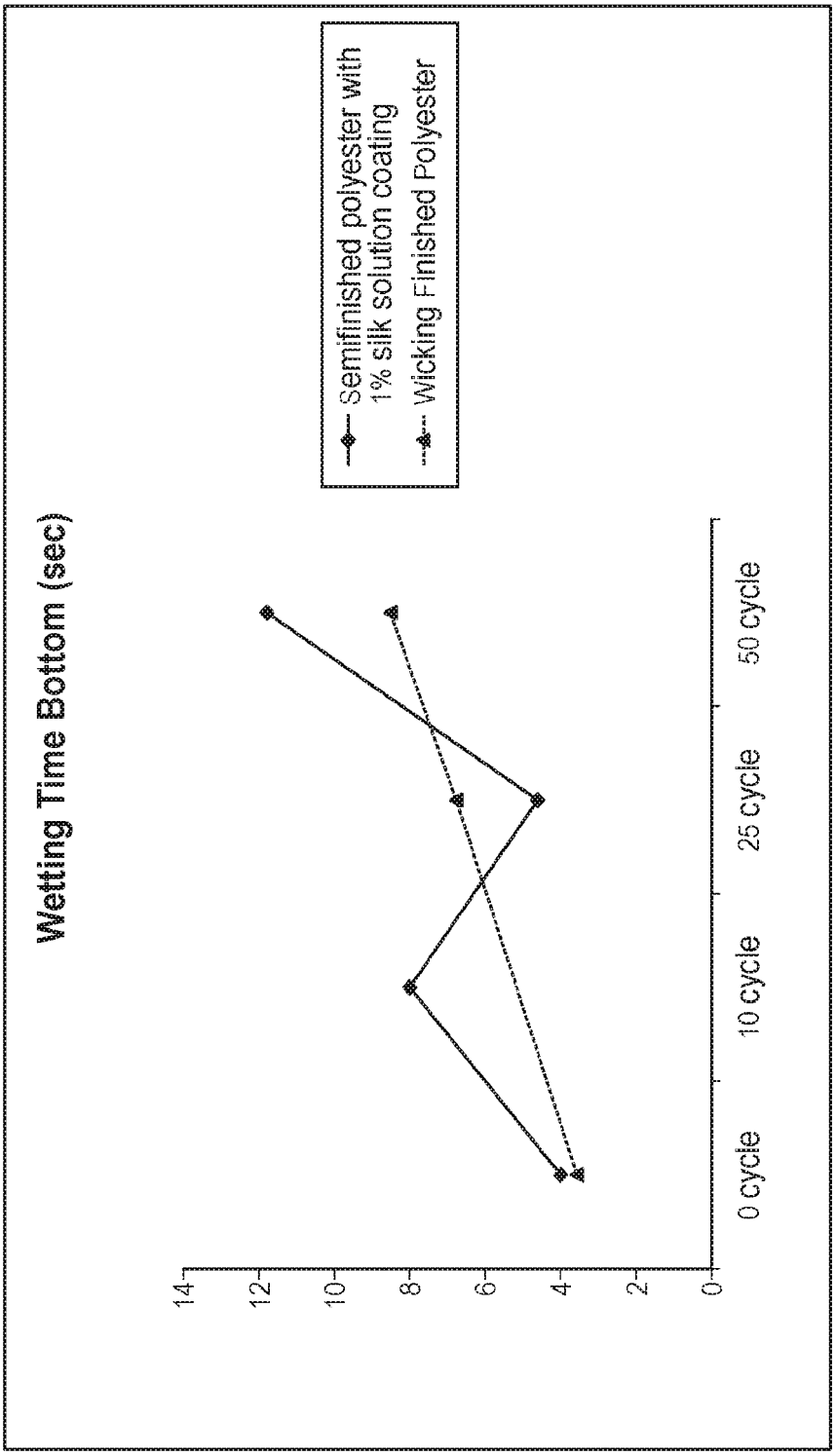

Wetting Time Bottom (sec)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
14
12
10
8
6
4
2
0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 96

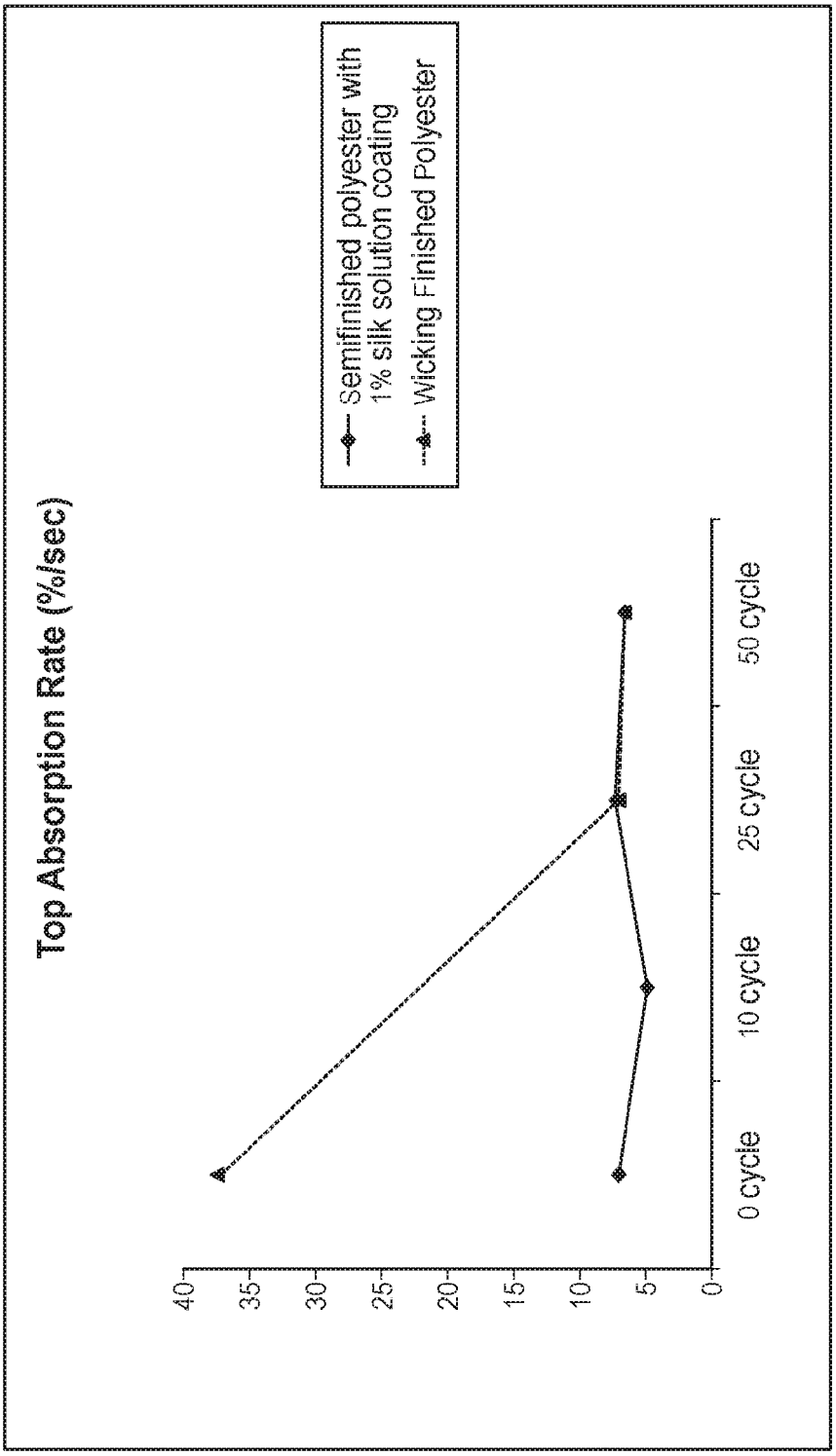

Top Absorption Rate (%/sec)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
40
35
30
25
20
15
10
5
0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 97

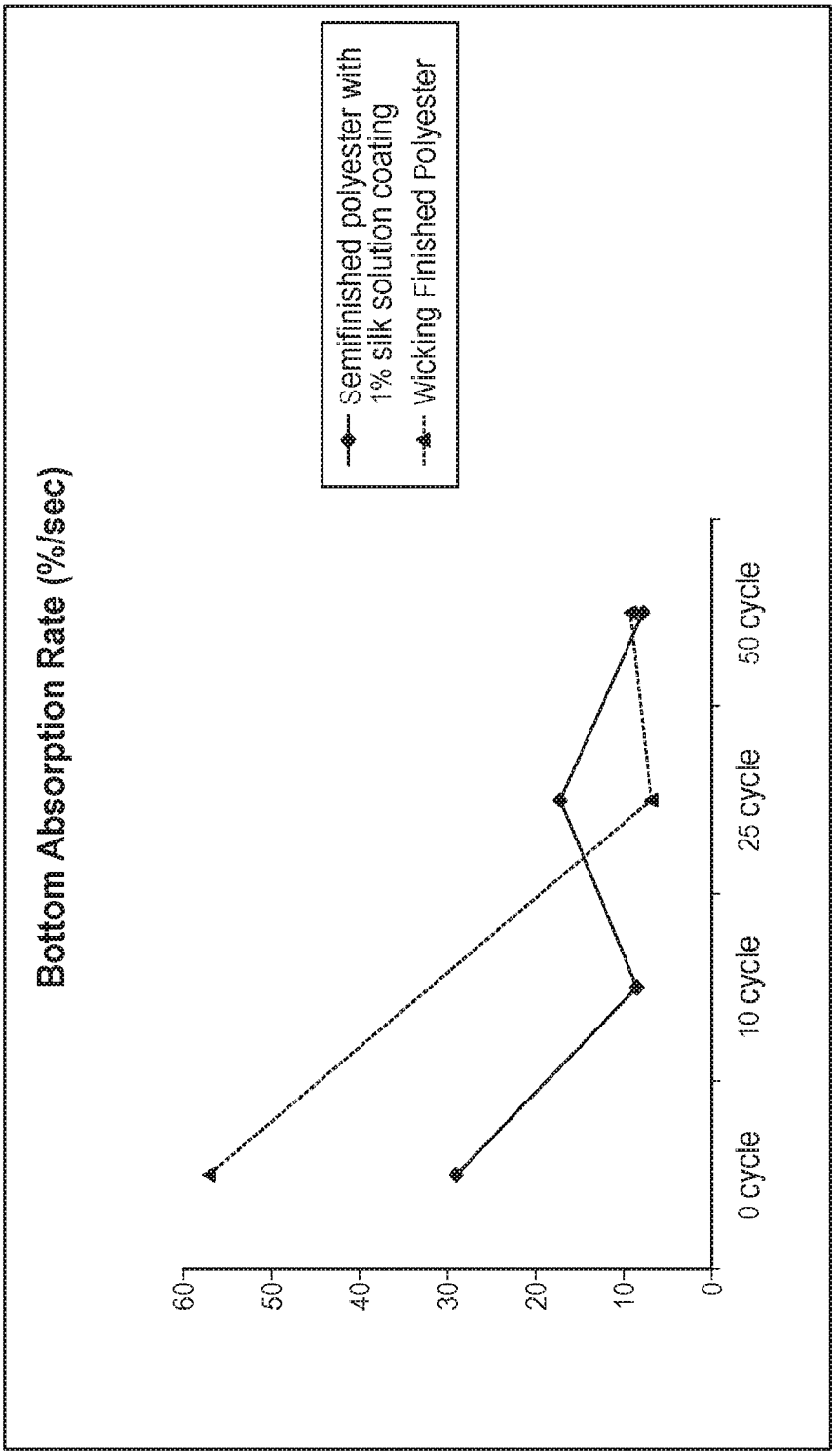

Bottom Absorption Rate (%/sec)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
60
50
40
30
20
10
0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 98

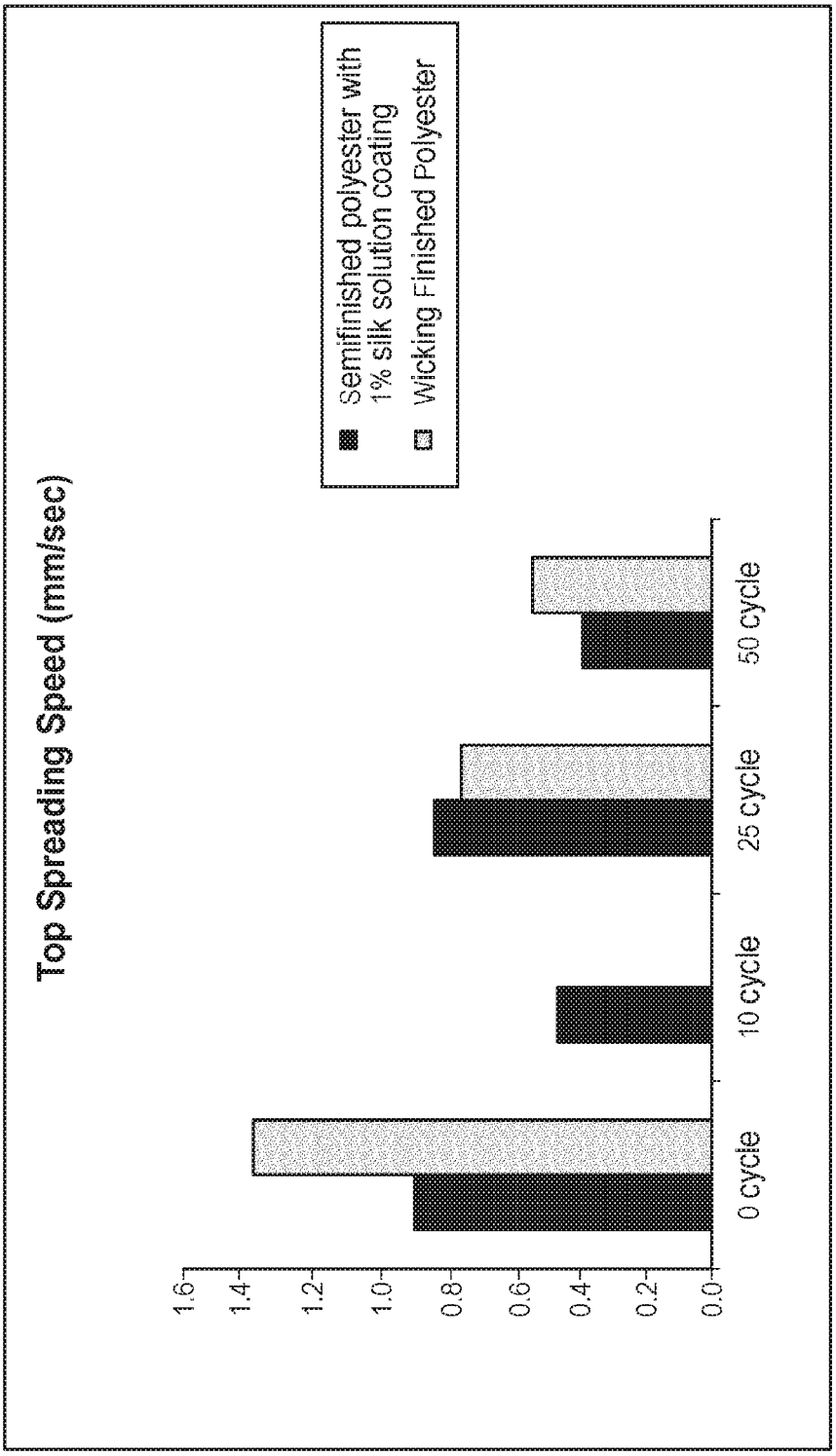

Top Spreading Speed (mm/sec)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 99

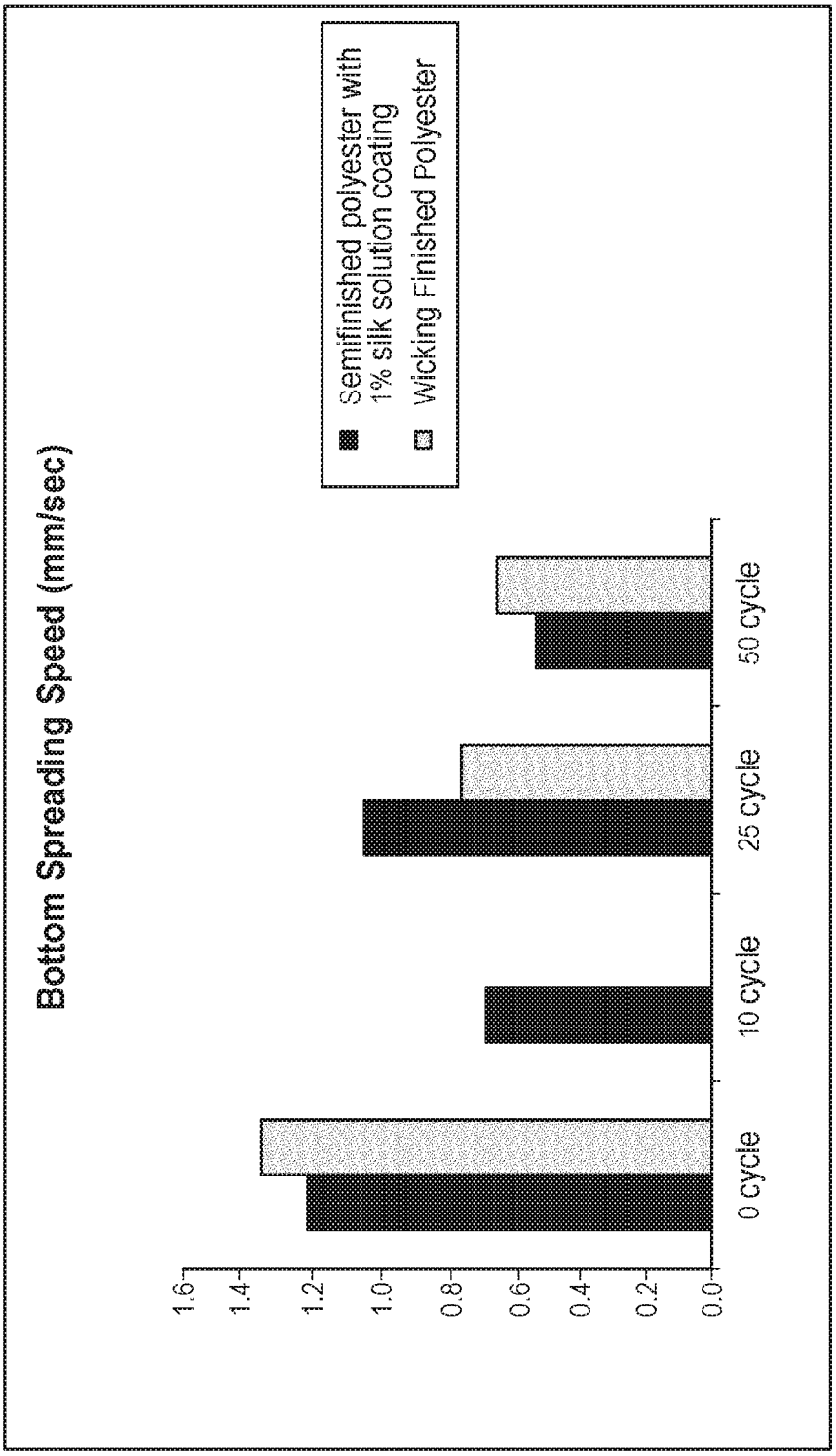

Bottom Spreading Speed (mm/sec)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 100

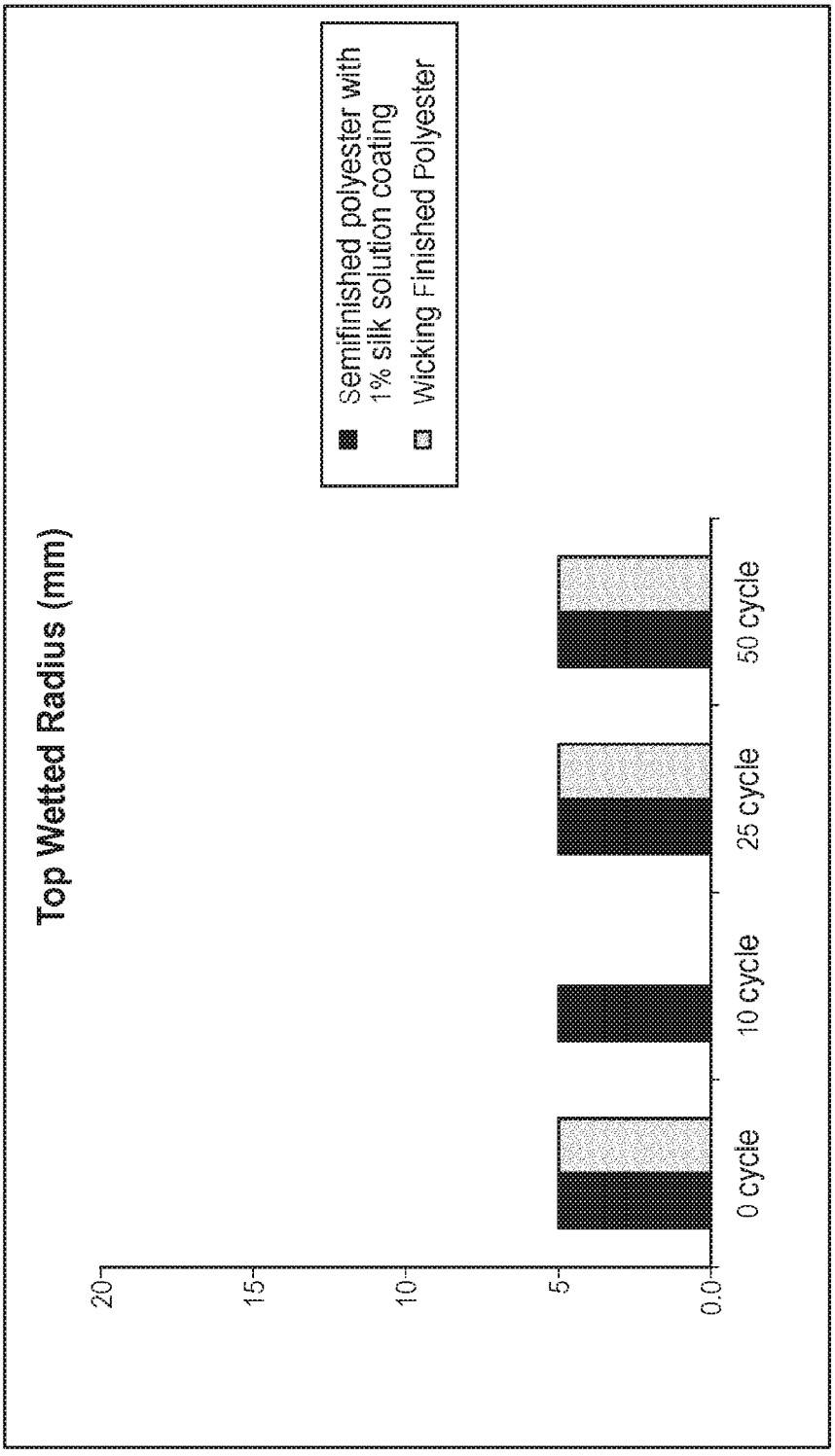

Top Wetted Radius (mm)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
20
15
10
5
0.0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 101

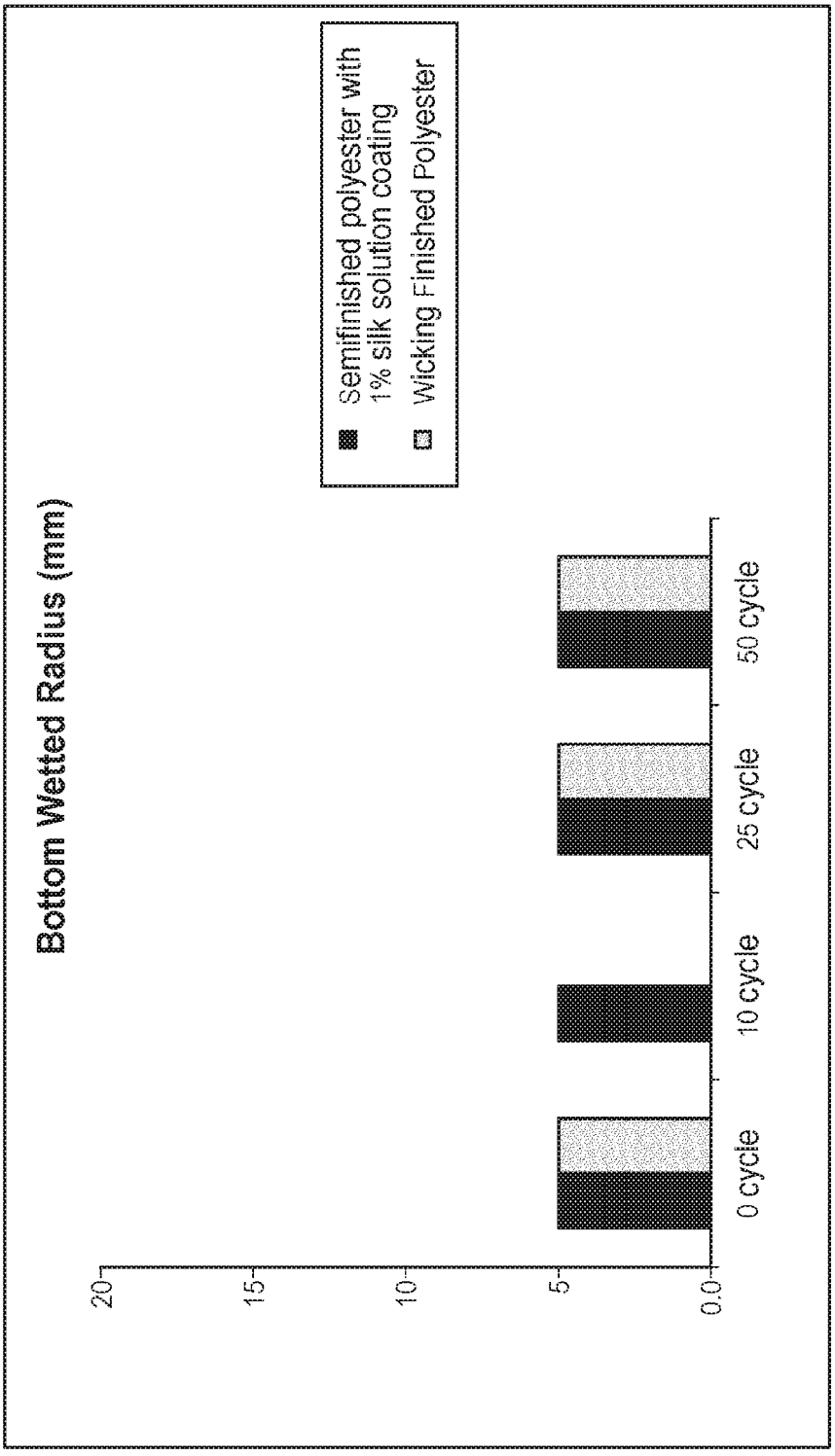

Bottom Wetted Radius (mm)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
20
15
10
5
0.0
0 cycle
10 cycle
25 cycle
50 cycle

FIG. 102

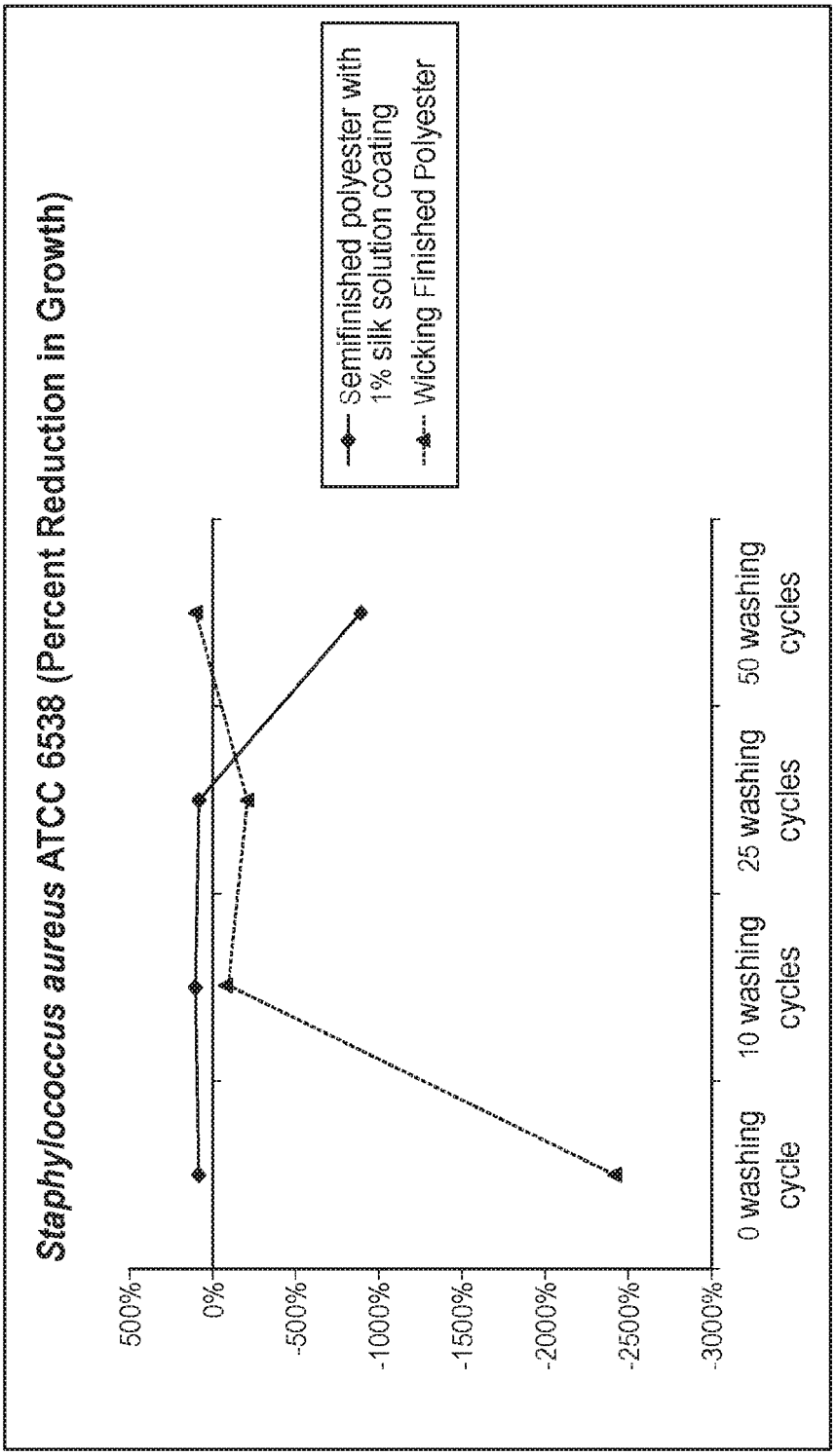

Staphylococcus aureus ATCC 6538 (Percent Reduction in Growth)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
500%
0%
-500%
-1000%
-1500%
-2000%
-2500%
-3000%
0 washing cycle
10 washing cycles
25 washing cycles
50 washing cycles

FIG. 103

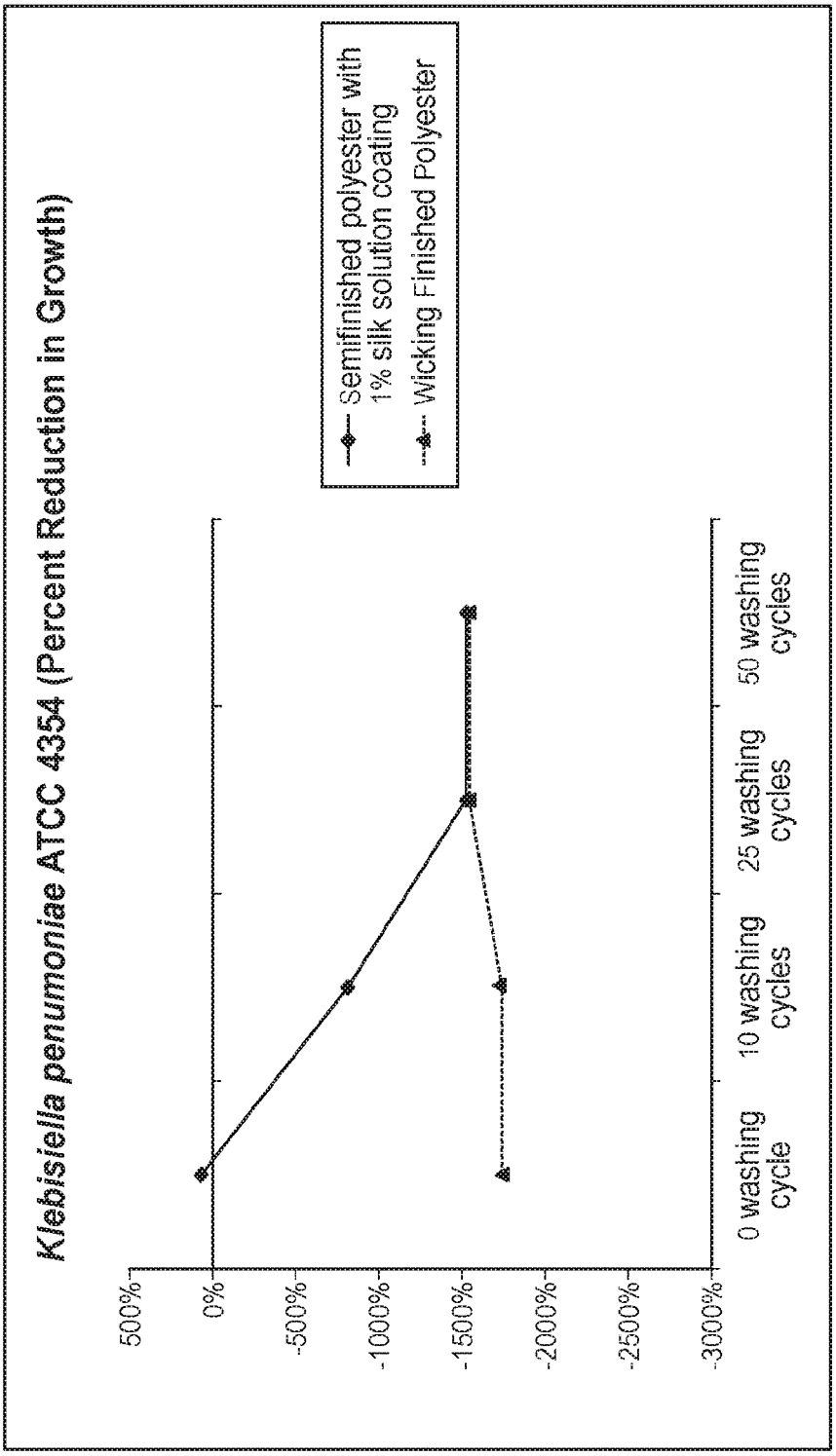

Klebisiella penumoniae ATCC 4354 (Percent Reduction in Growth)
Semifinished polyester with 1% silk solution coating
Wicking Finished Polyester
500%
0%
-500%
-1000%
-1500%
-2000%
-2500%
-3000%
0 washing cycle
10 washing cycles
25 washing cycles
50 washing cycles

FIG. 104

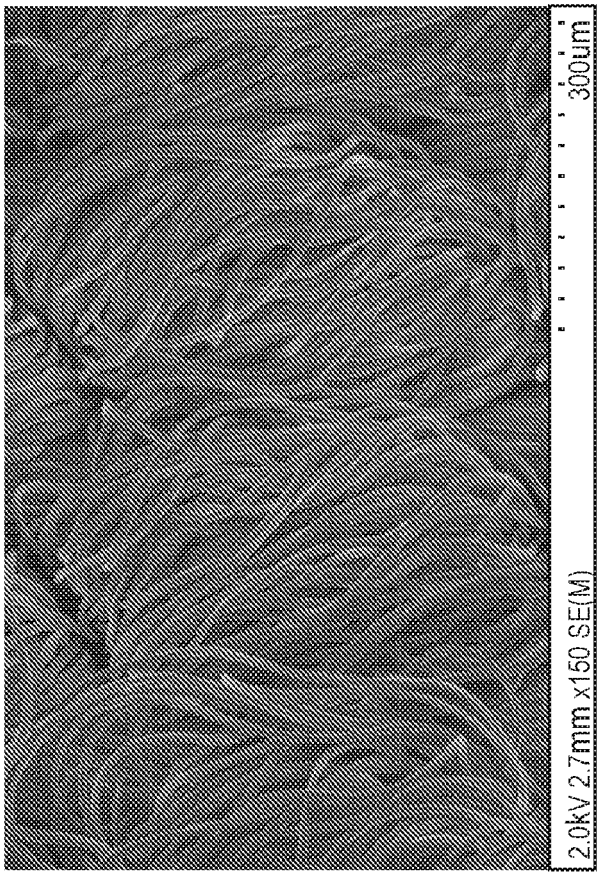


FIG. 105

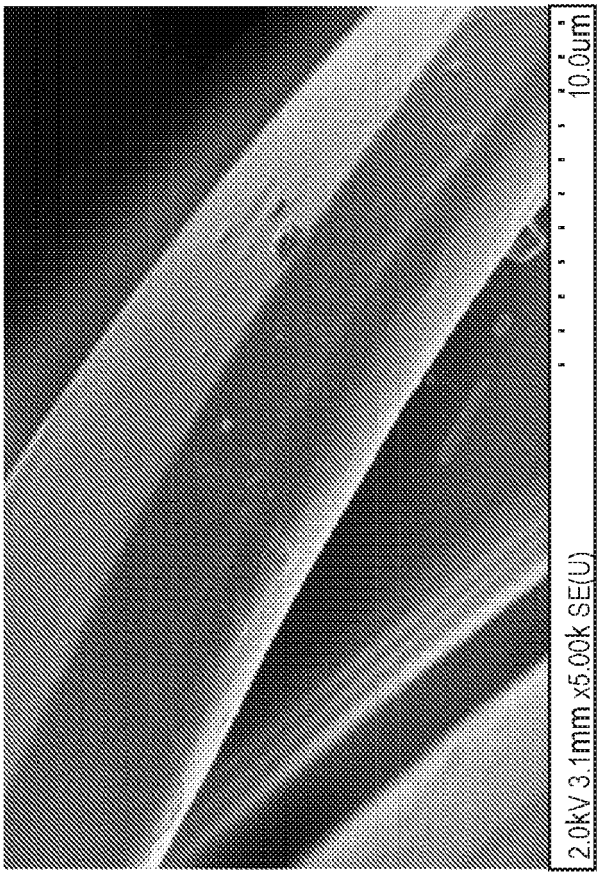


FIG. 106

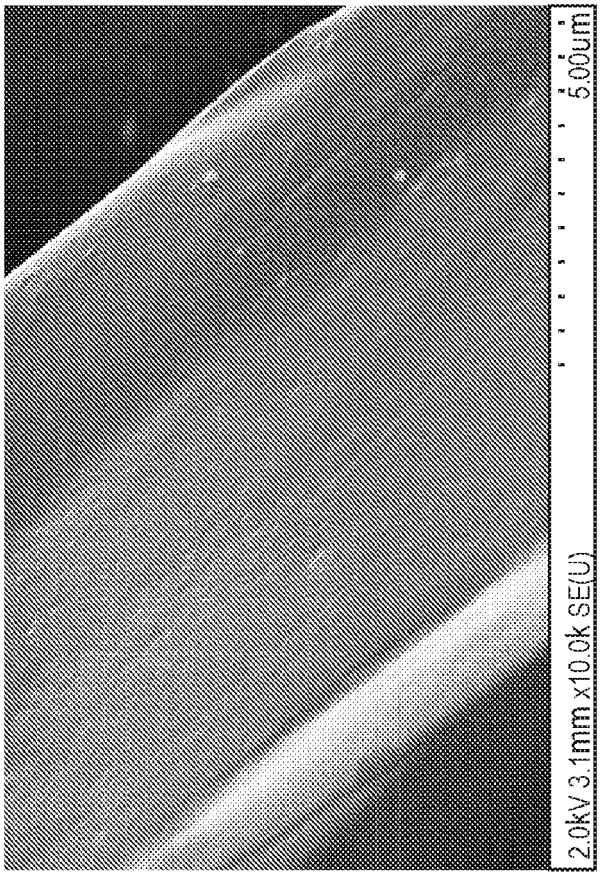


FIG. 107

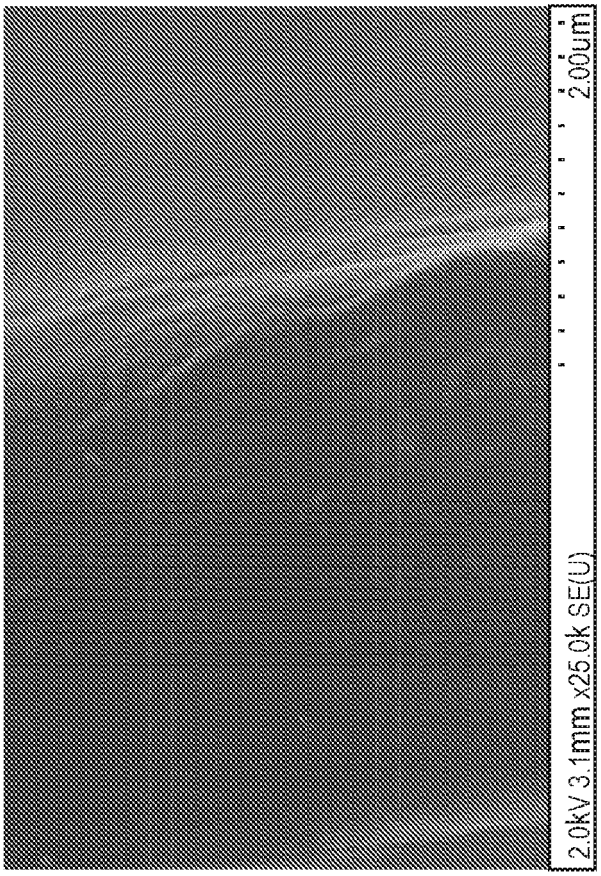


FIG. 108

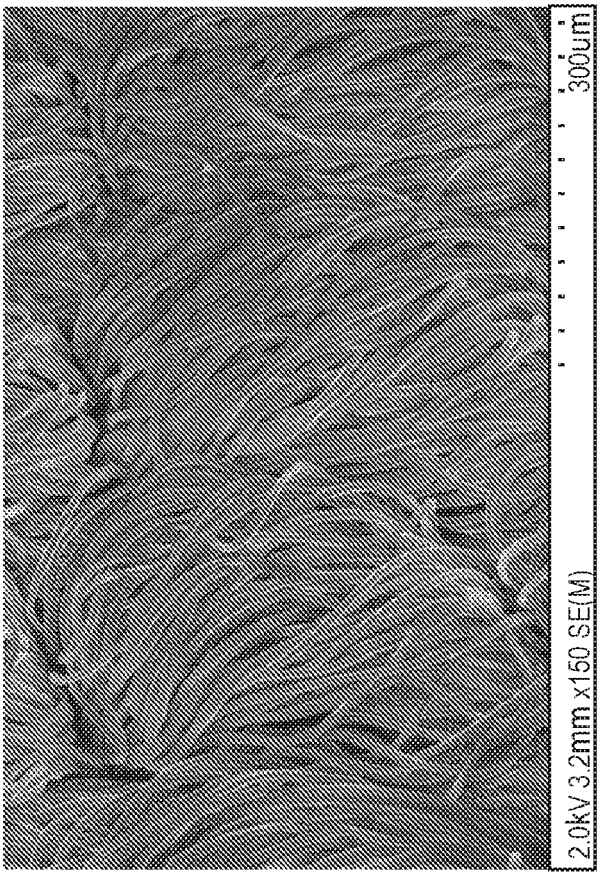


FIG. 109

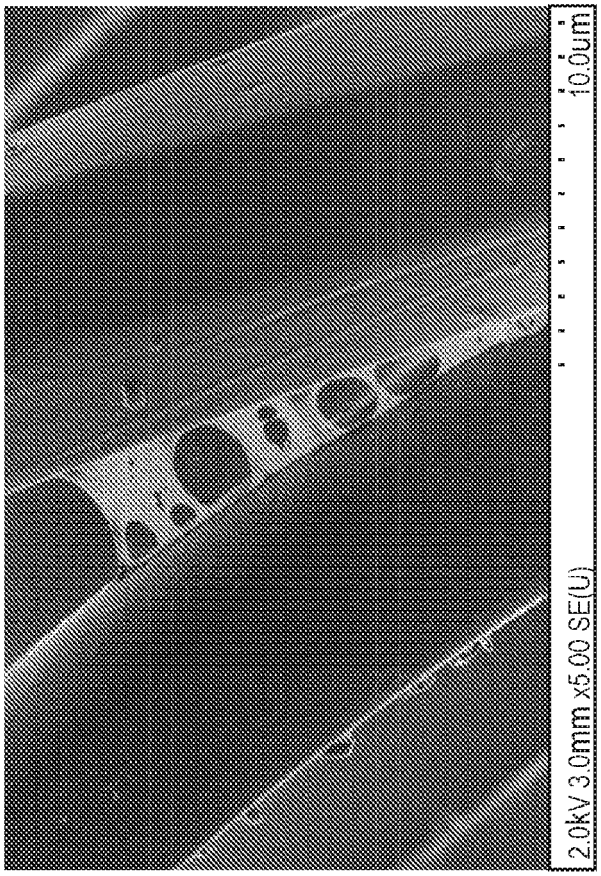


FIG. 110



FIG. 111

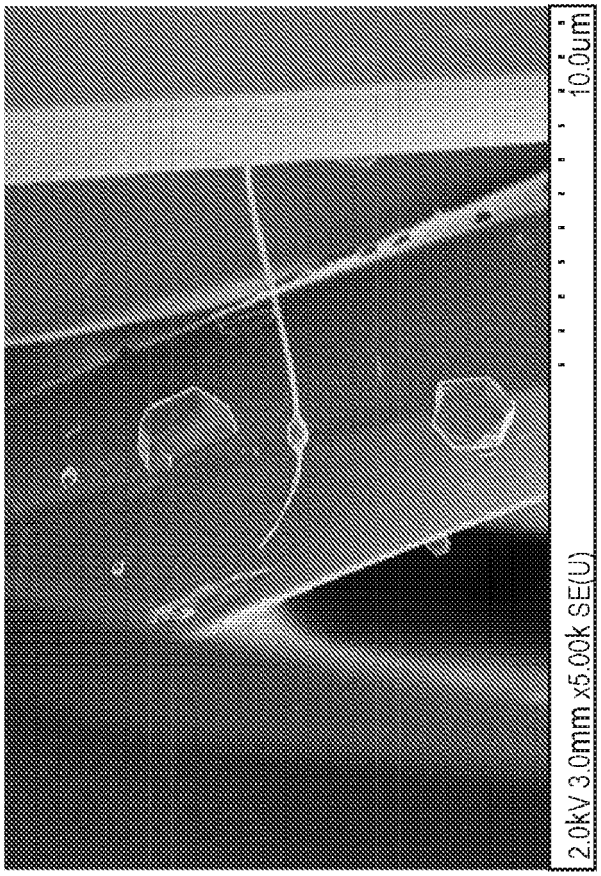


FIG. 112

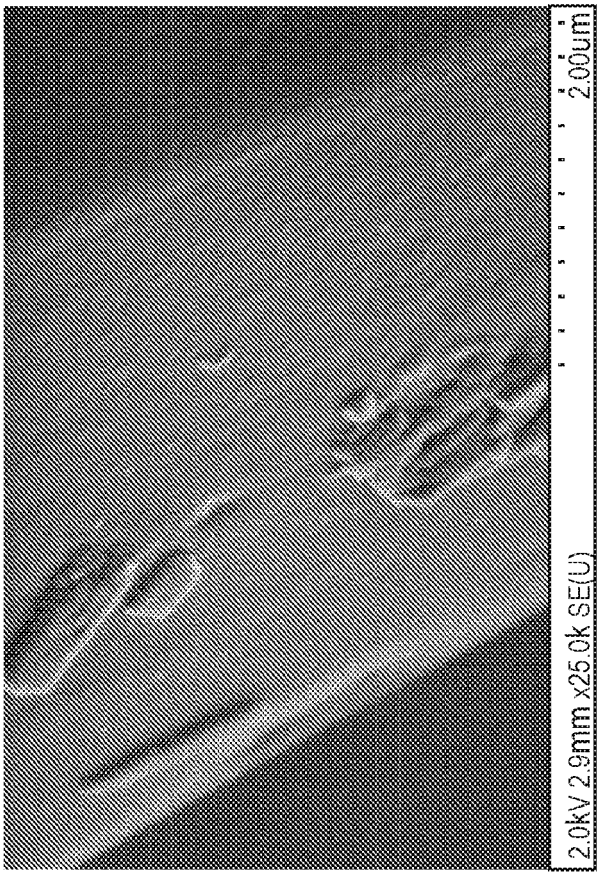


FIG. 113

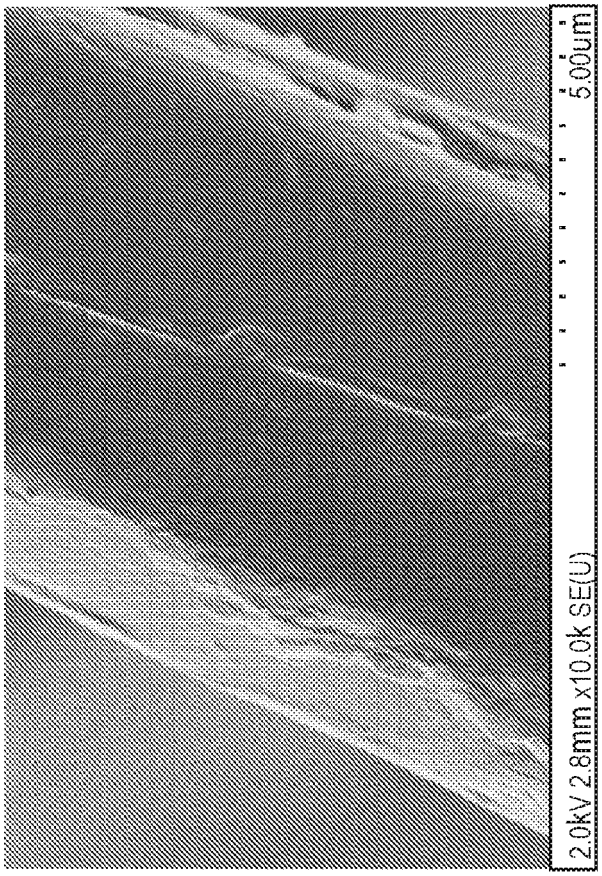


FIG. 114

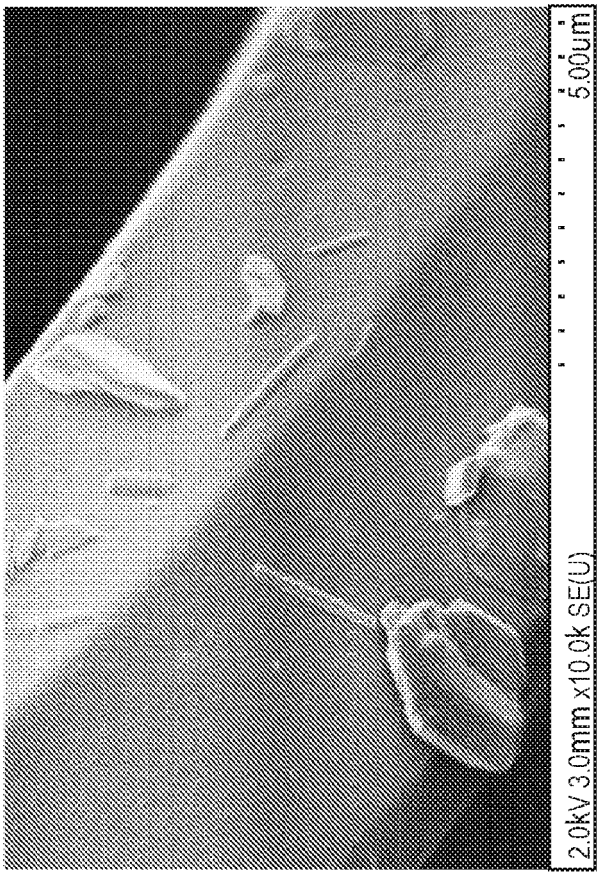


FIG. 115

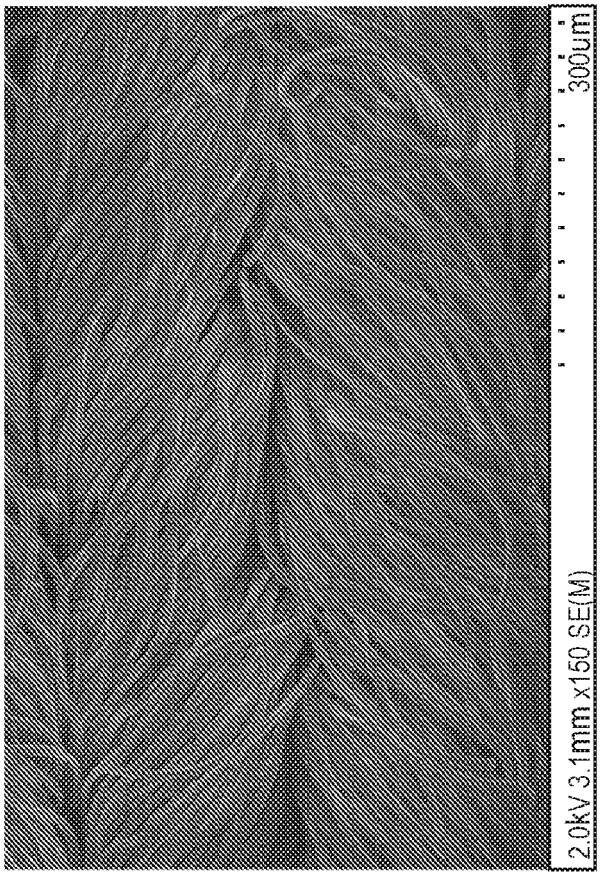


FIG. 116

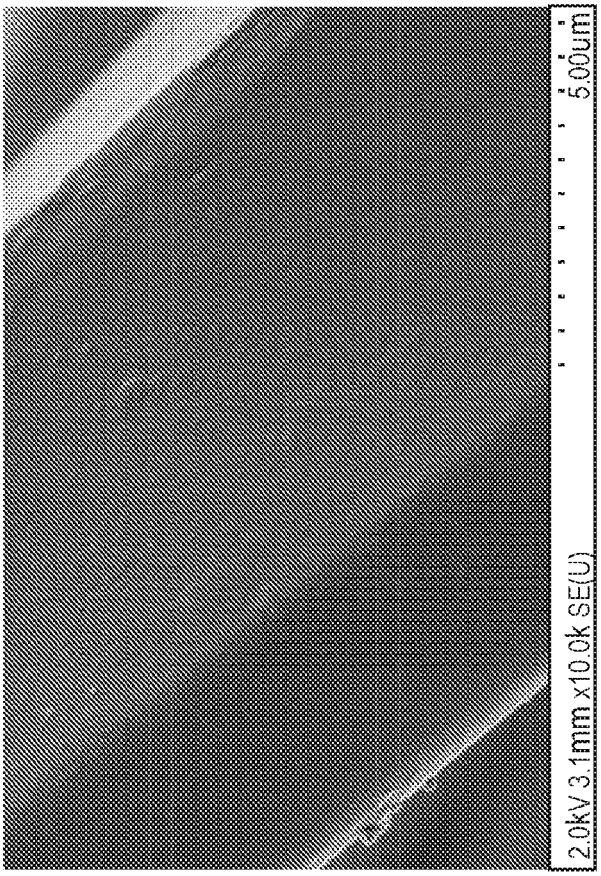


FIG. 117

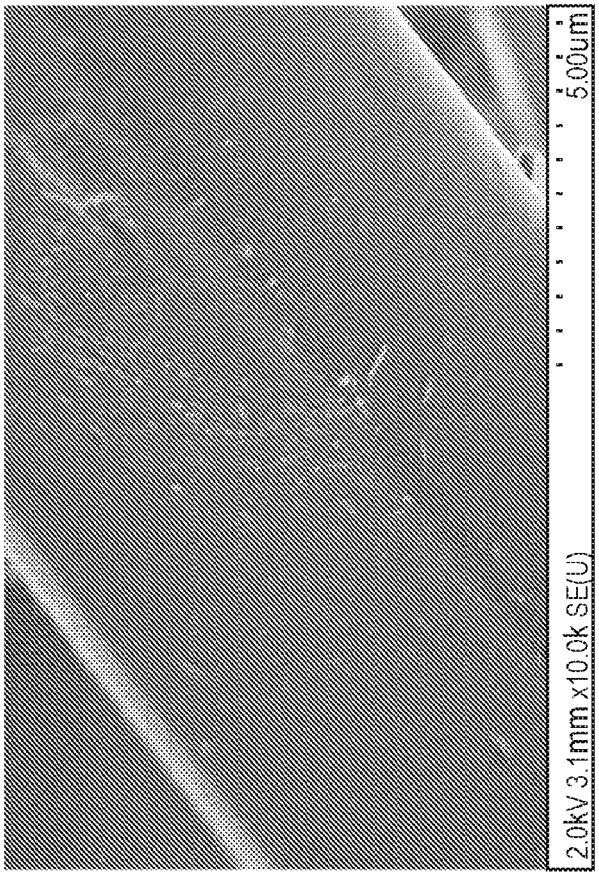


FIG. 118

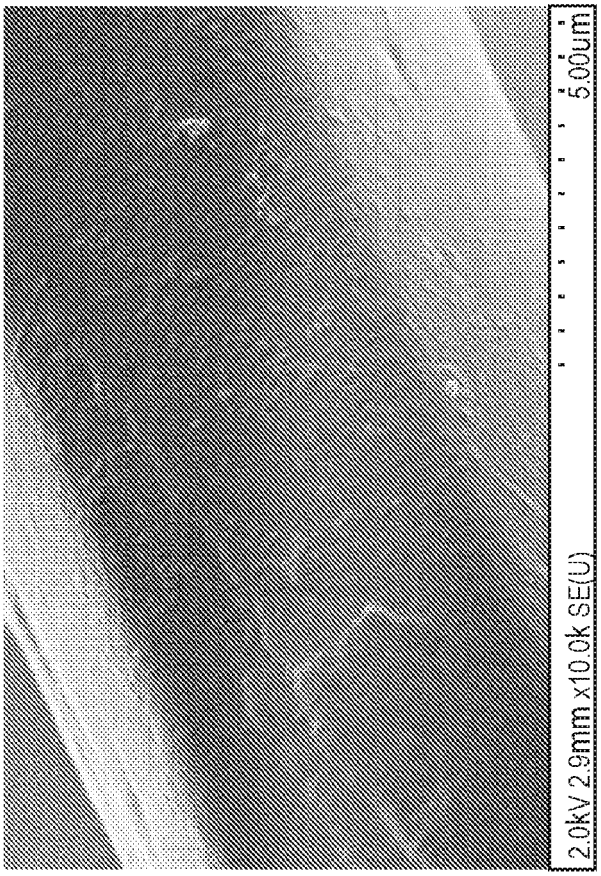


FIG. 119

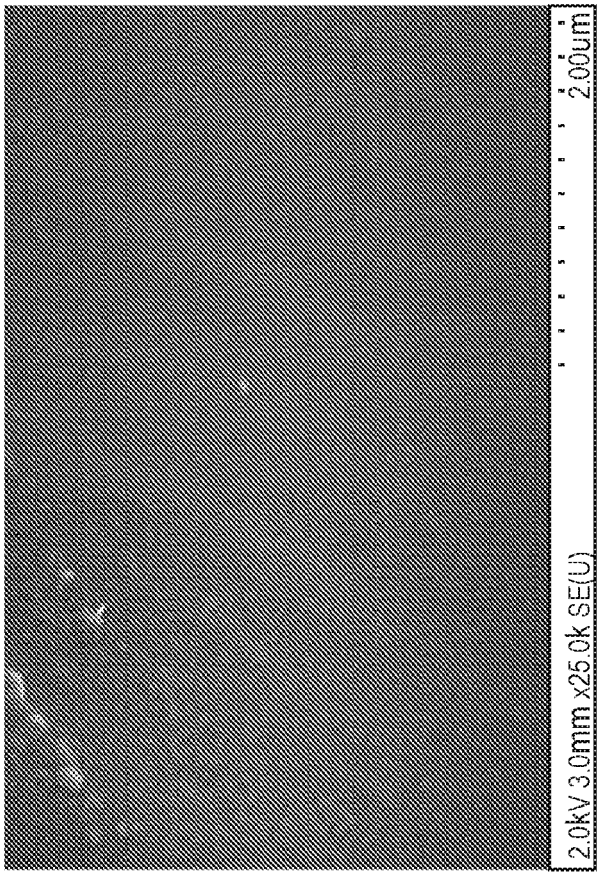


FIG. 120

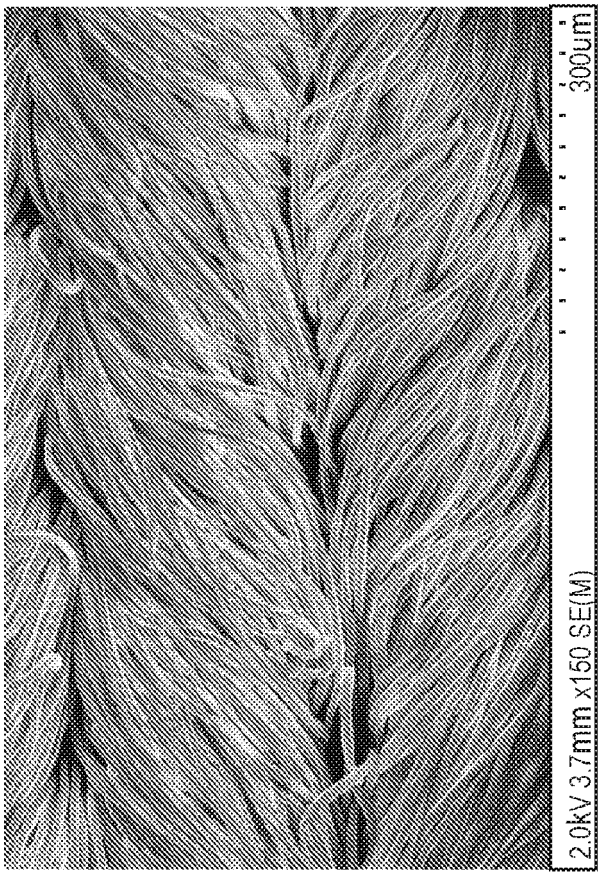


FIG. 121

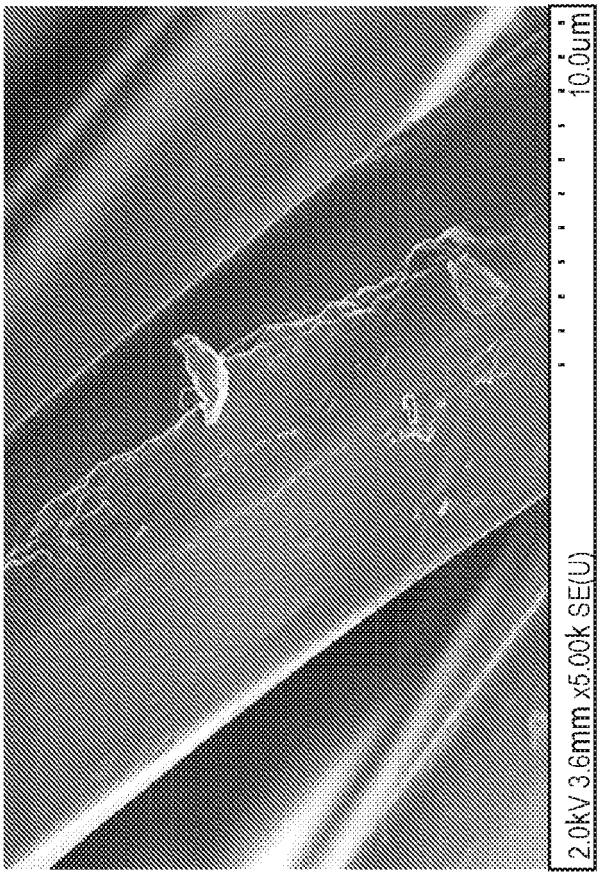


FIG. 122

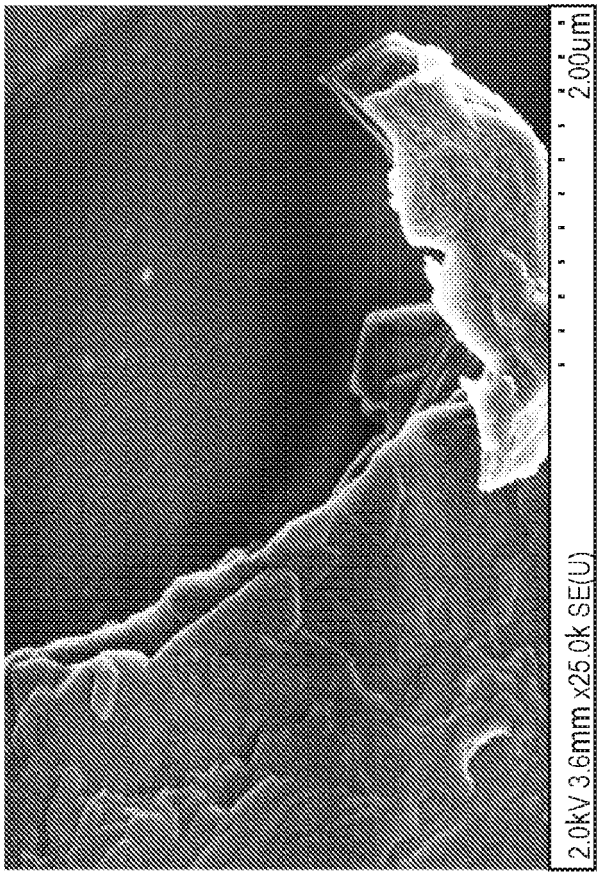


FIG. 123

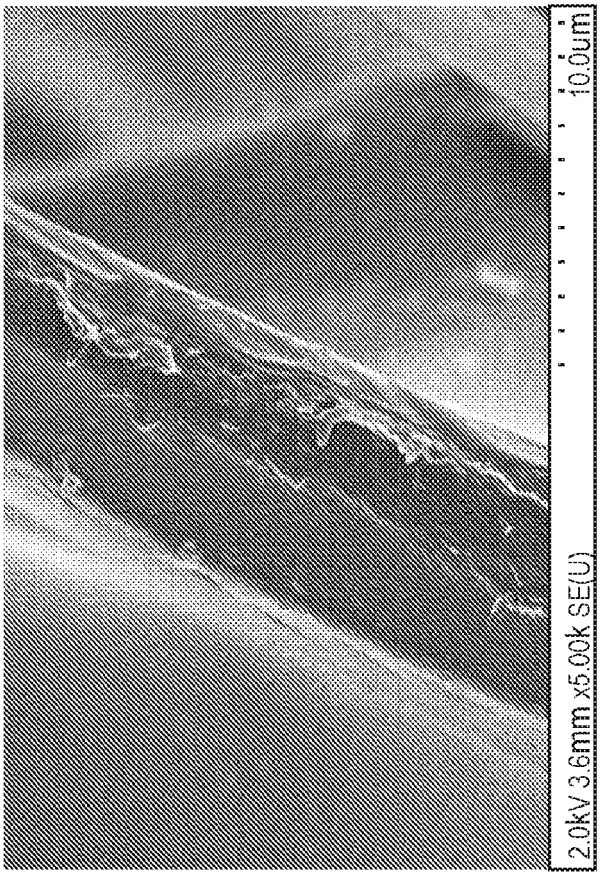


FIG. 124

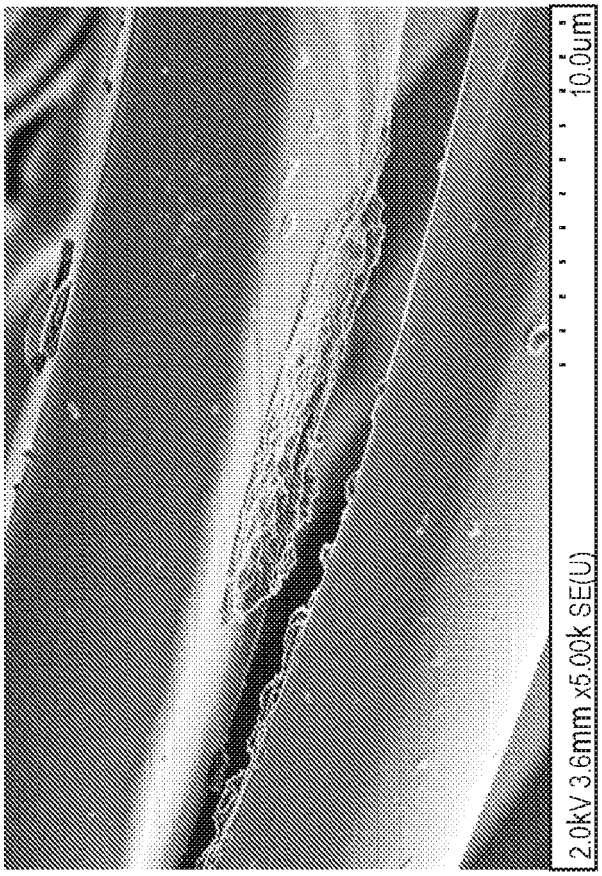


FIG. 125

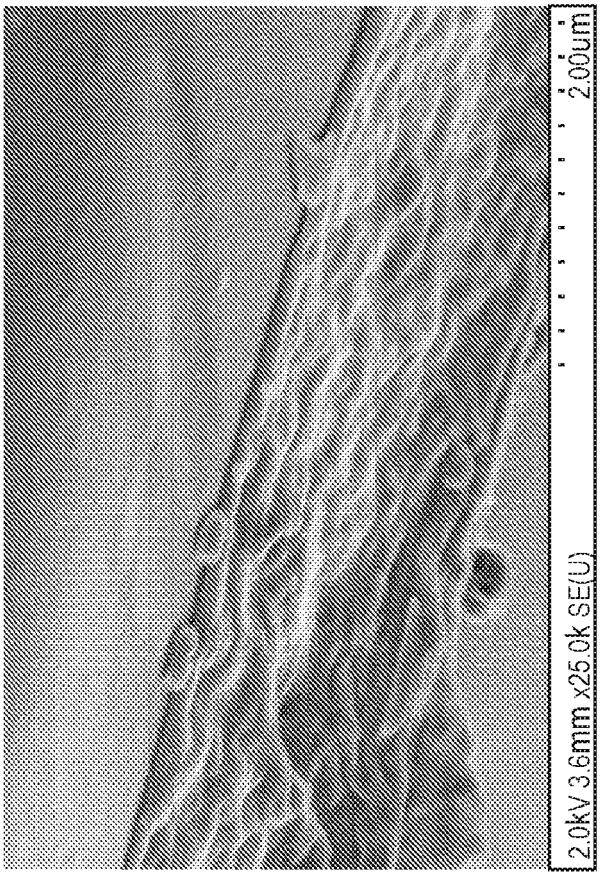


FIG. 126

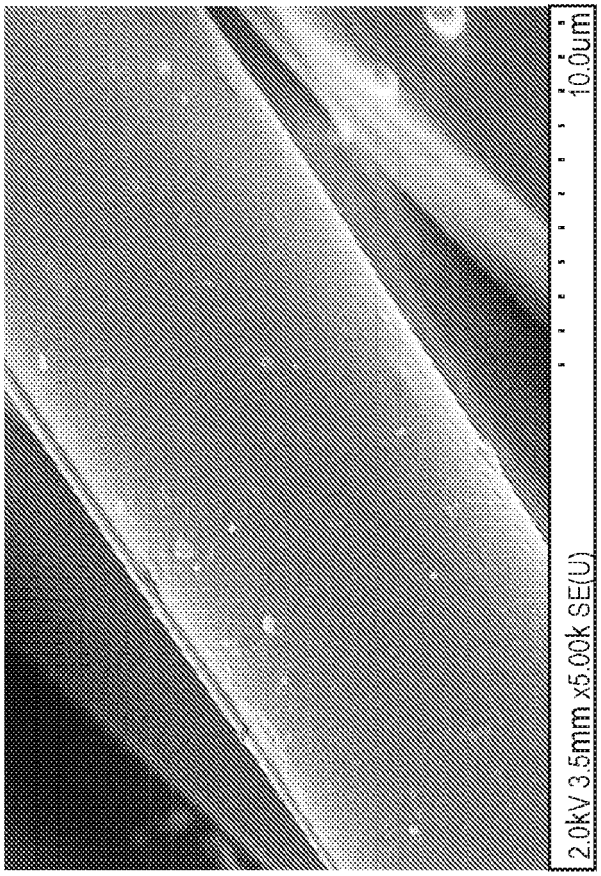


FIG. 127

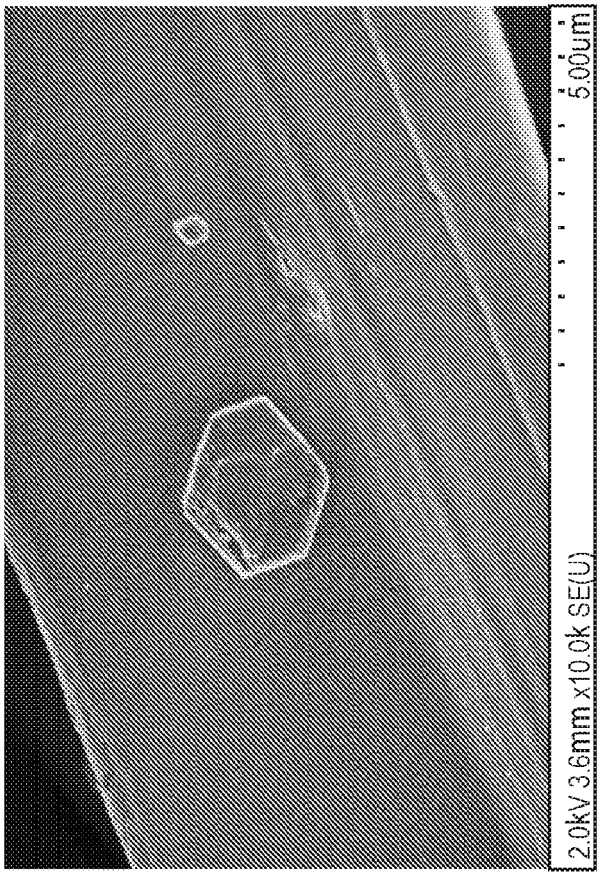


FIG. 128

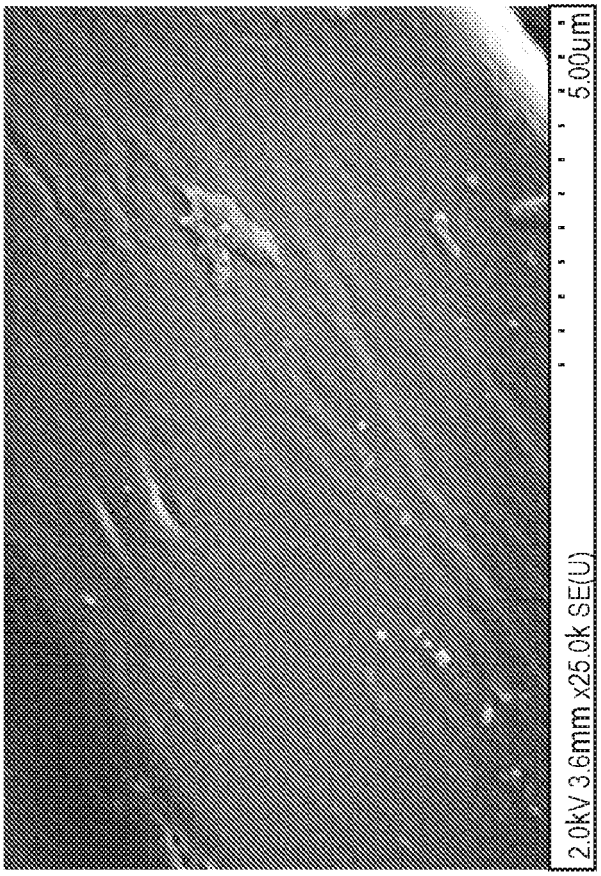


FIG. 129

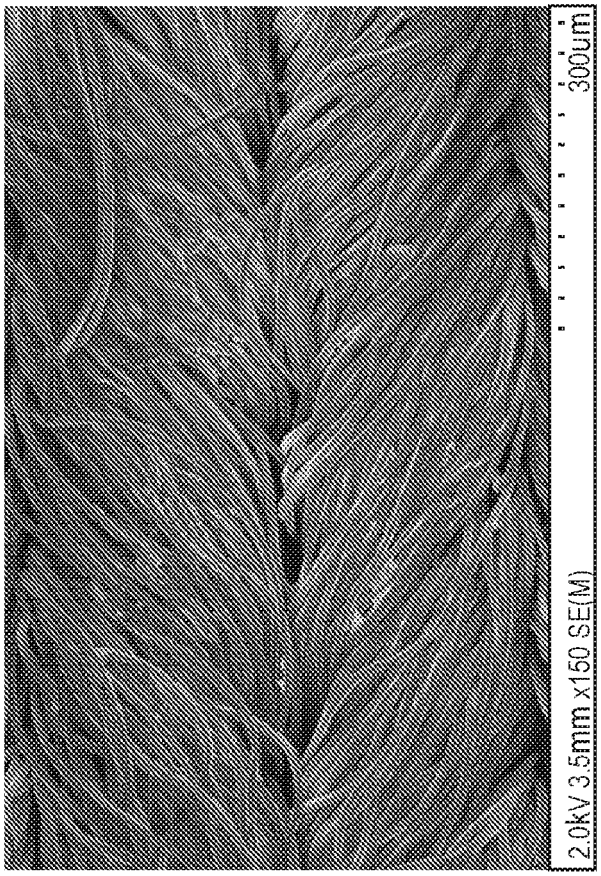


FIG. 130

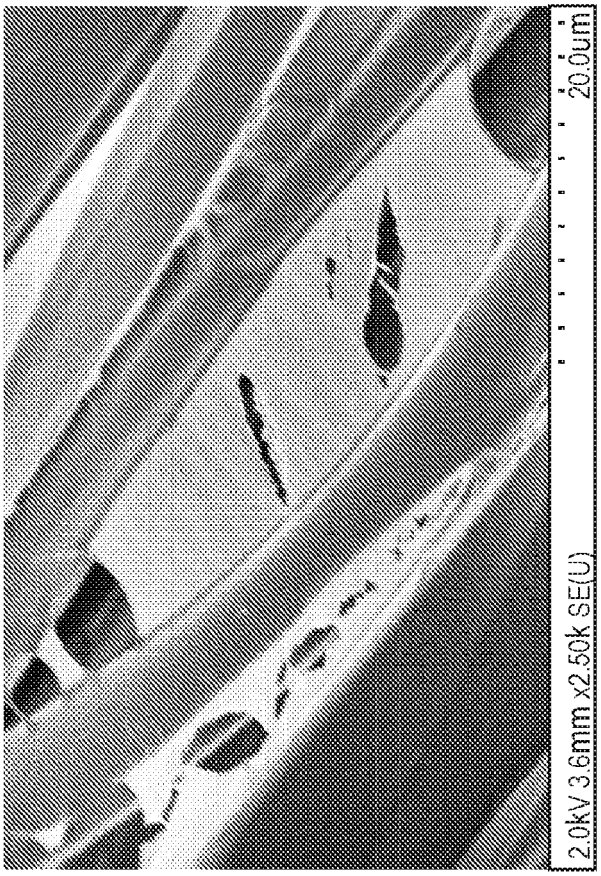


FIG. 131

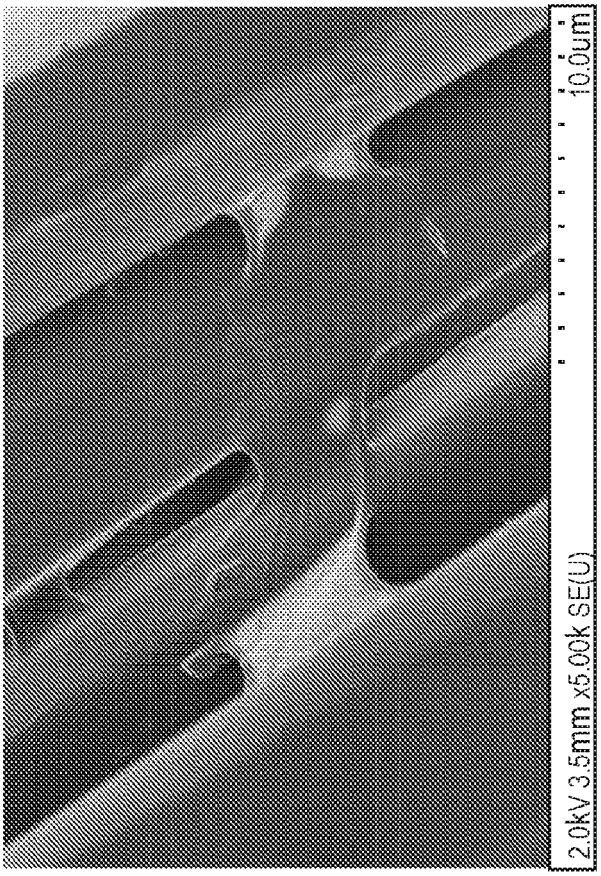


FIG. 132

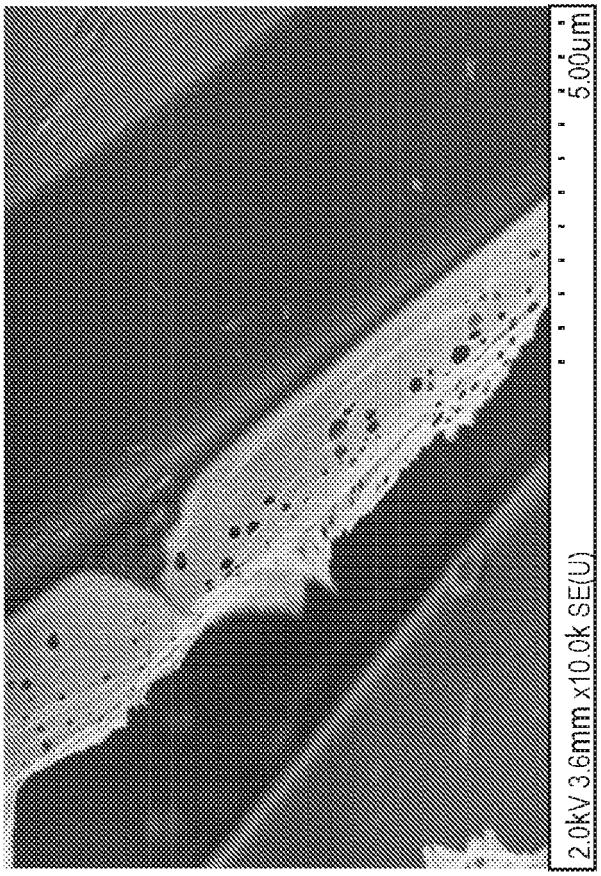


FIG. 133

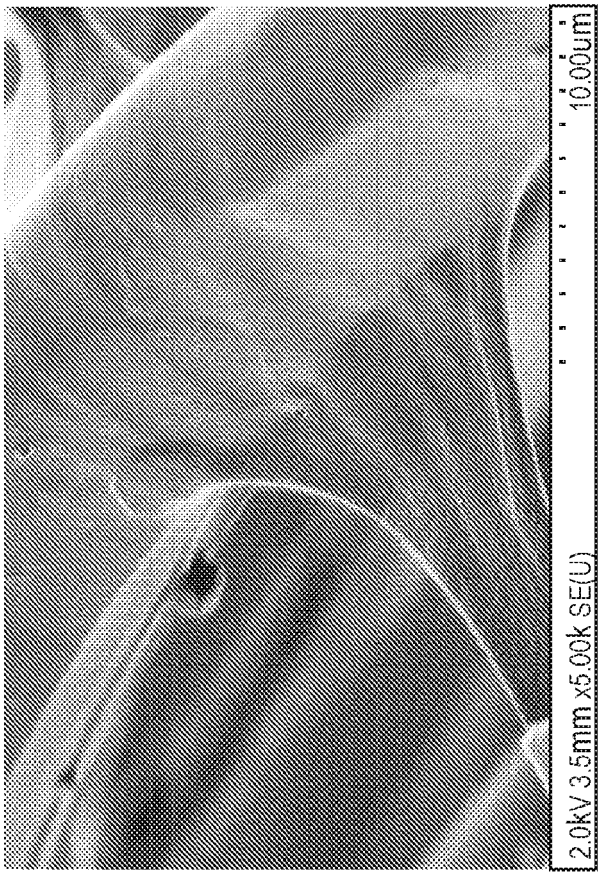


FIG. 134

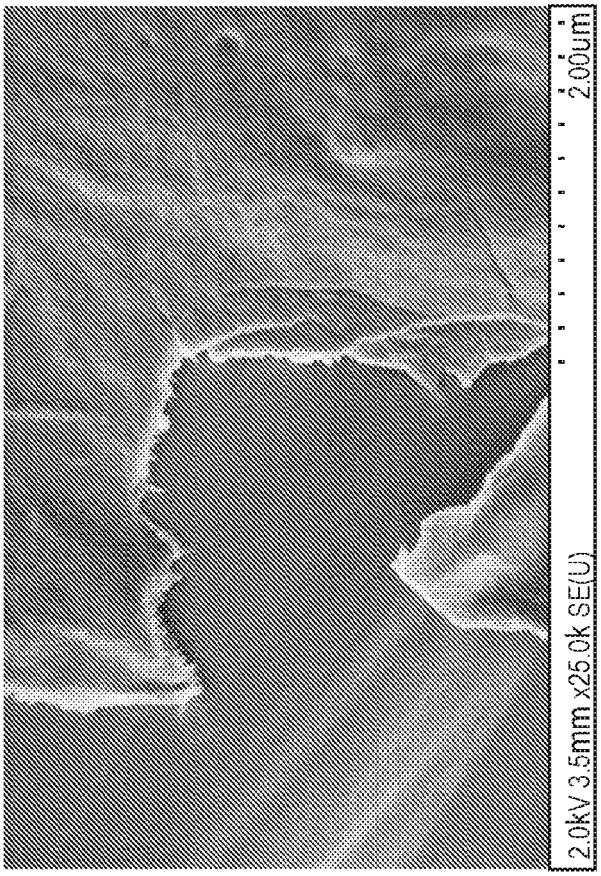


FIG. 135

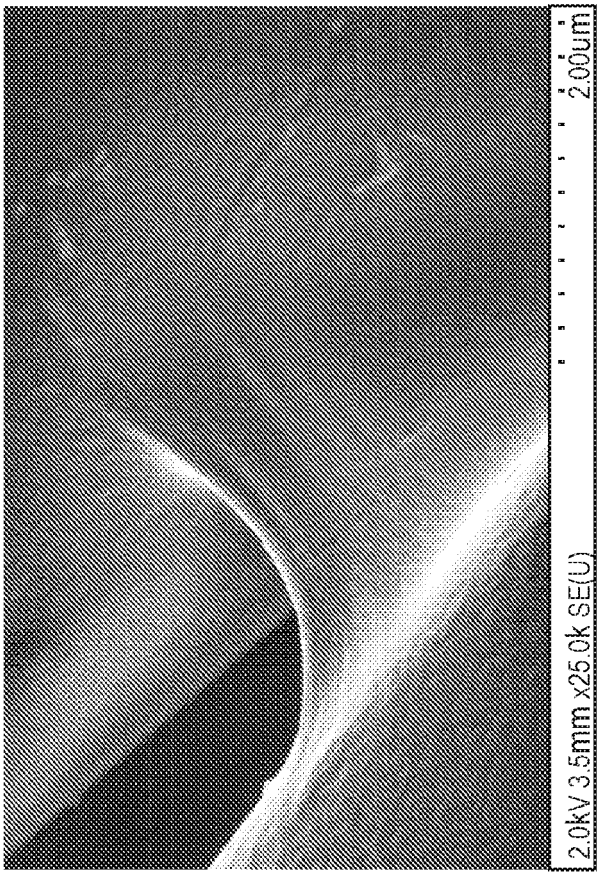


FIG. 136

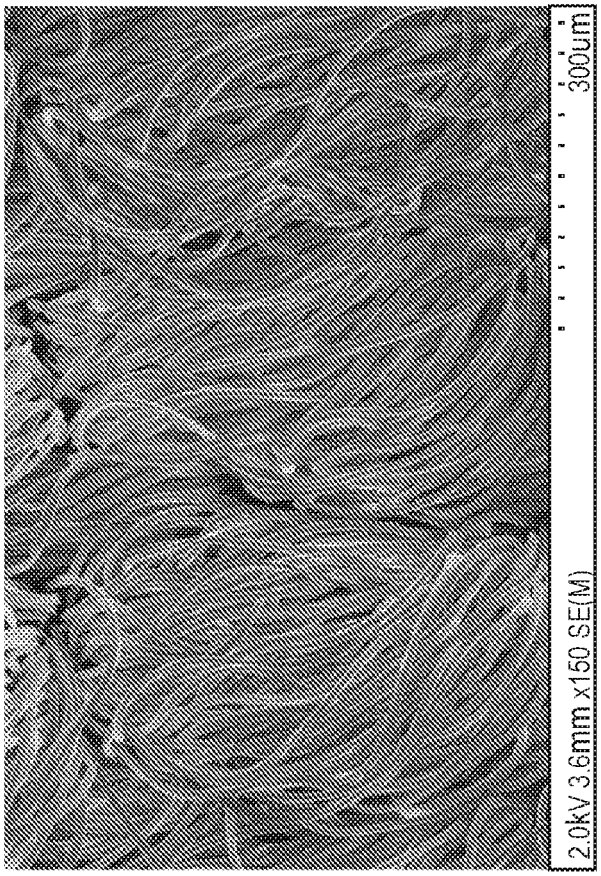


FIG. 137

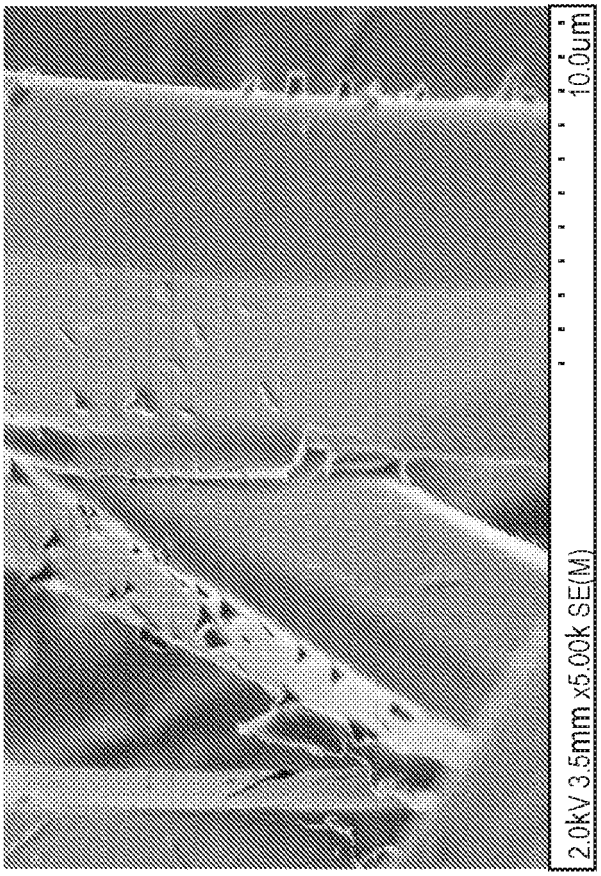


FIG. 138

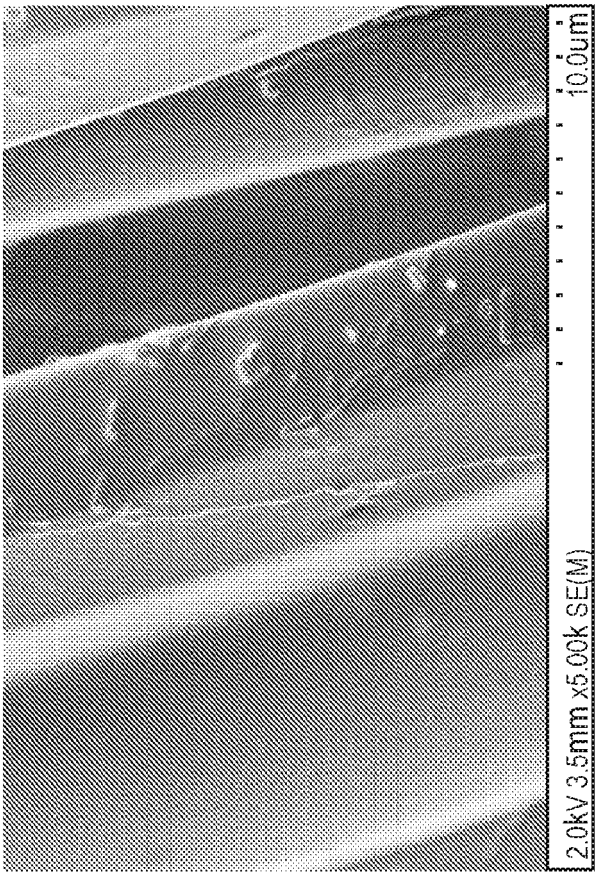


FIG. 139

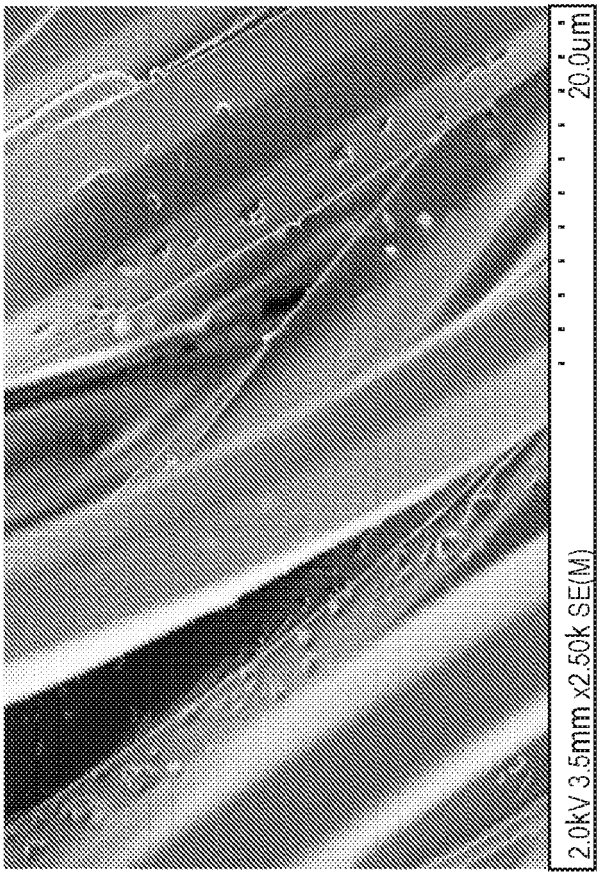


FIG. 140

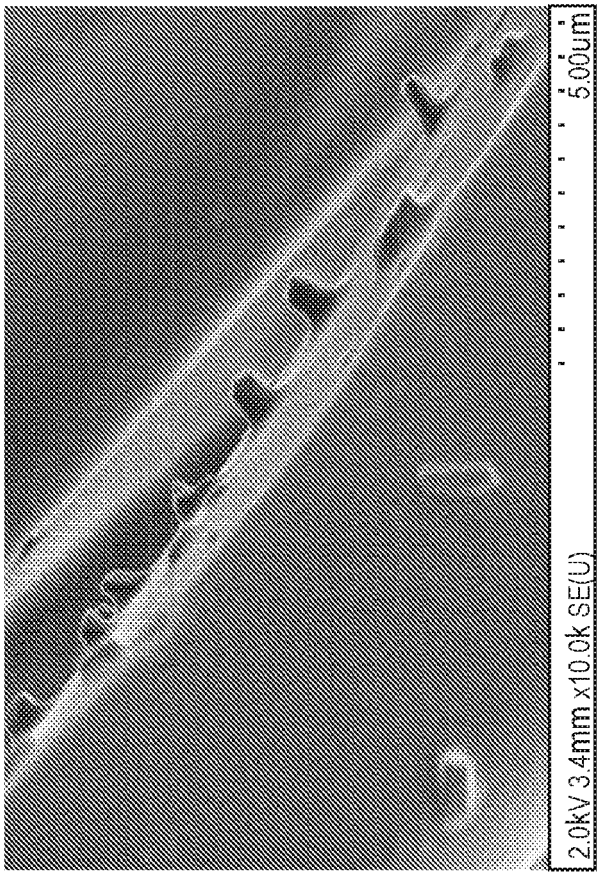


FIG. 141

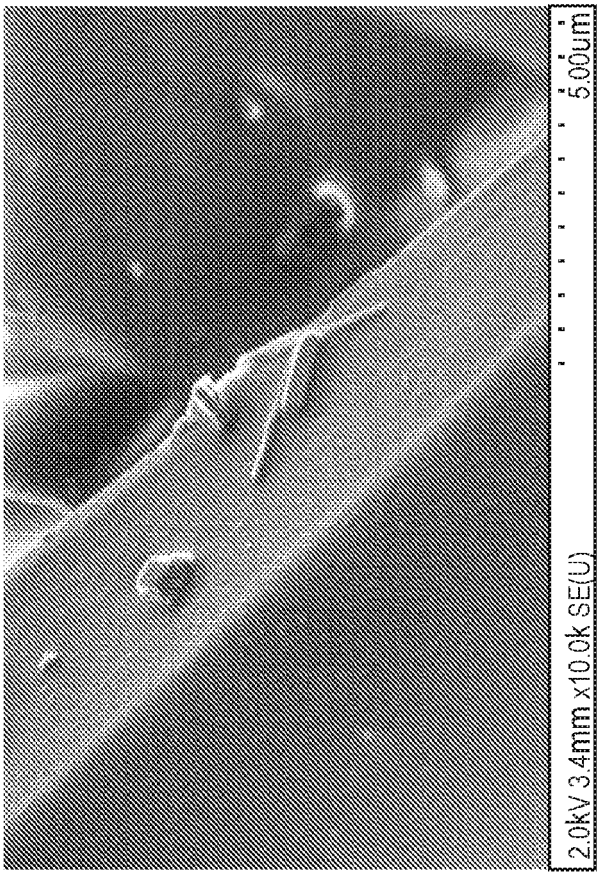


FIG. 142

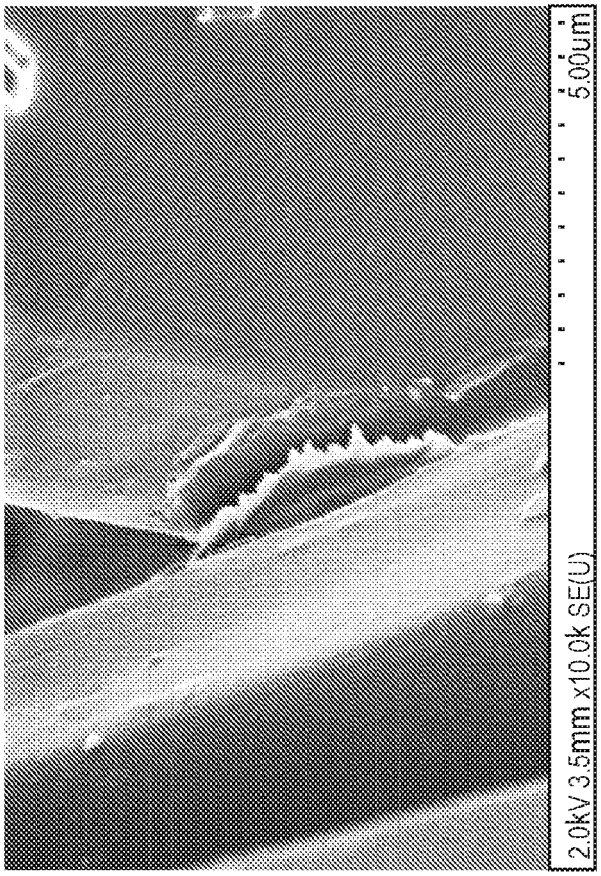


FIG. 143

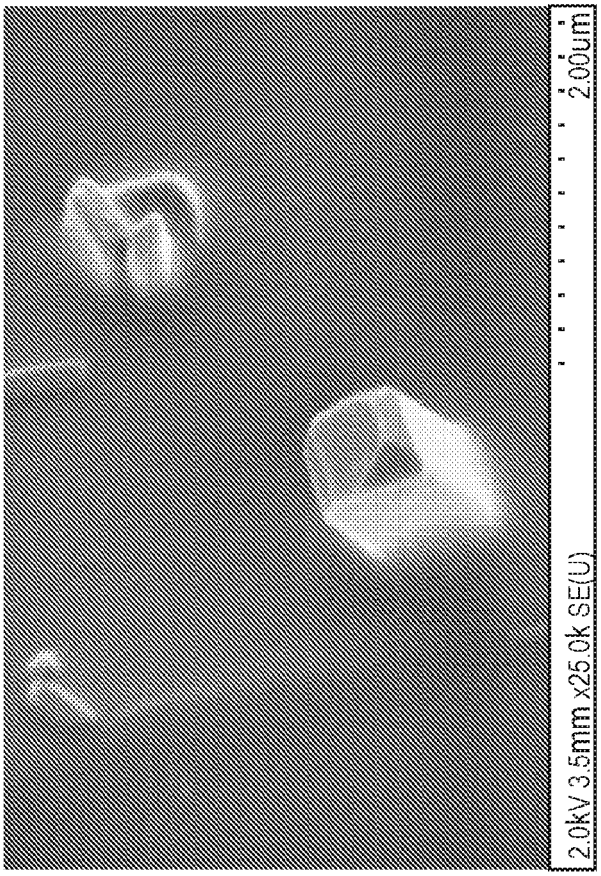


FIG. 144

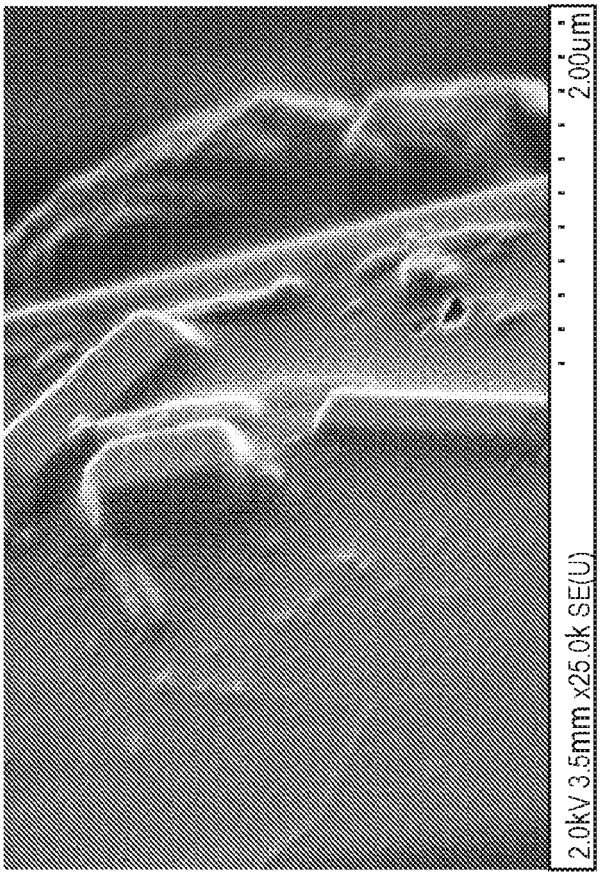


FIG. 145

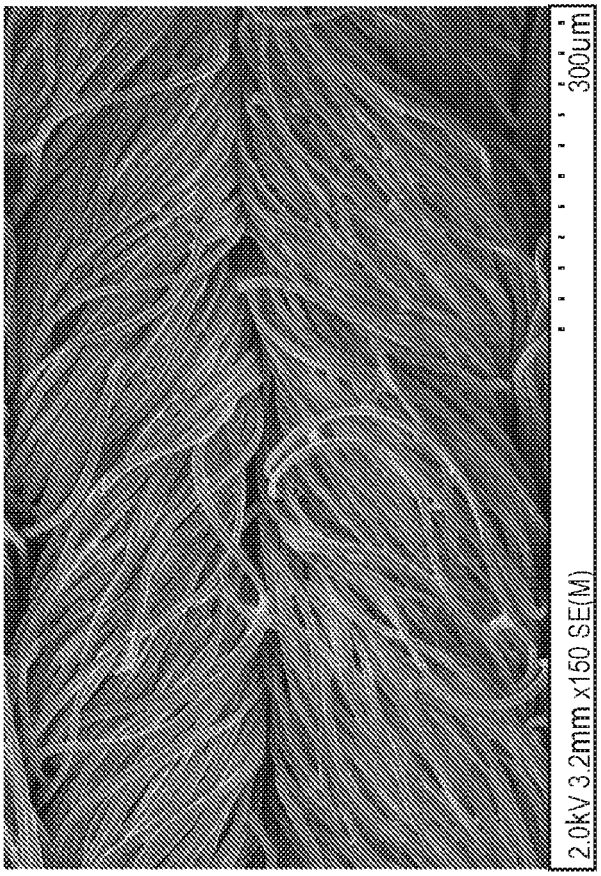


FIG. 146

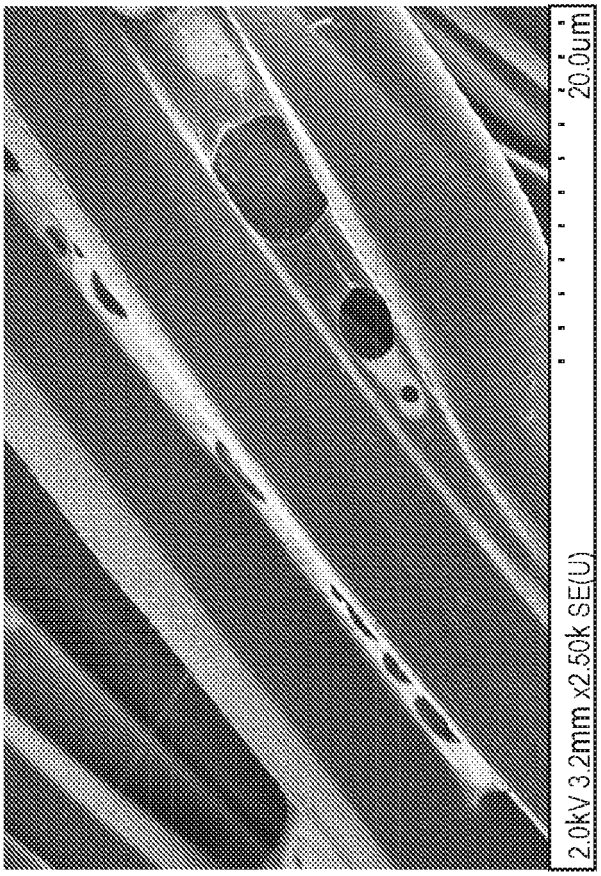


FIG. 147

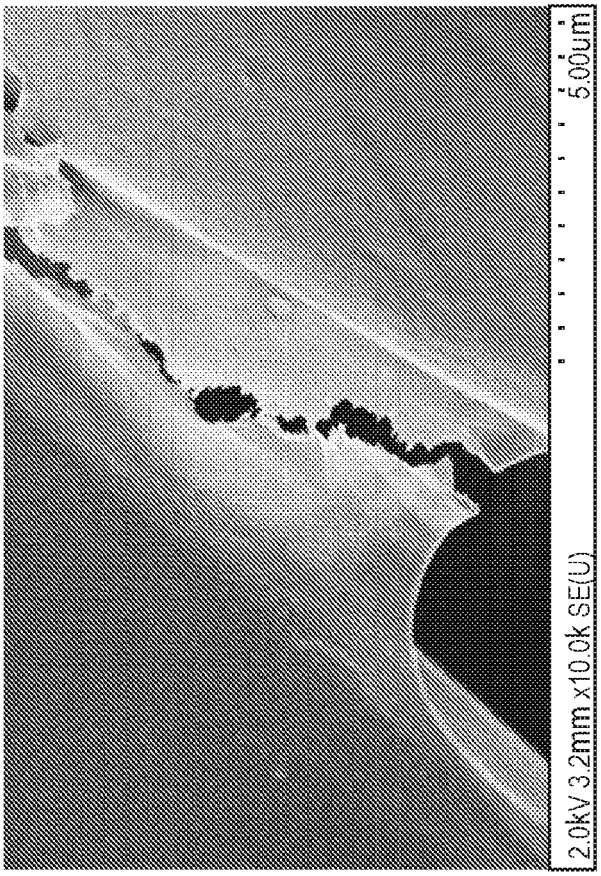


FIG. 148

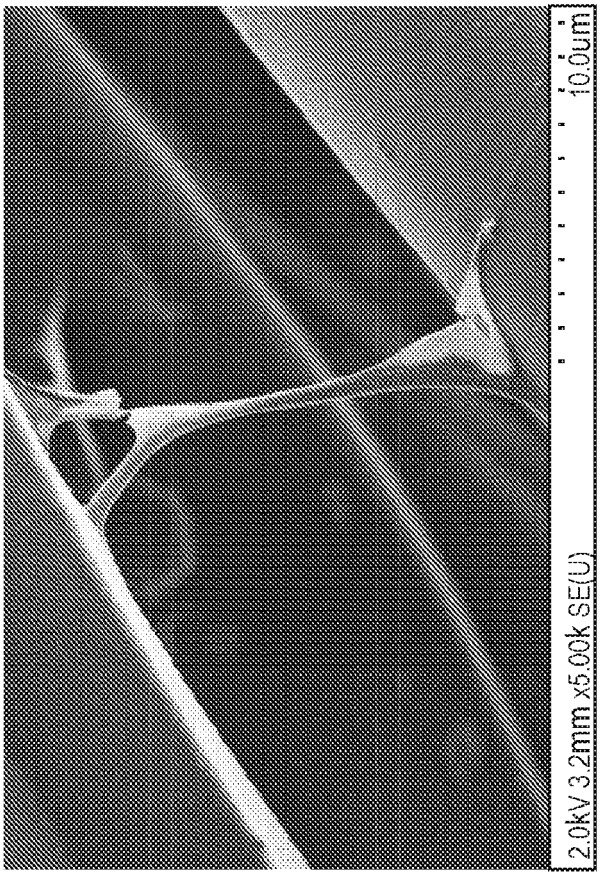


FIG. 149

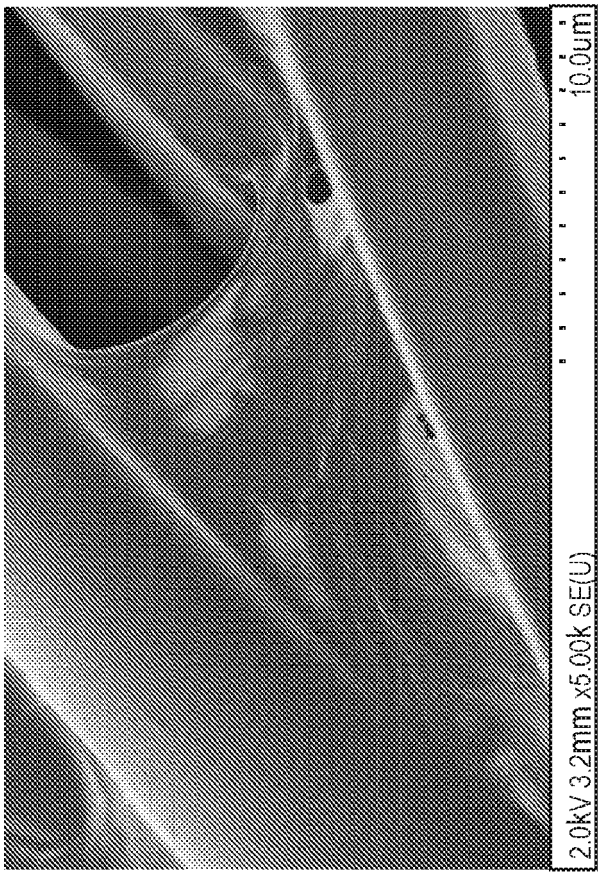


FIG. 150

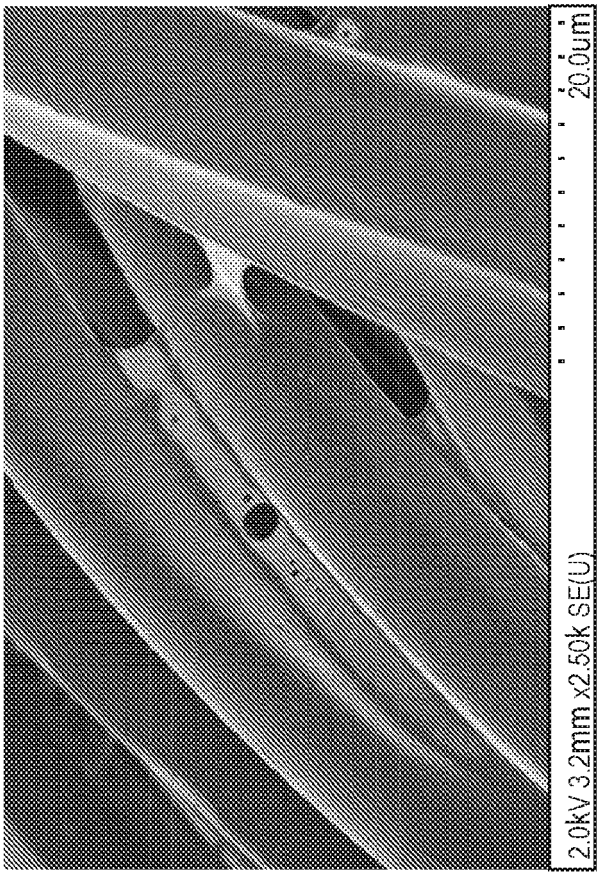


FIG. 151

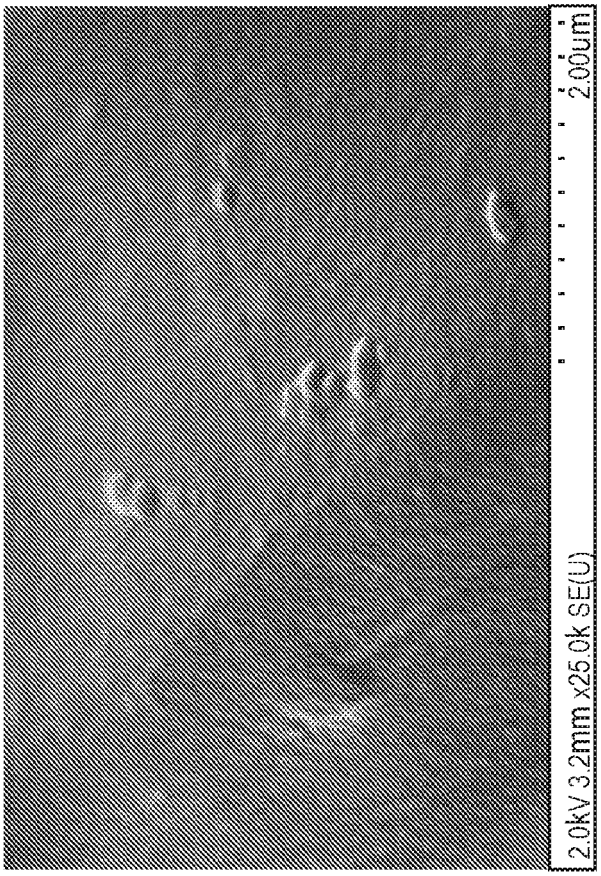


FIG. 152

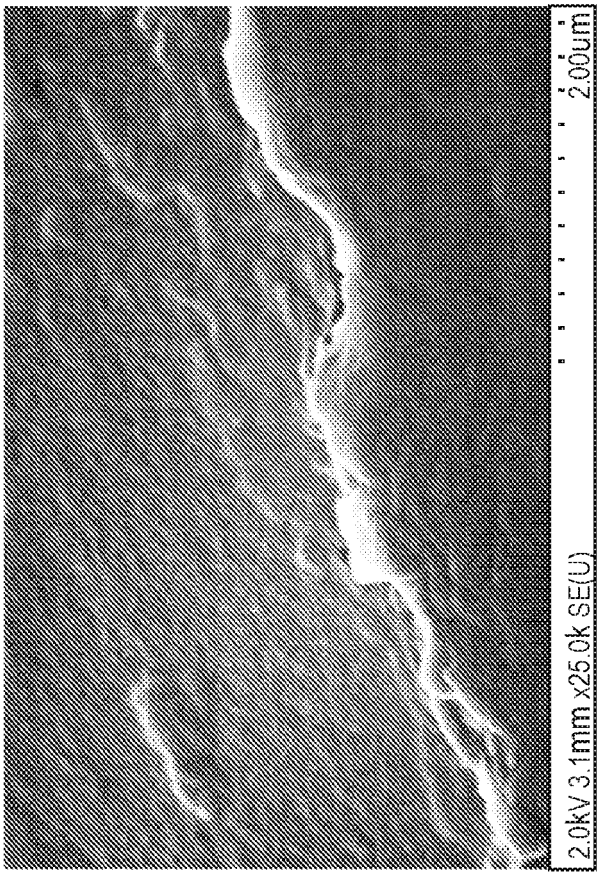


FIG. 153

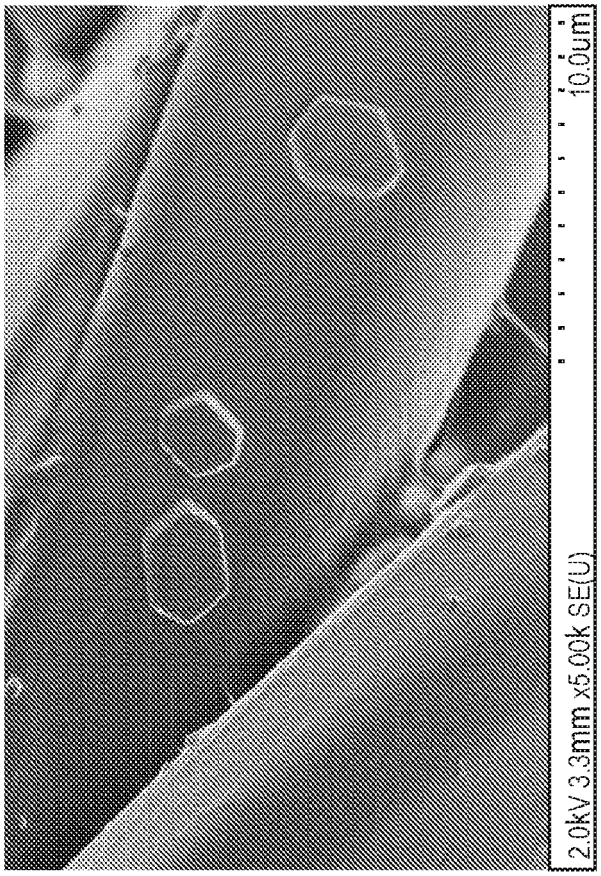


FIG. 154

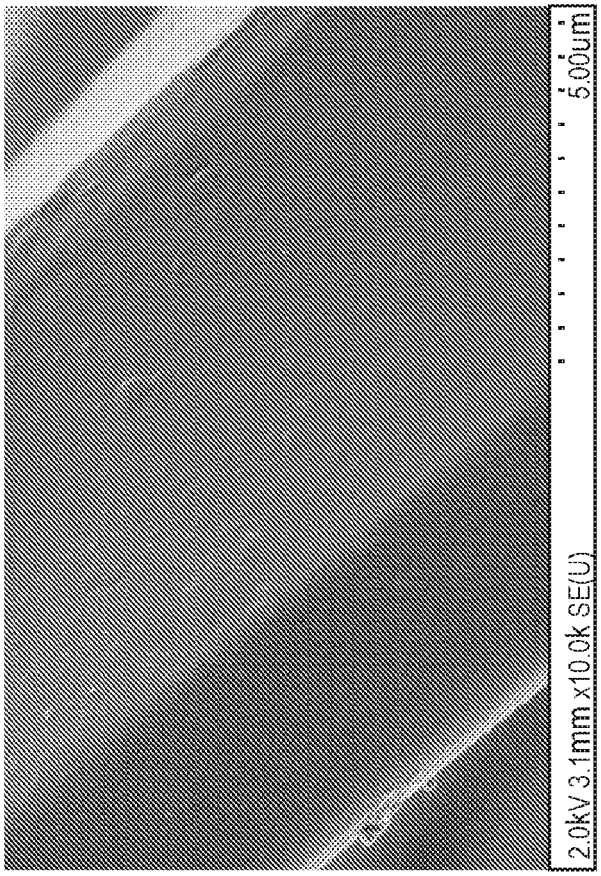


FIG. 155

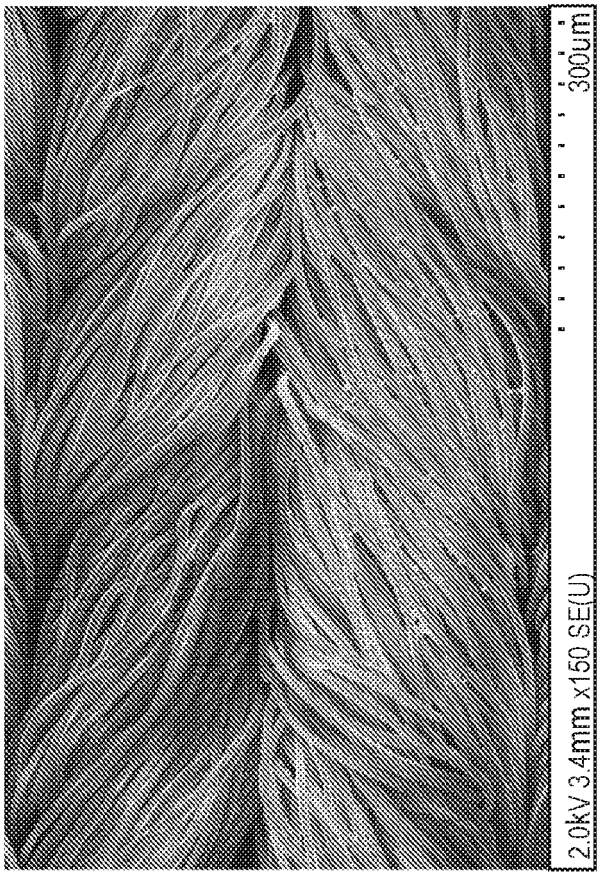


FIG. 156

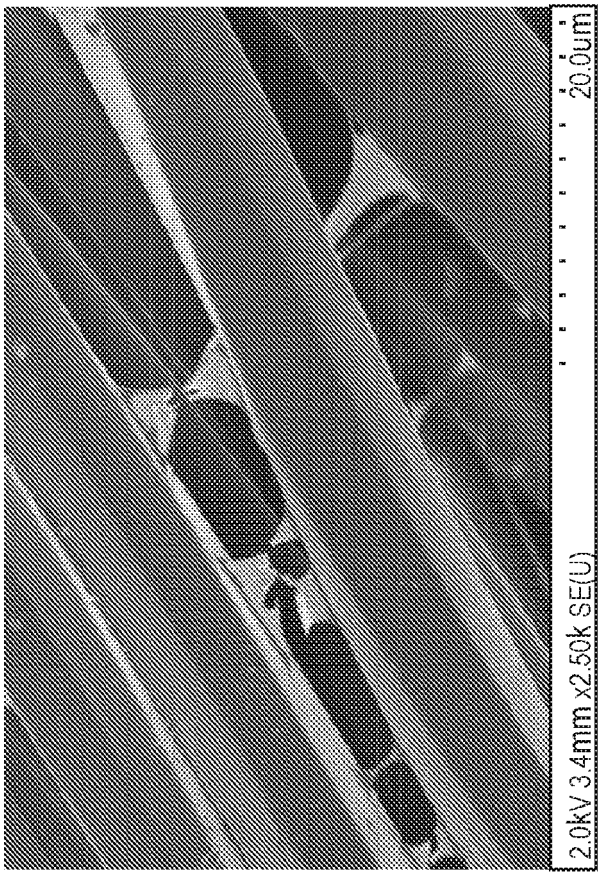


FIG. 157

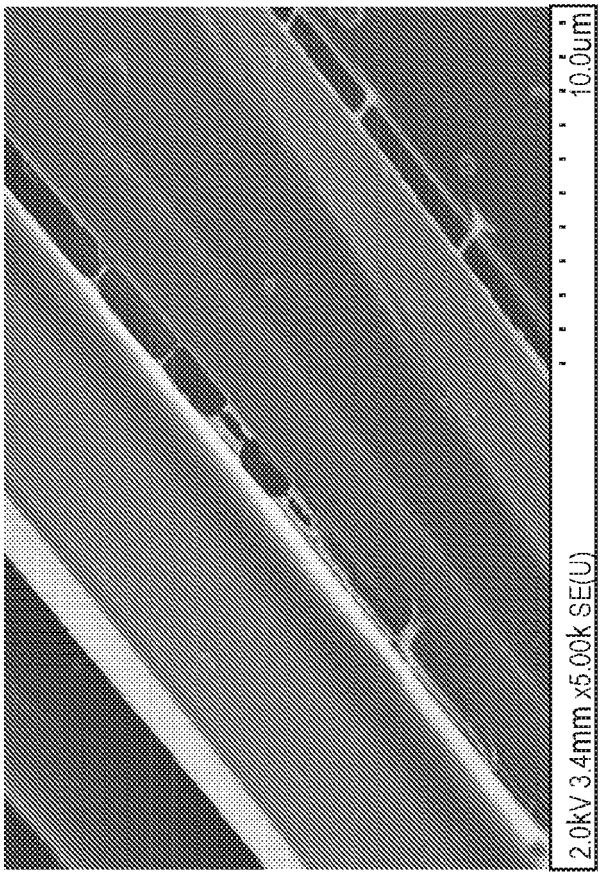


FIG. 158

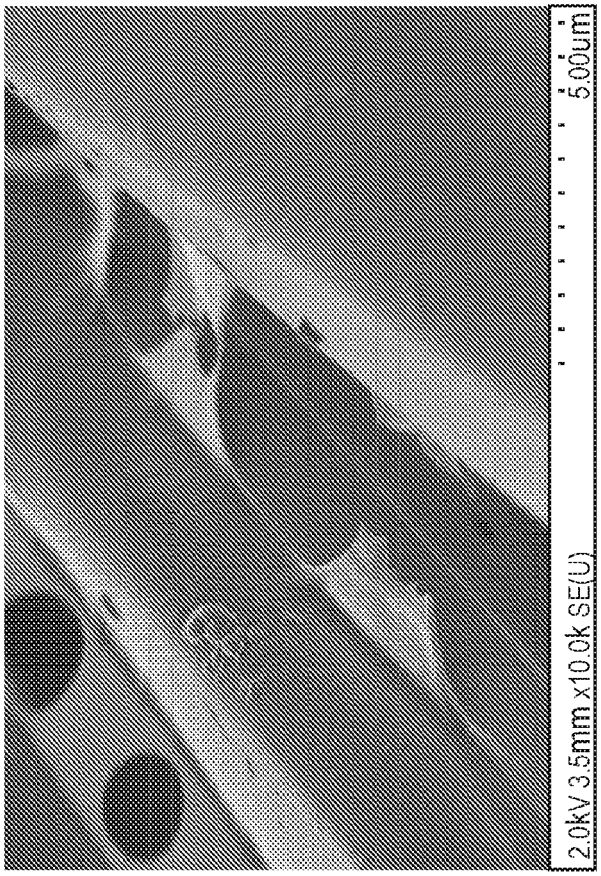


FIG. 159

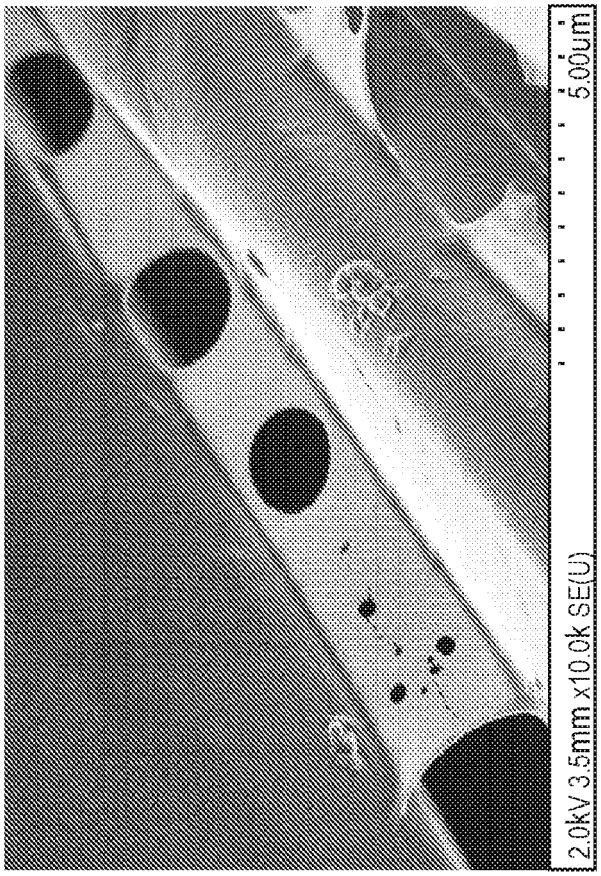


FIG. 160

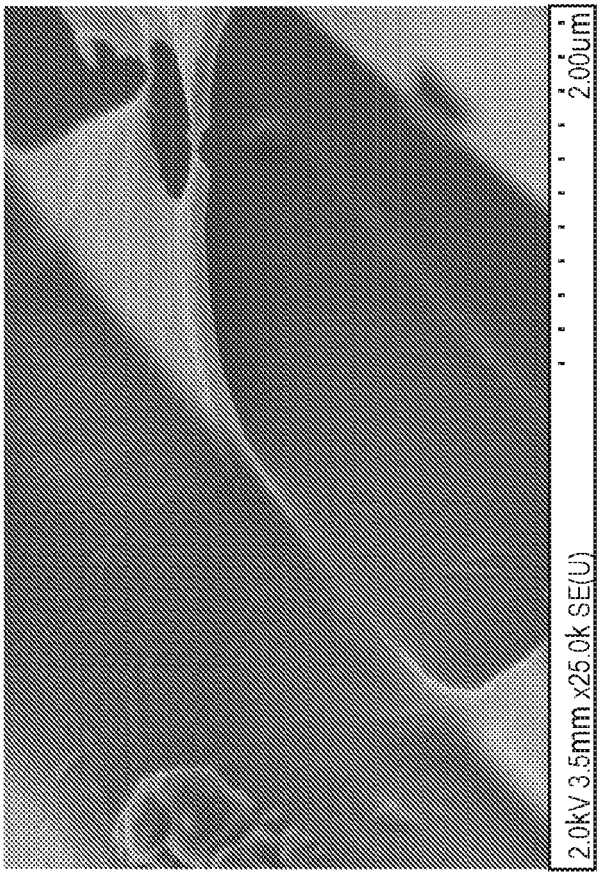


FIG. 161

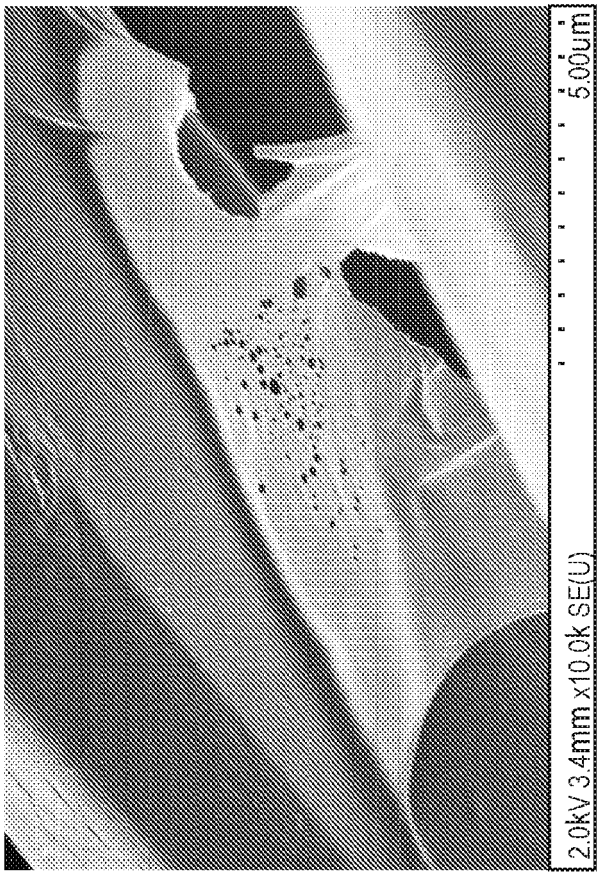


FIG. 162

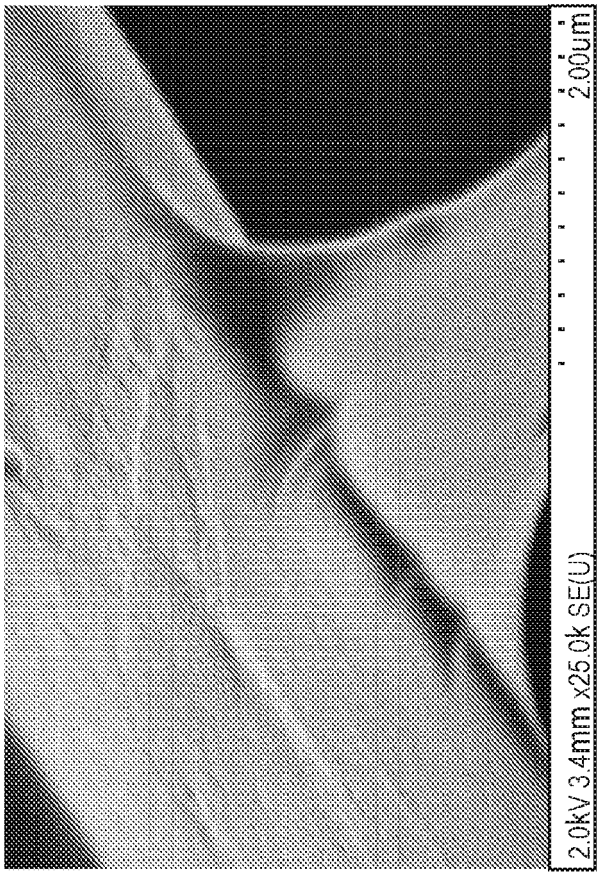


FIG. 163

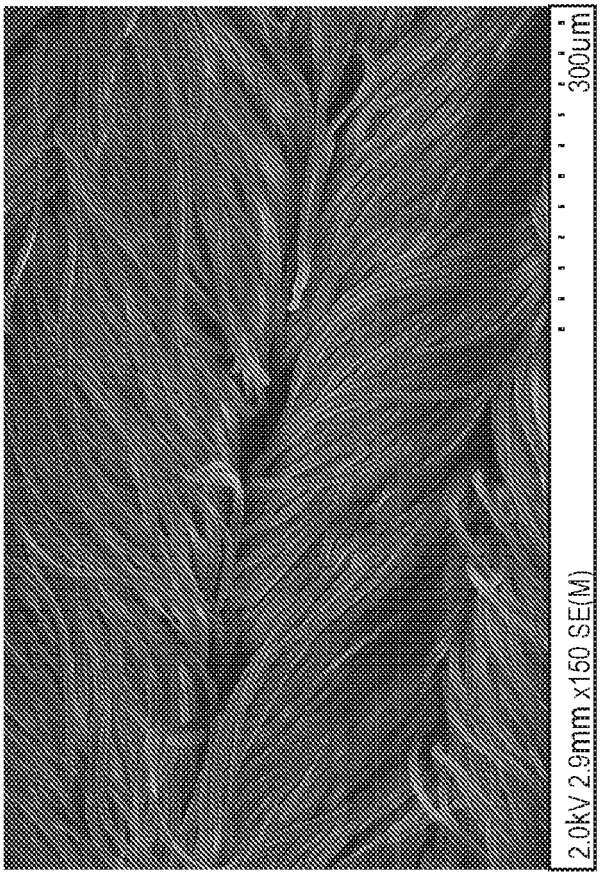


FIG. 164

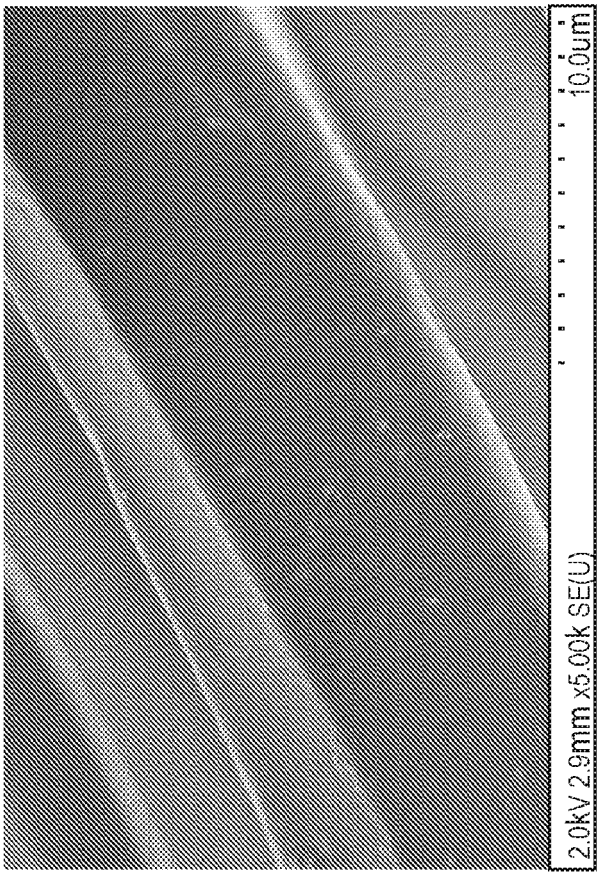


FIG. 165

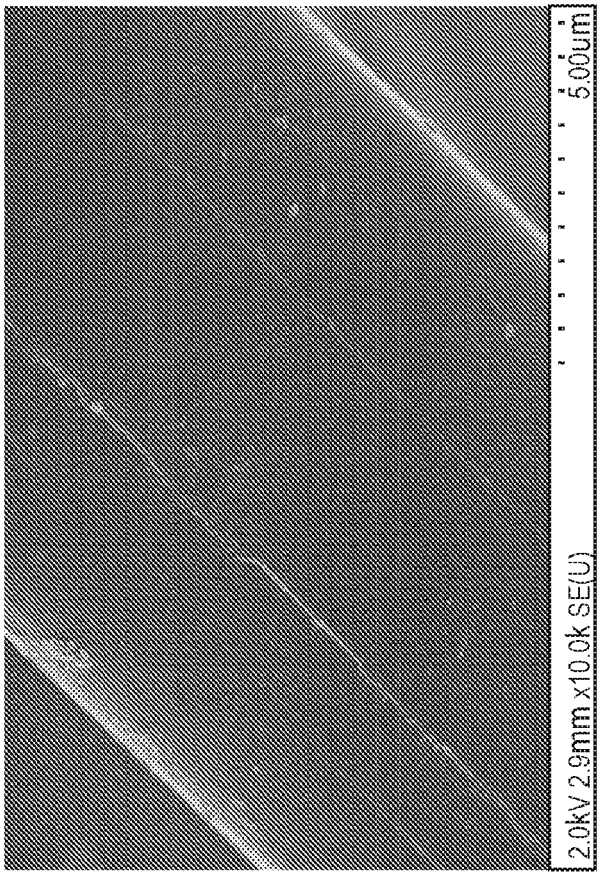


FIG. 166

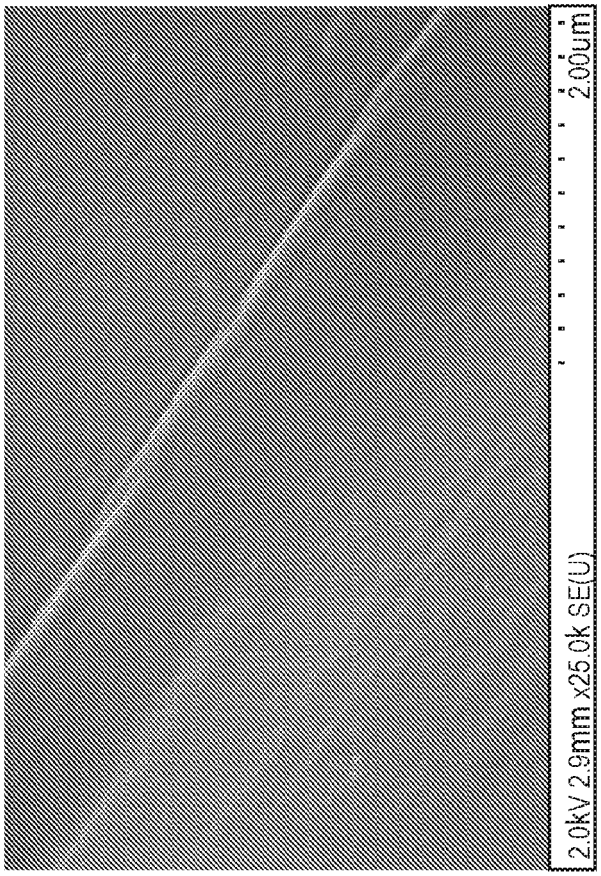


FIG. 167

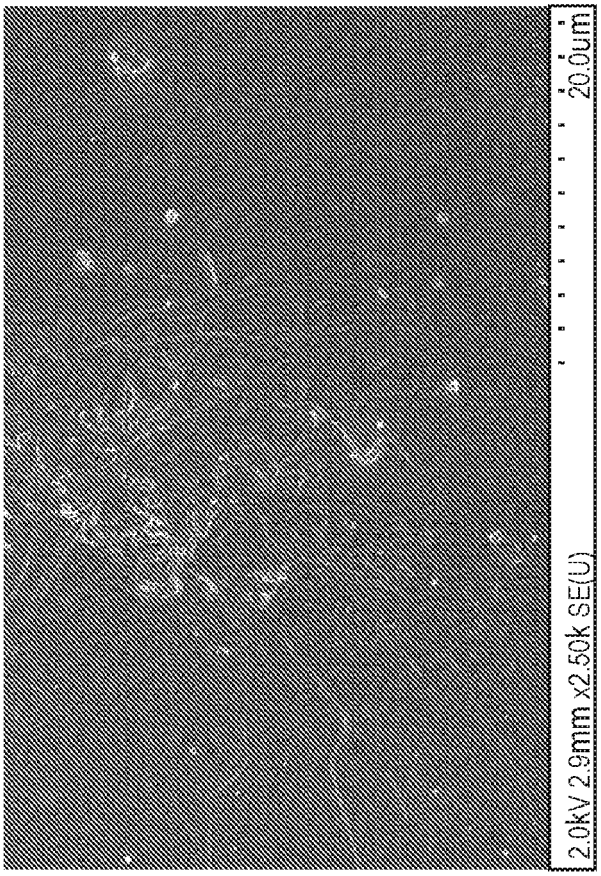


FIG. 168

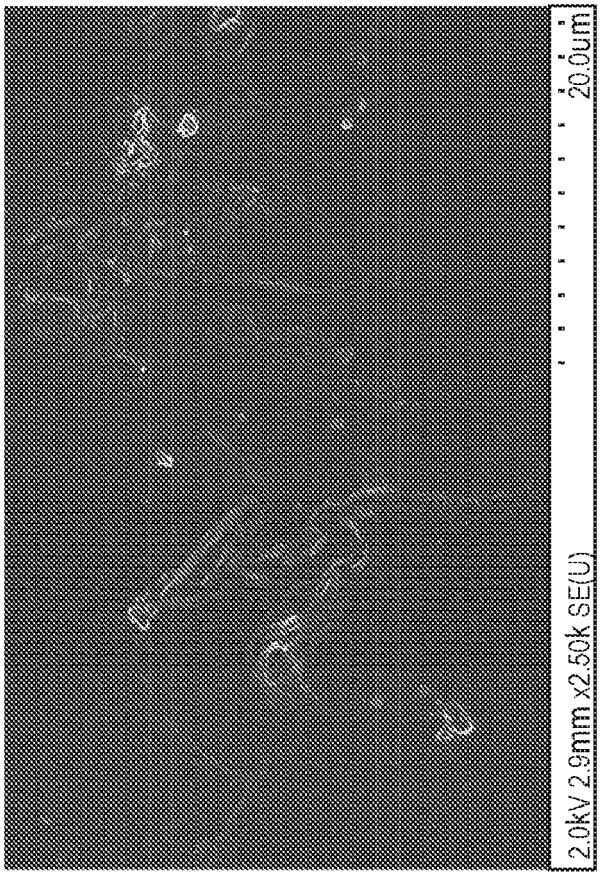


FIG. 169

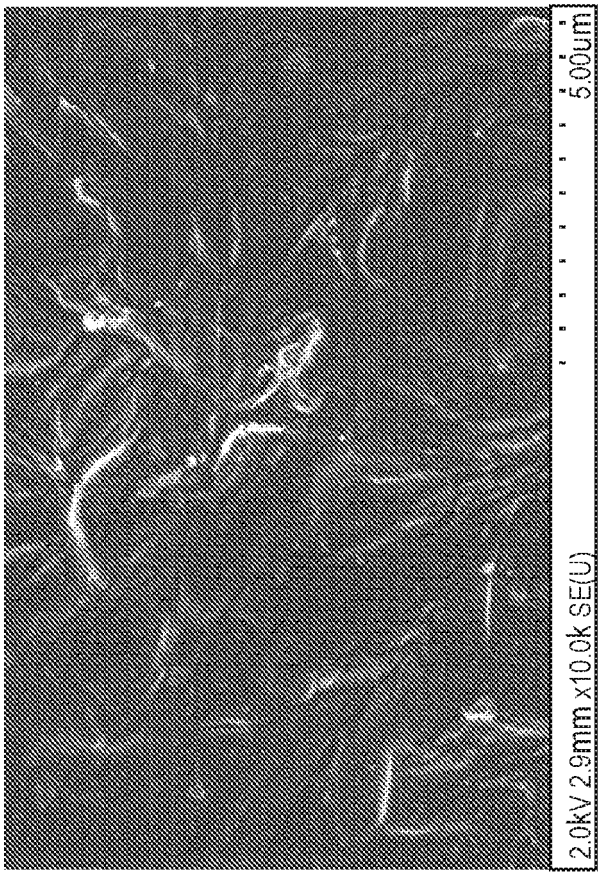


FIG. 170

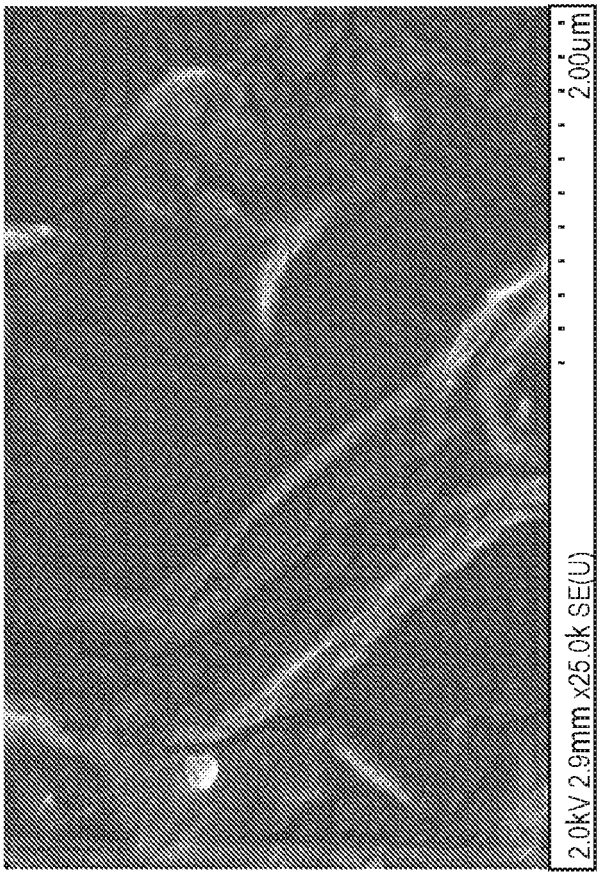


FIG. 171

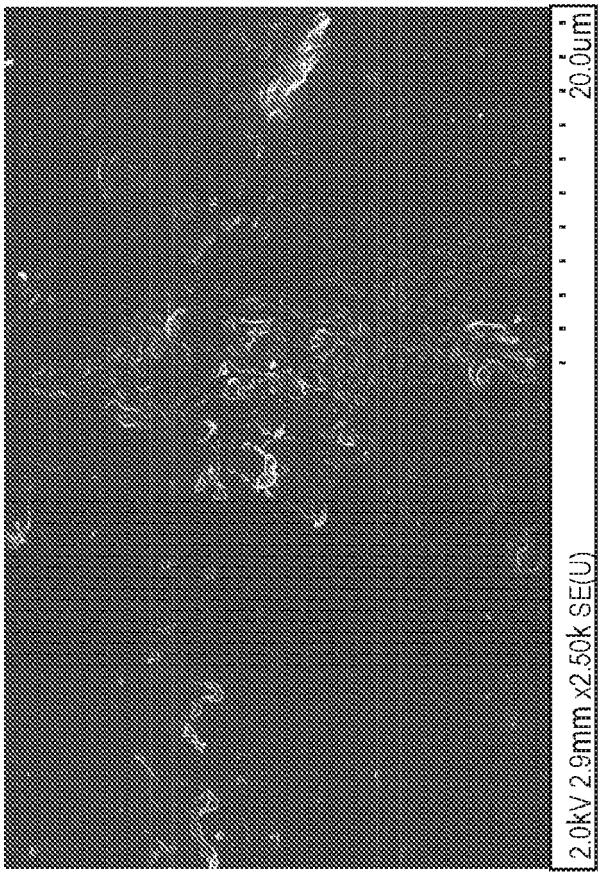


FIG. 172

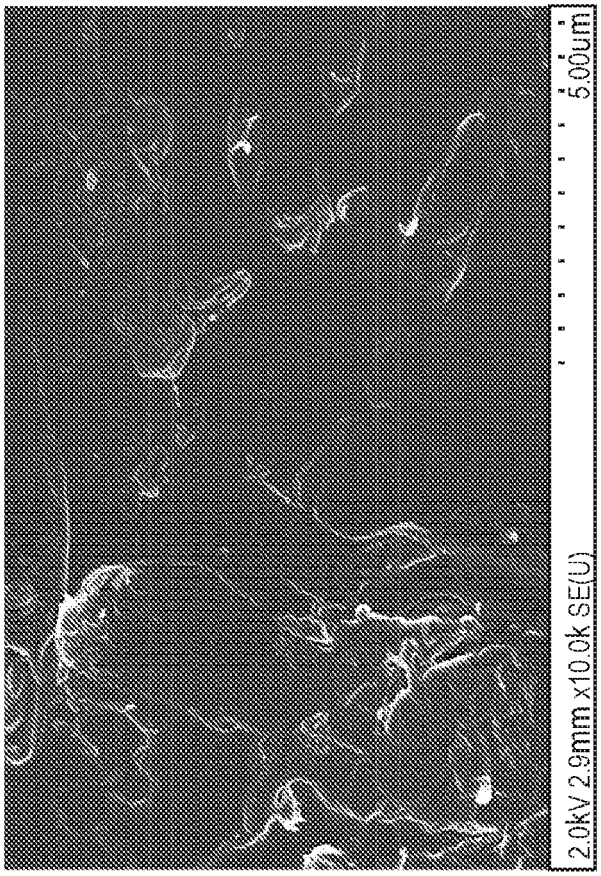


FIG. 173



FIG. 174

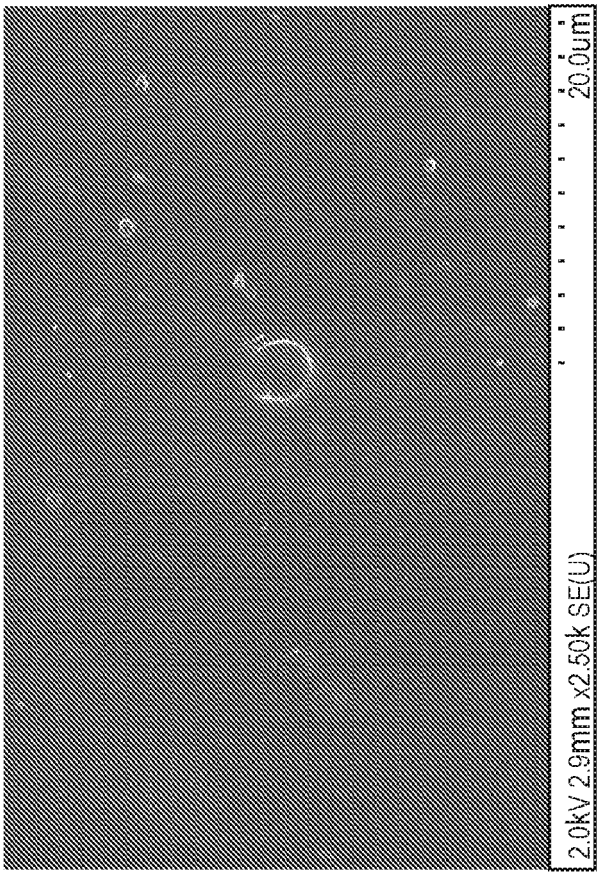


FIG. 175

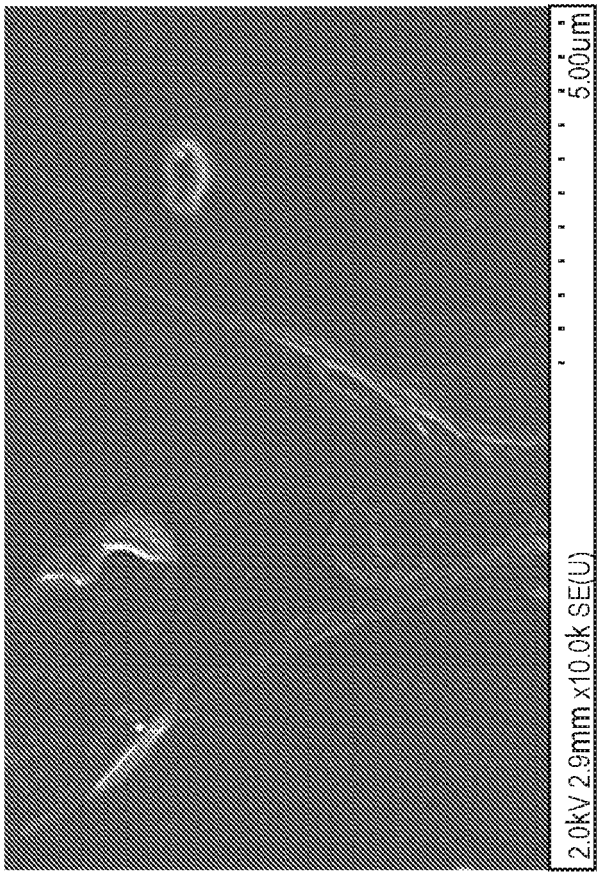


FIG. 176

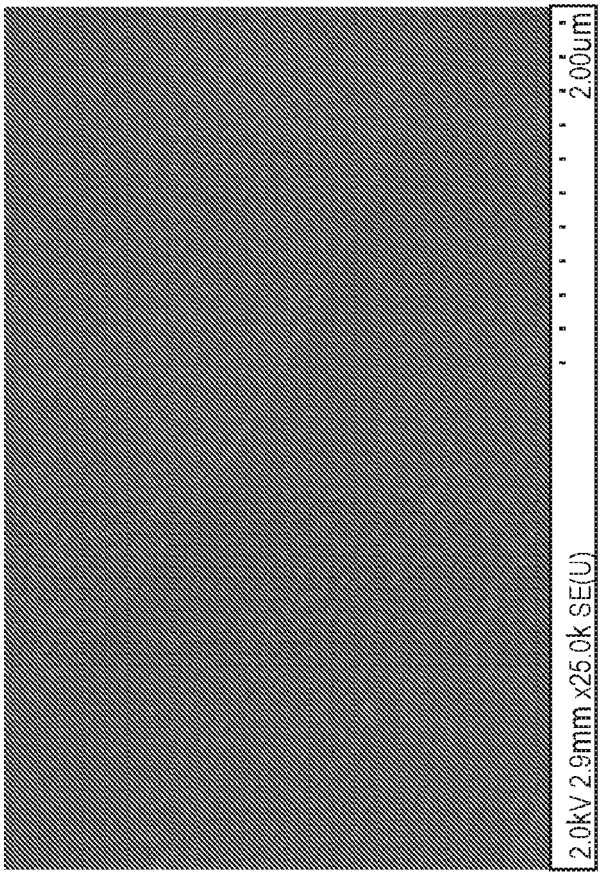


FIG. 177

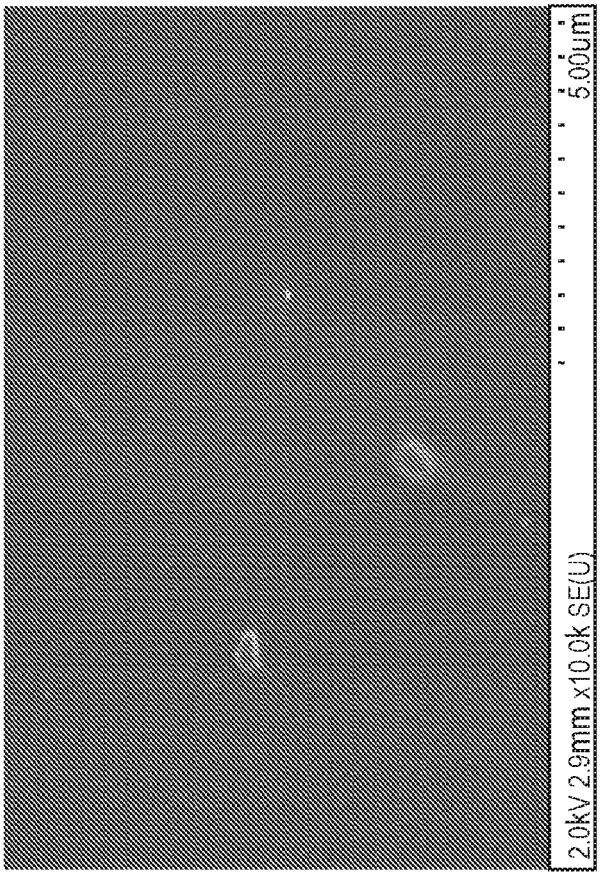


FIG. 178



FIG. 179

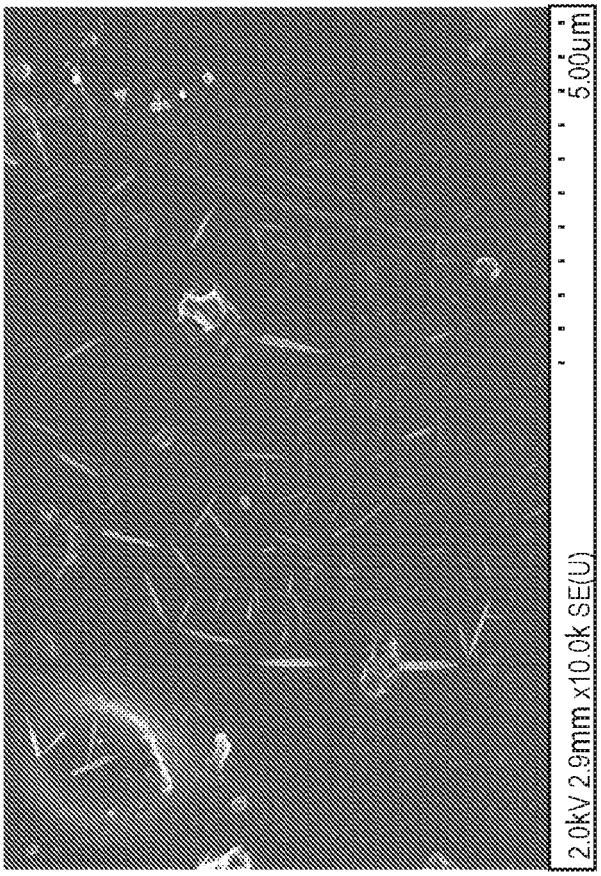


FIG. 180

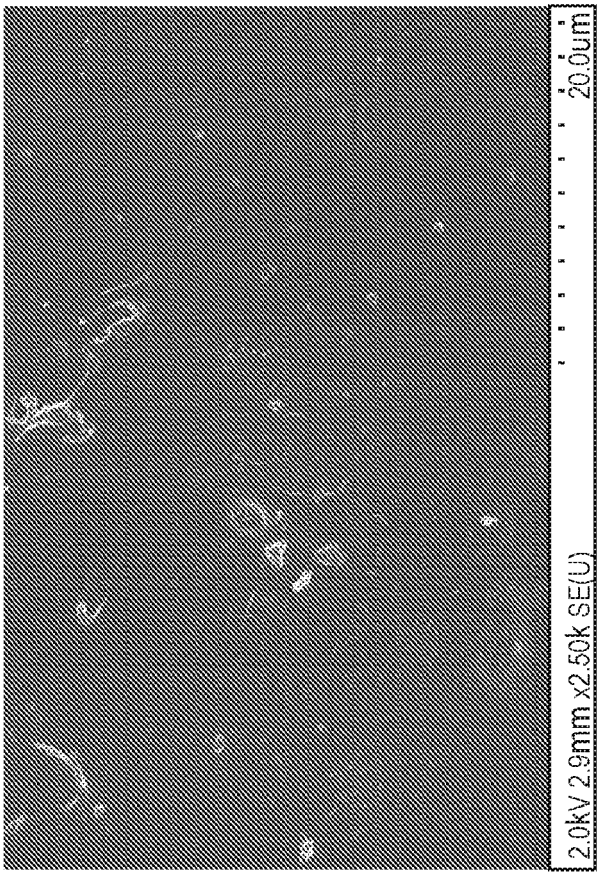


FIG. 181

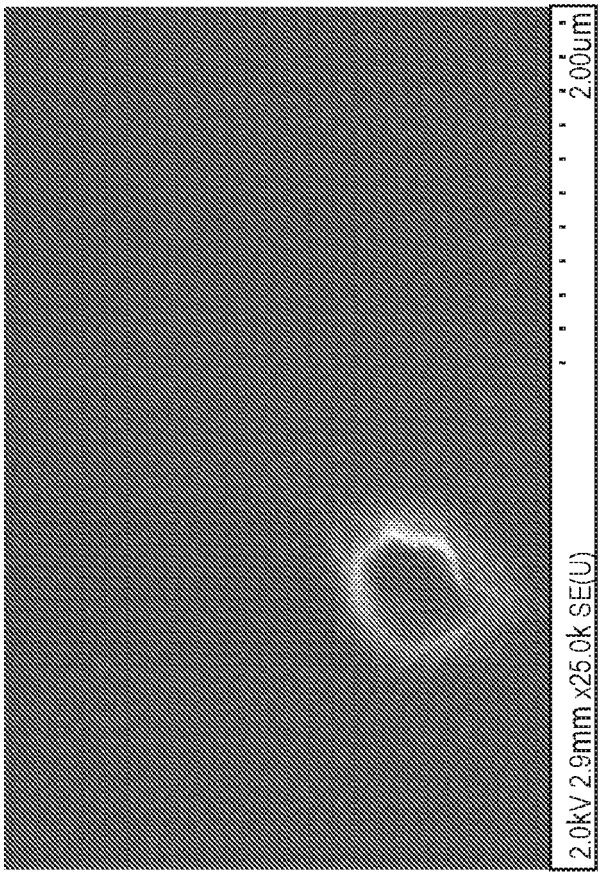


FIG. 182

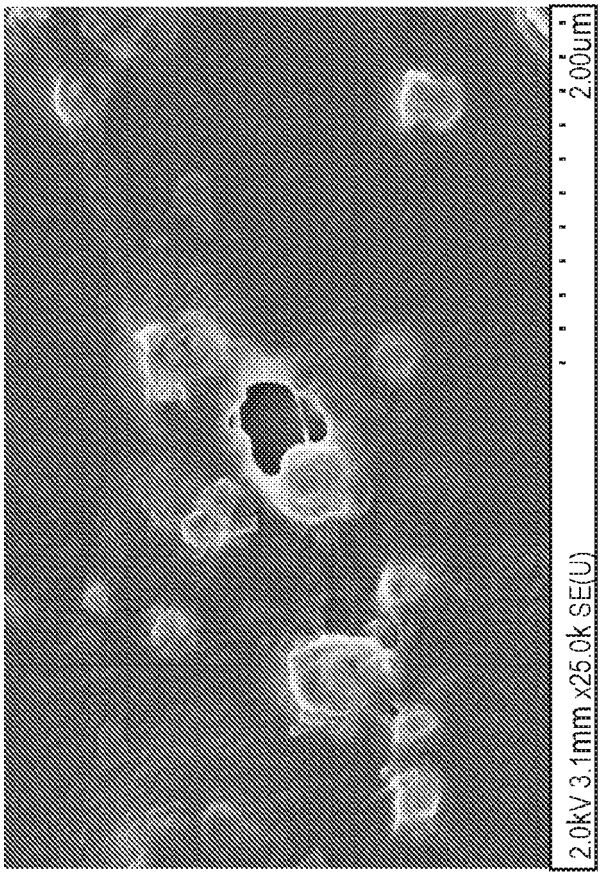


FIG. 183

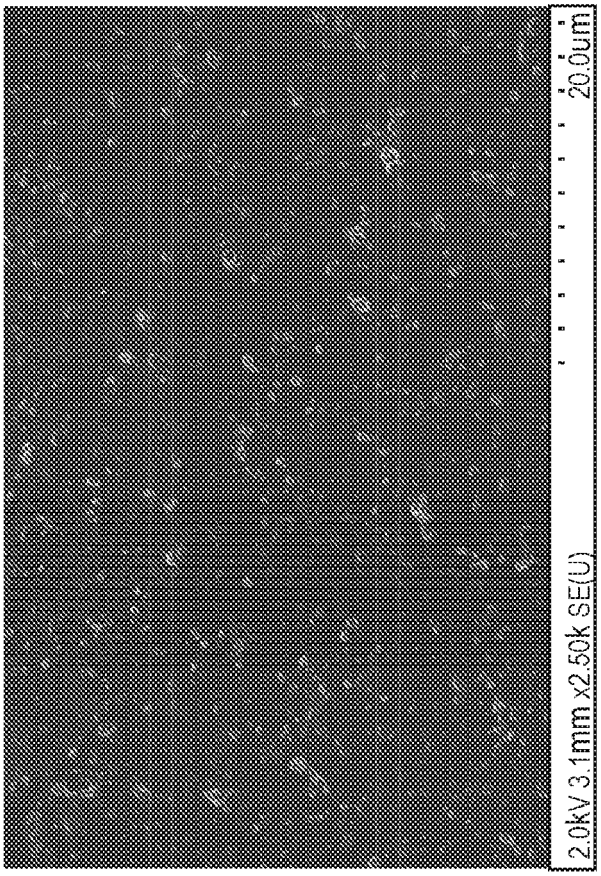


FIG. 184

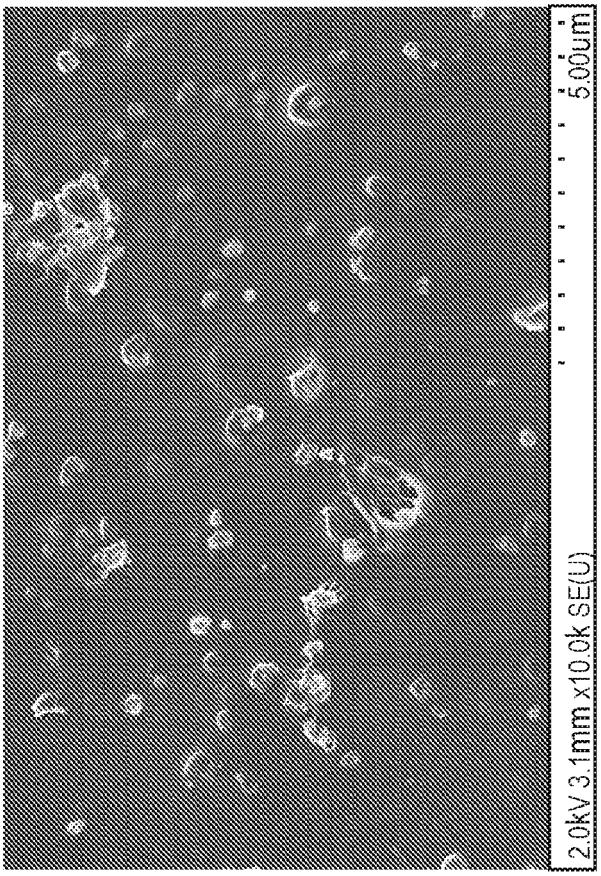


FIG. 185

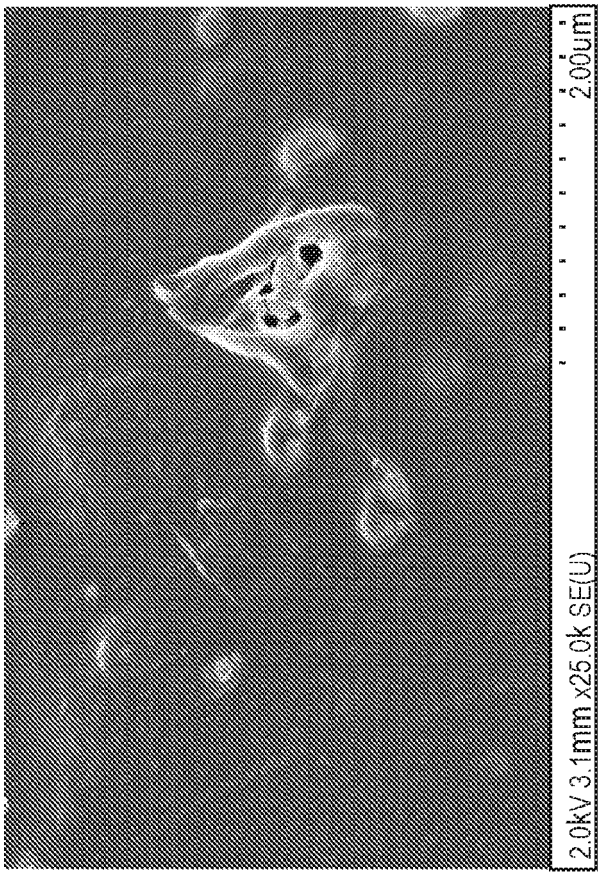


FIG. 186

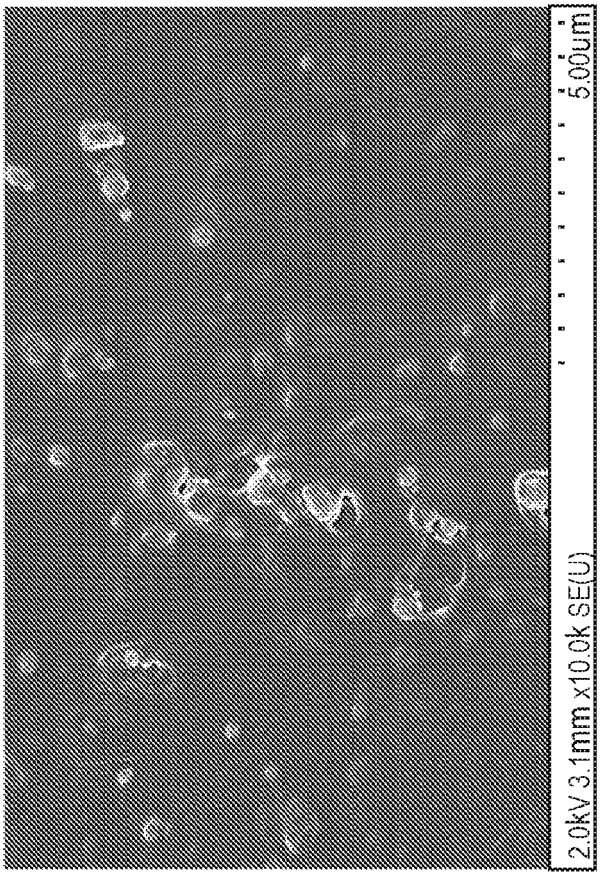


FIG. 187

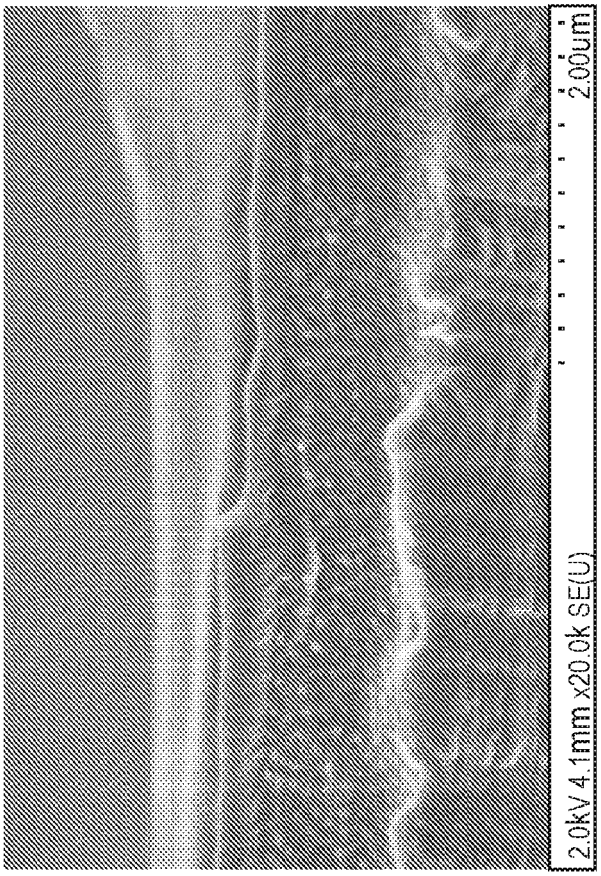


FIG. 188

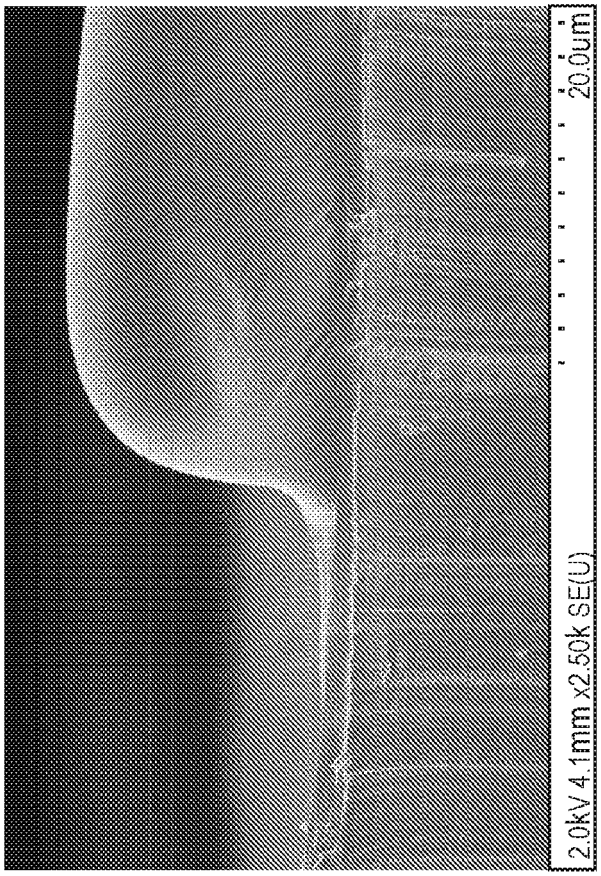


FIG. 189

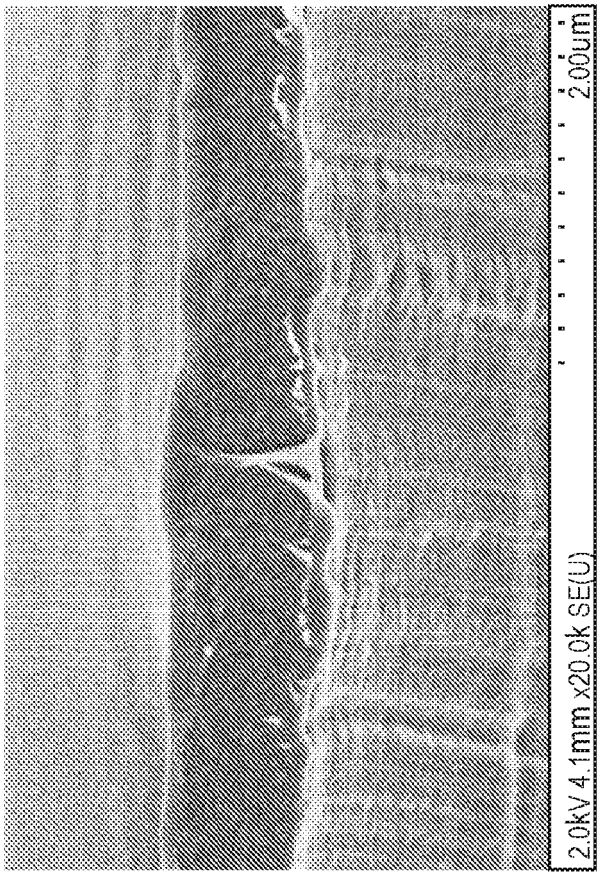


FIG. 190

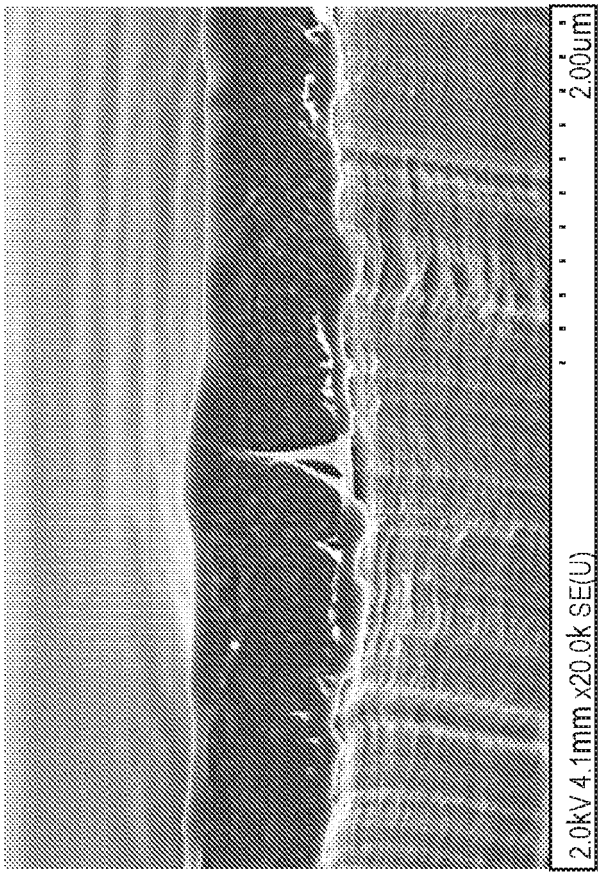


FIG. 191

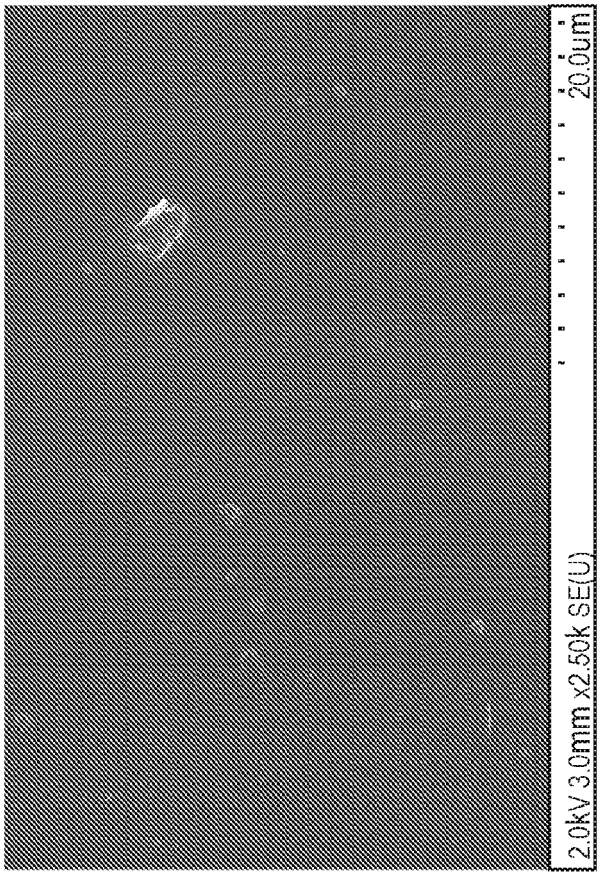


FIG. 192

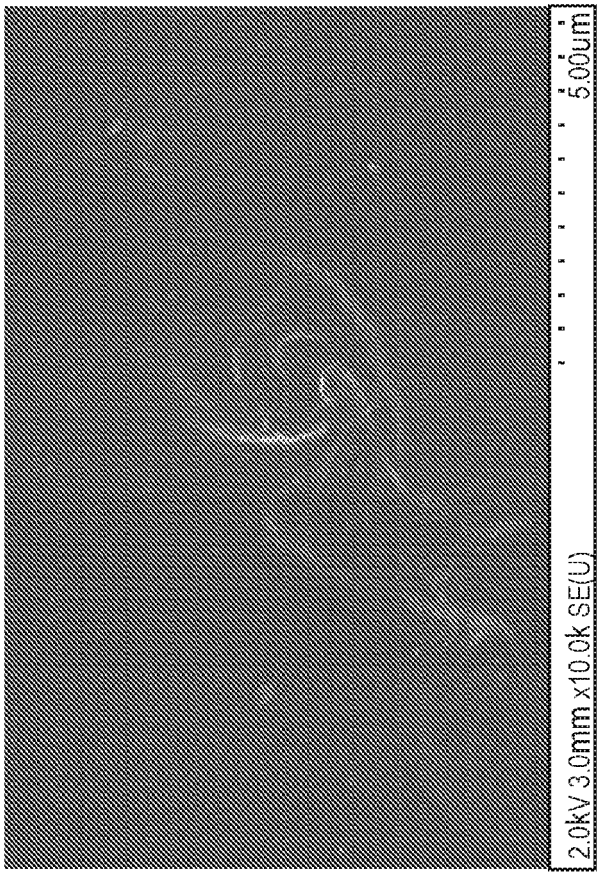


FIG. 193

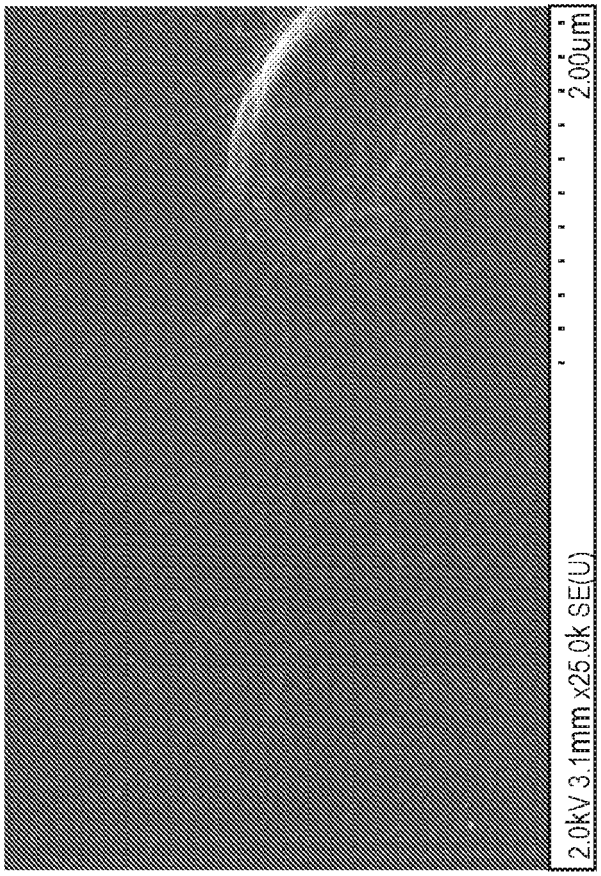


FIG. 194

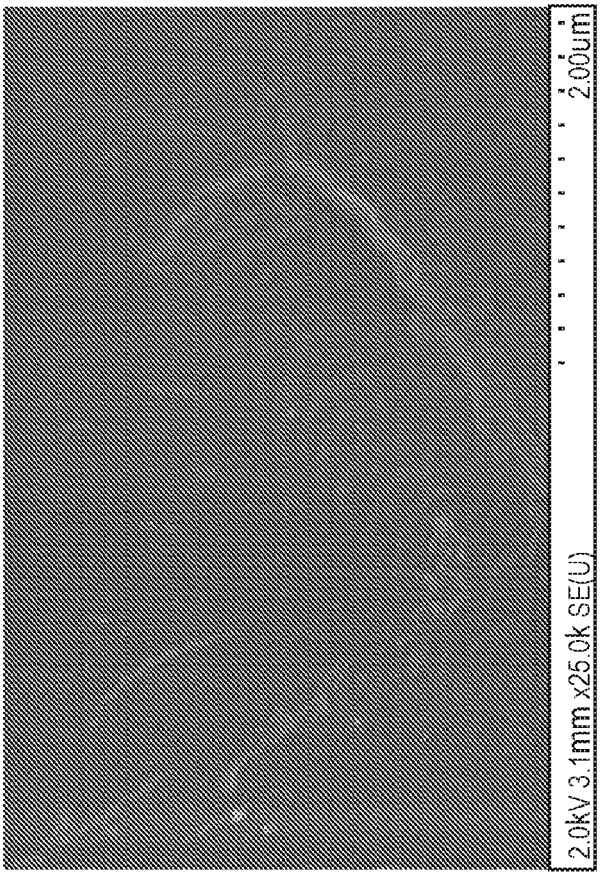


FIG. 195



FIG. 196

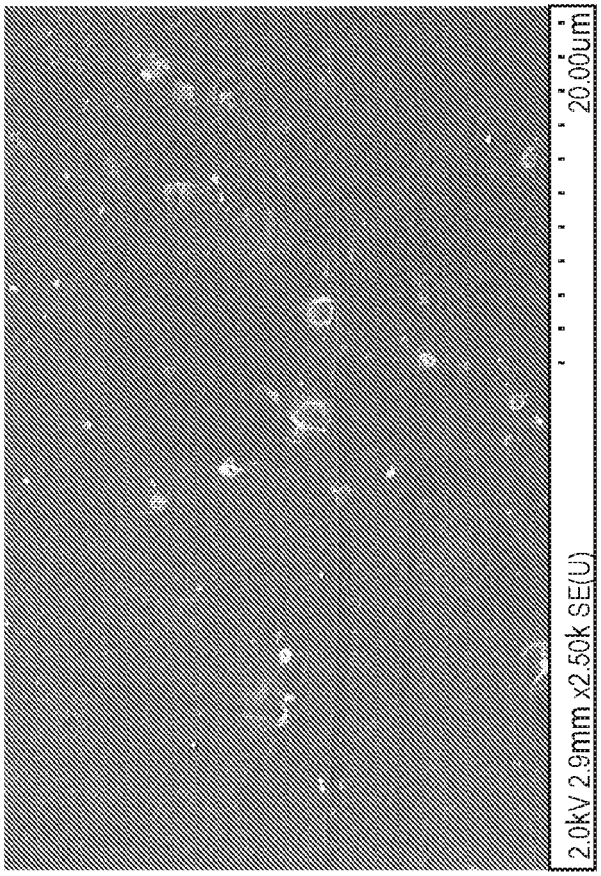


FIG. 197



FIG. 198

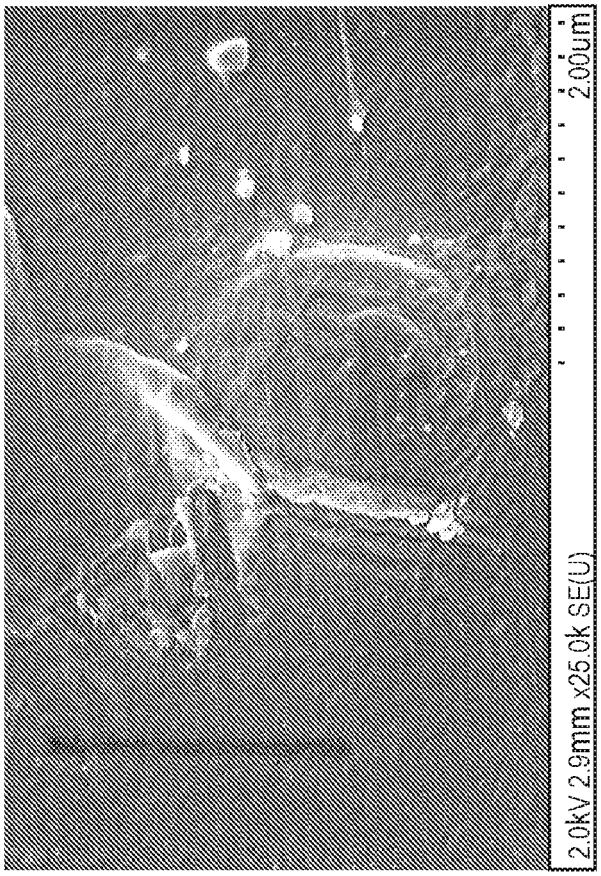


FIG. 199

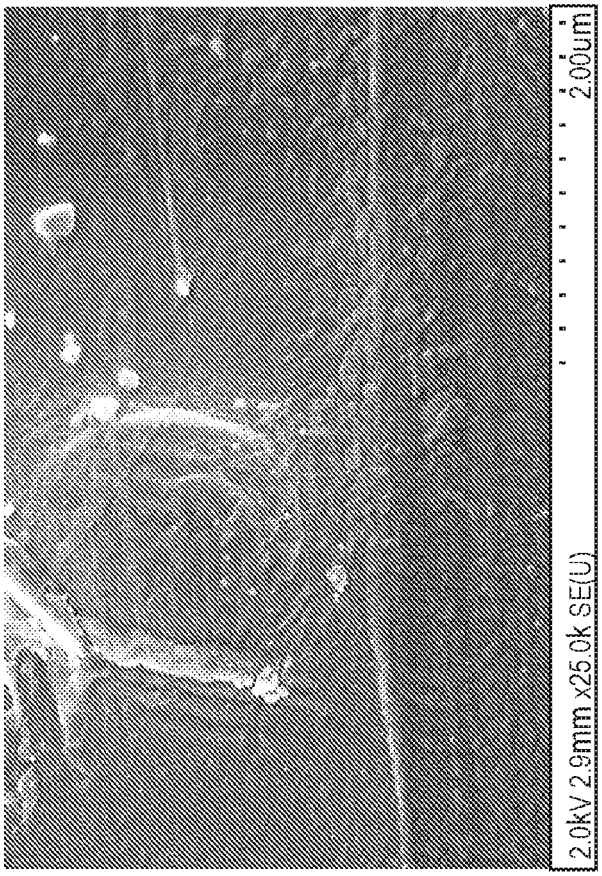


FIG. 200

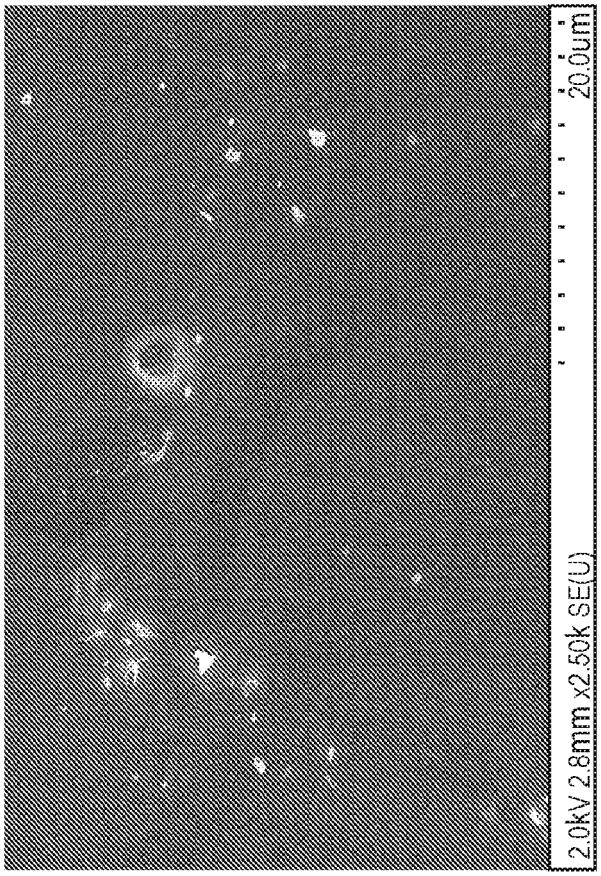


FIG. 201

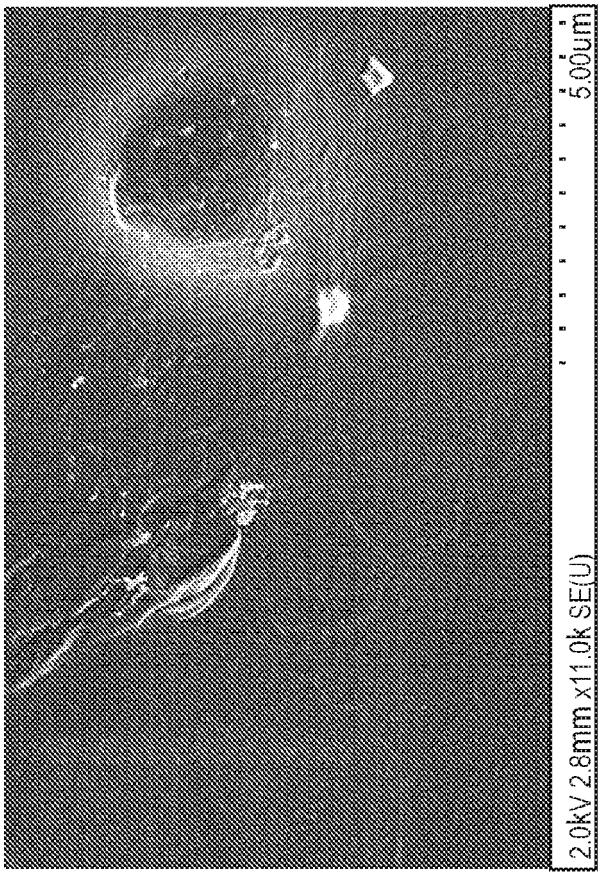


FIG. 202



FIG. 203

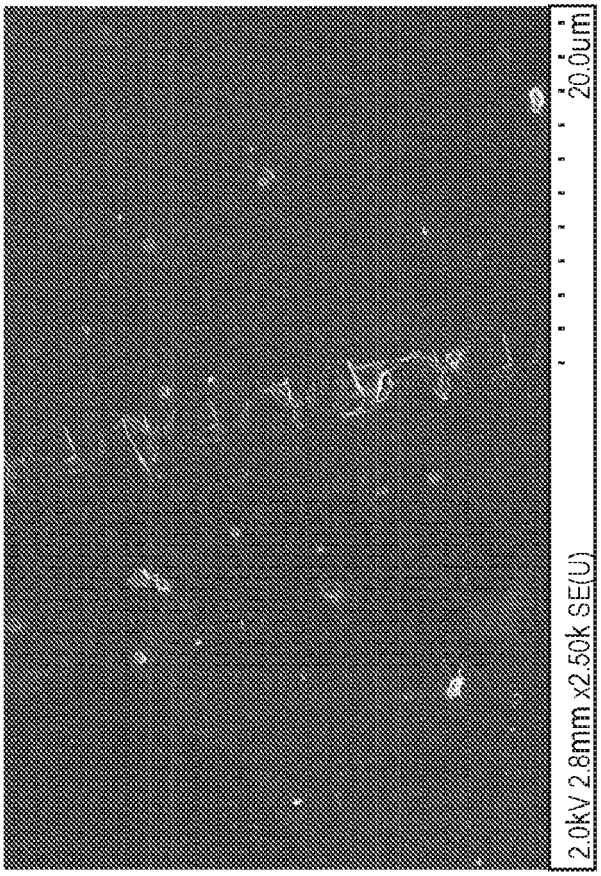


FIG. 204

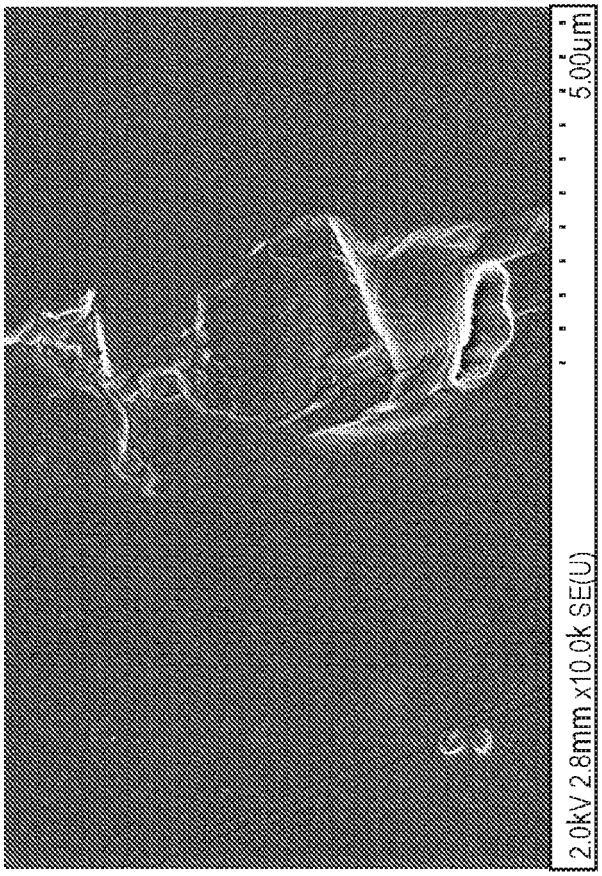


FIG. 205

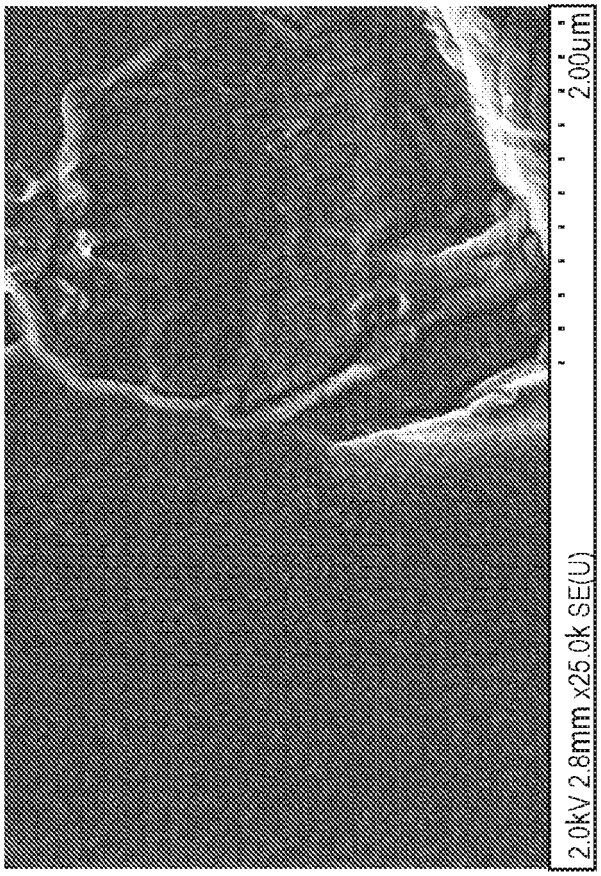


FIG. 206

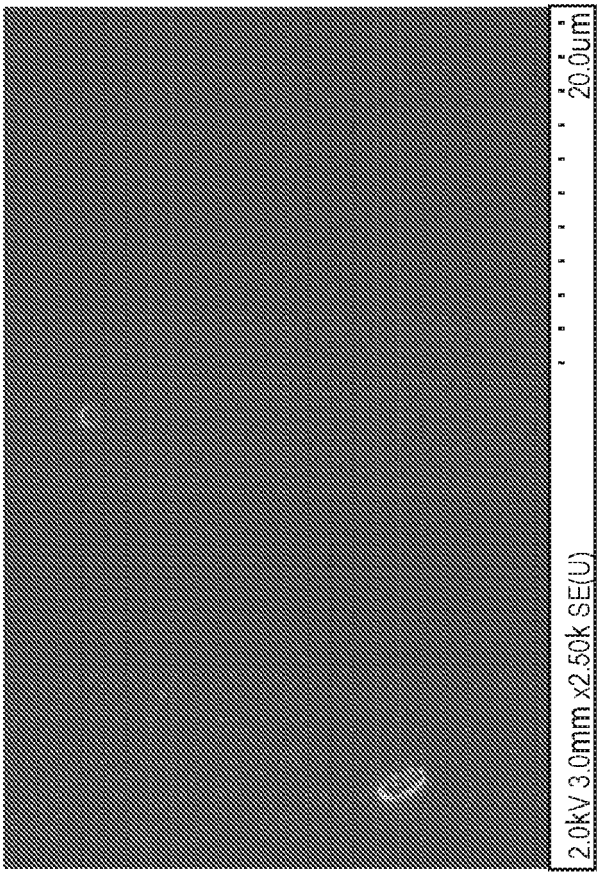


FIG. 207

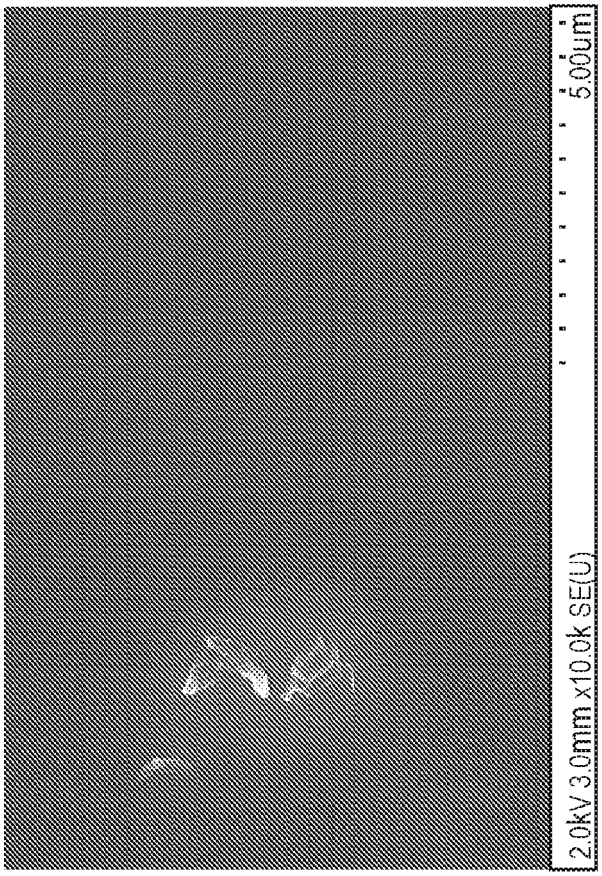


FIG. 208

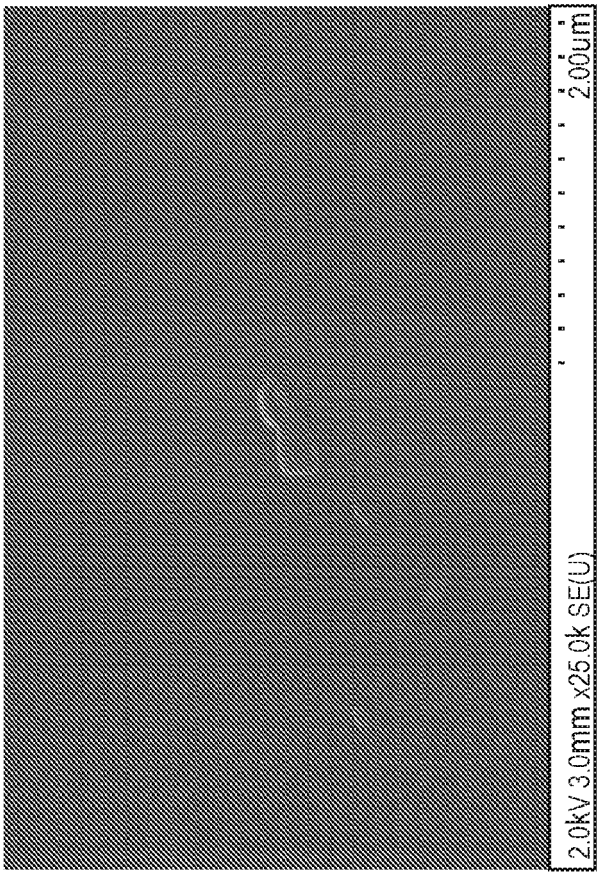


FIG. 209

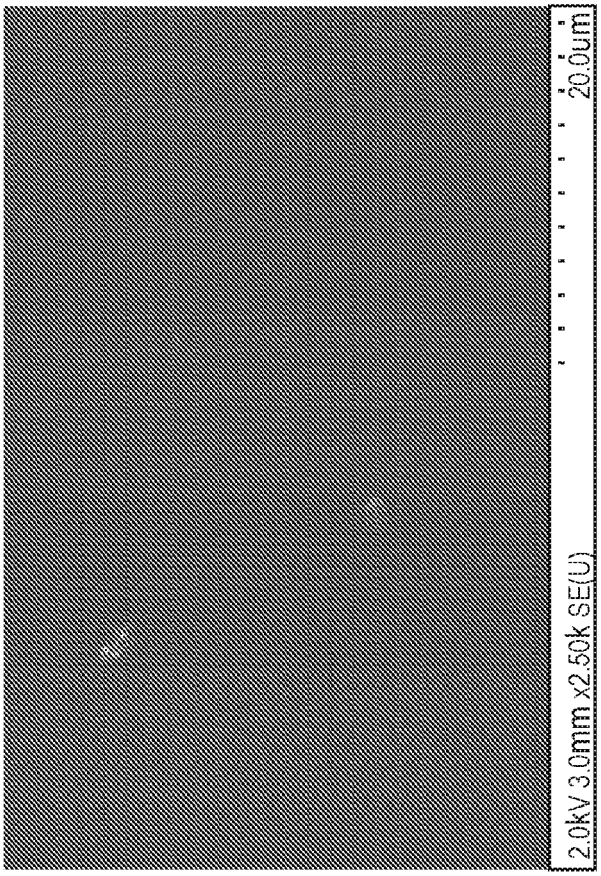


FIG. 210

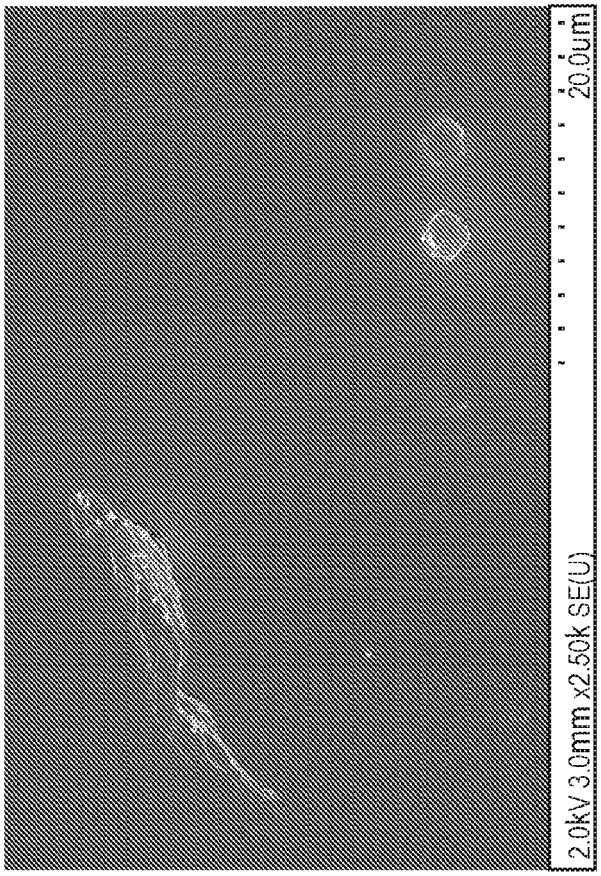


FIG. 211

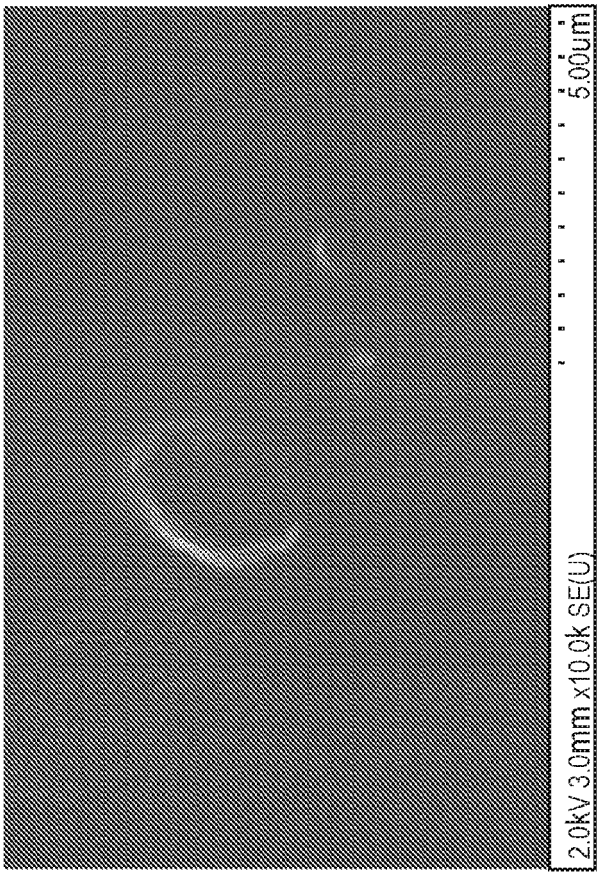


FIG. 212

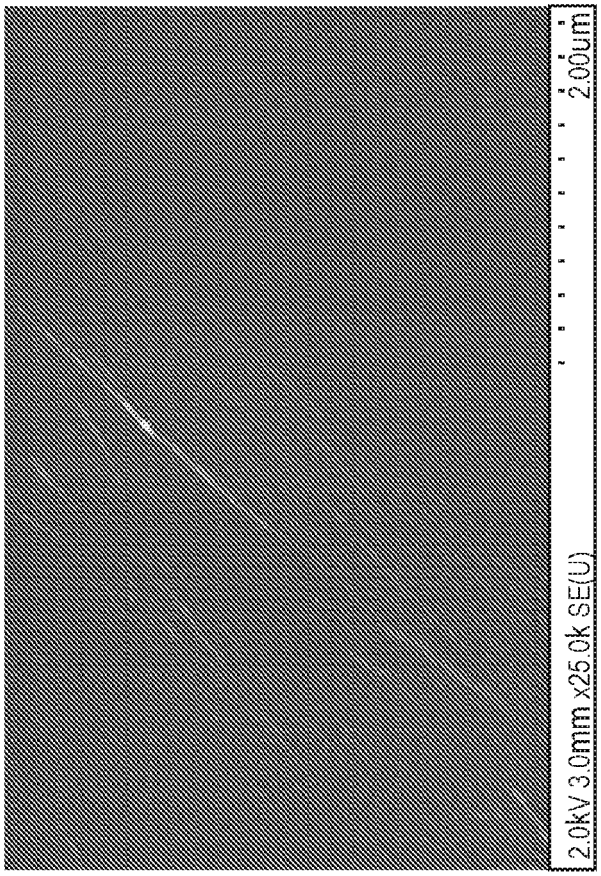


FIG. 213

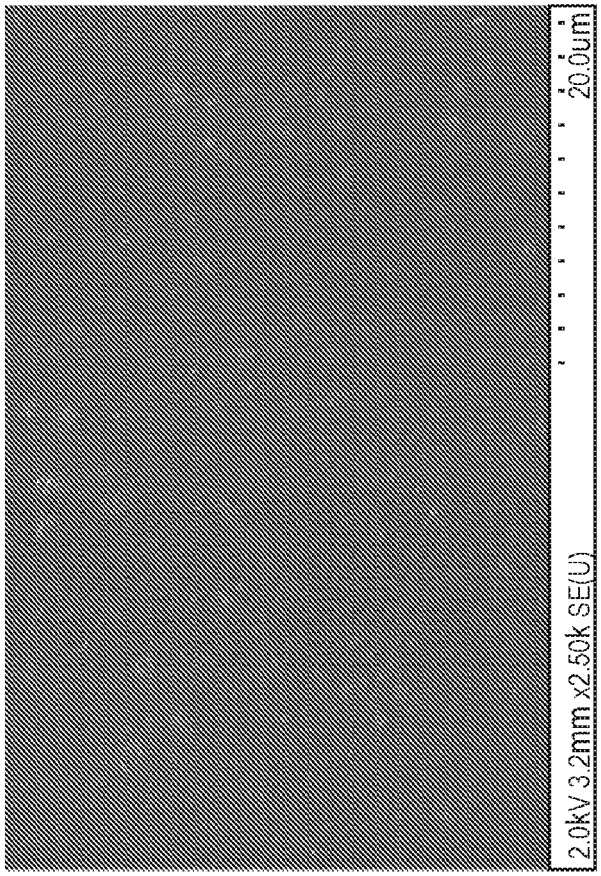


FIG. 214

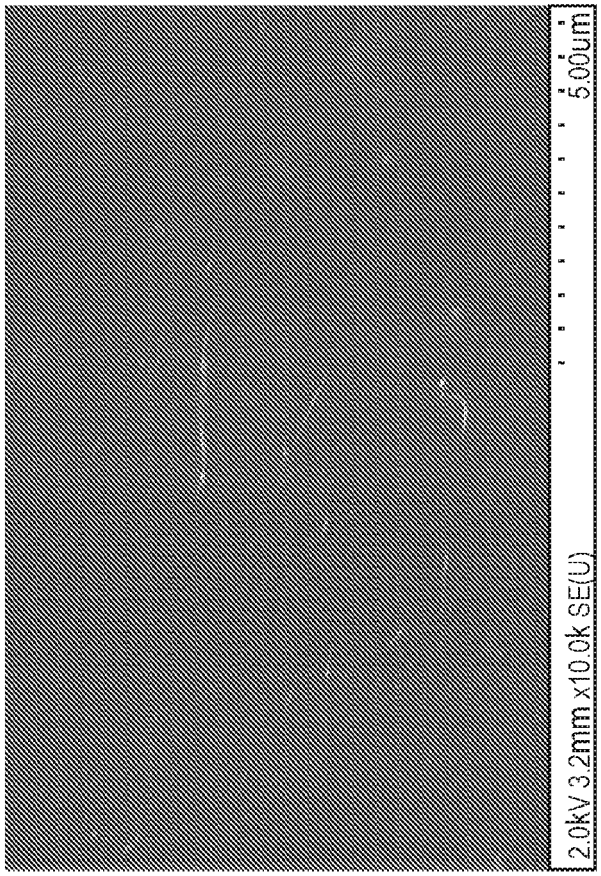


FIG. 215



FIG. 216



FIG. 217

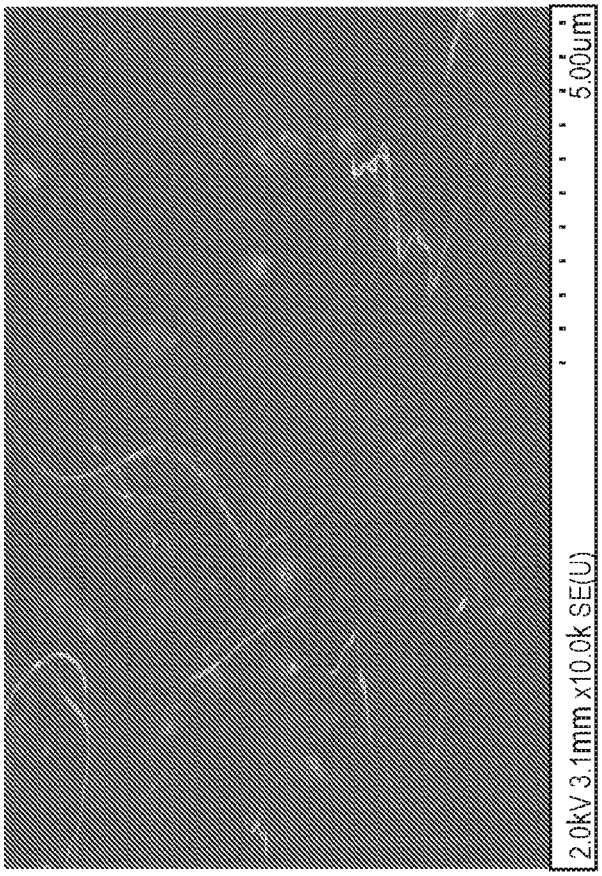


FIG. 218

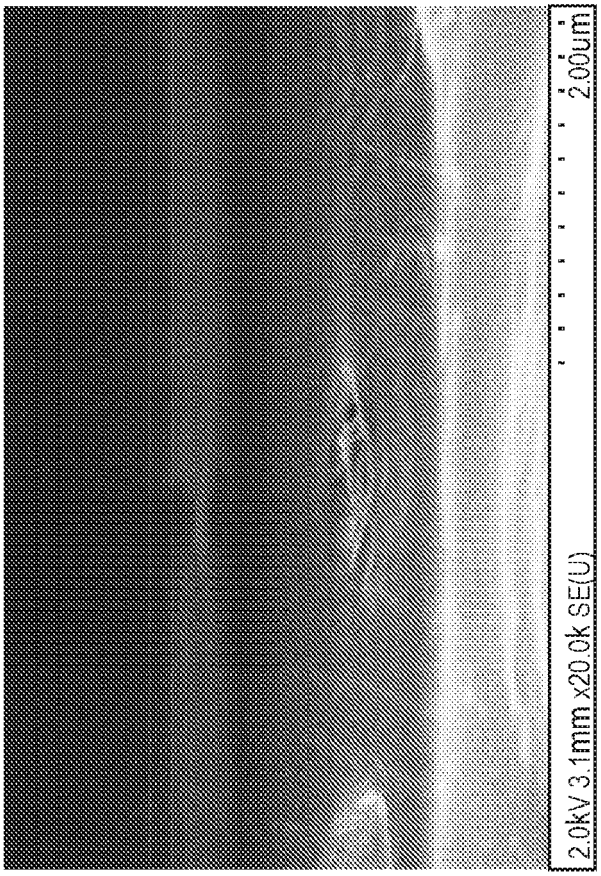


FIG. 219

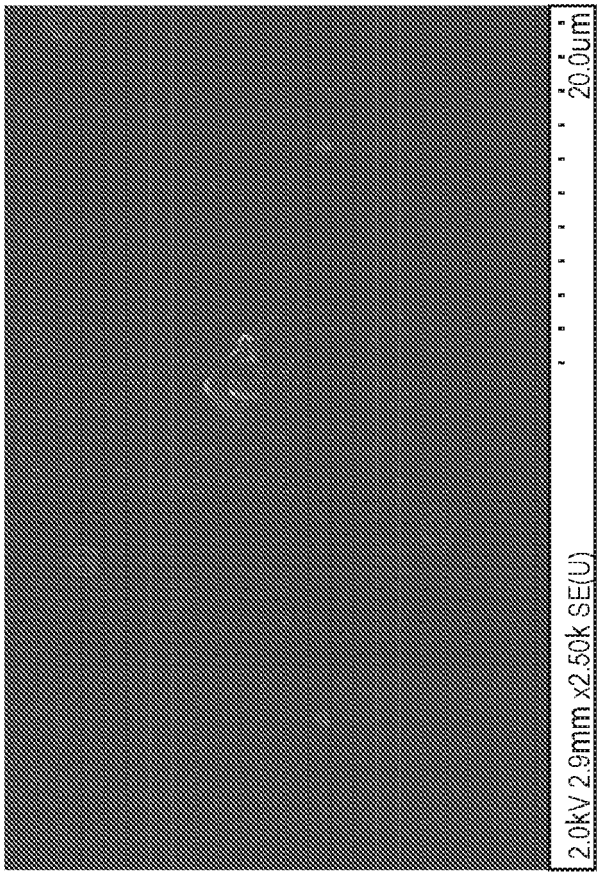


FIG. 220



FIG. 221

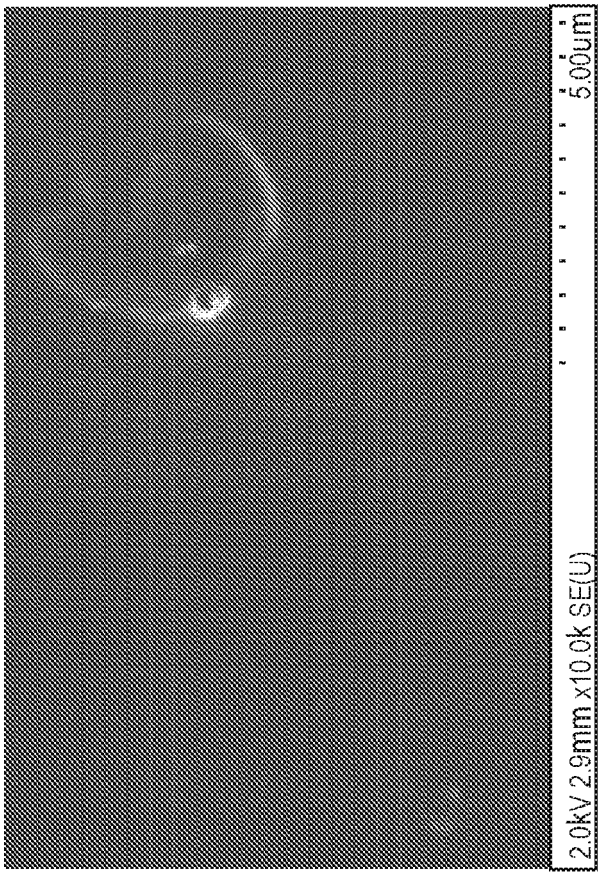


FIG. 222

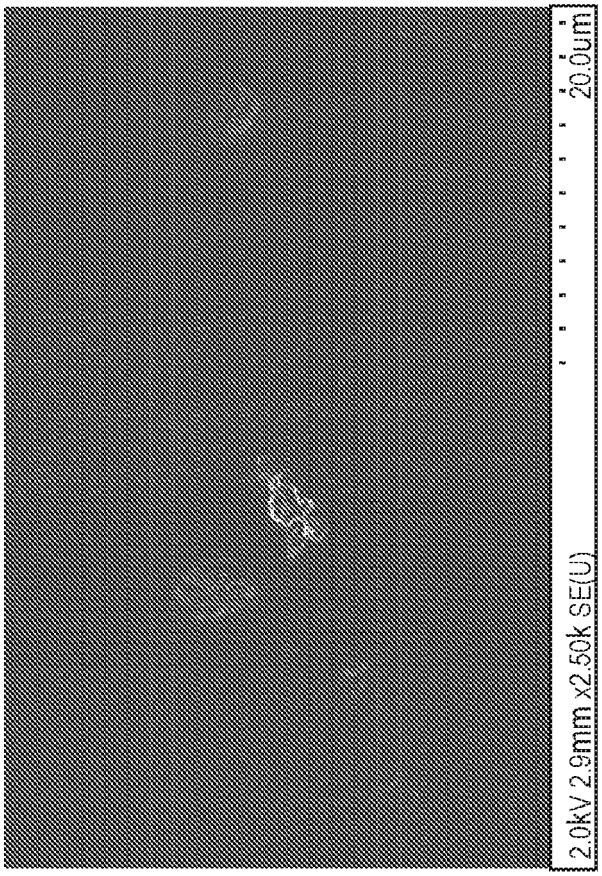


FIG. 223

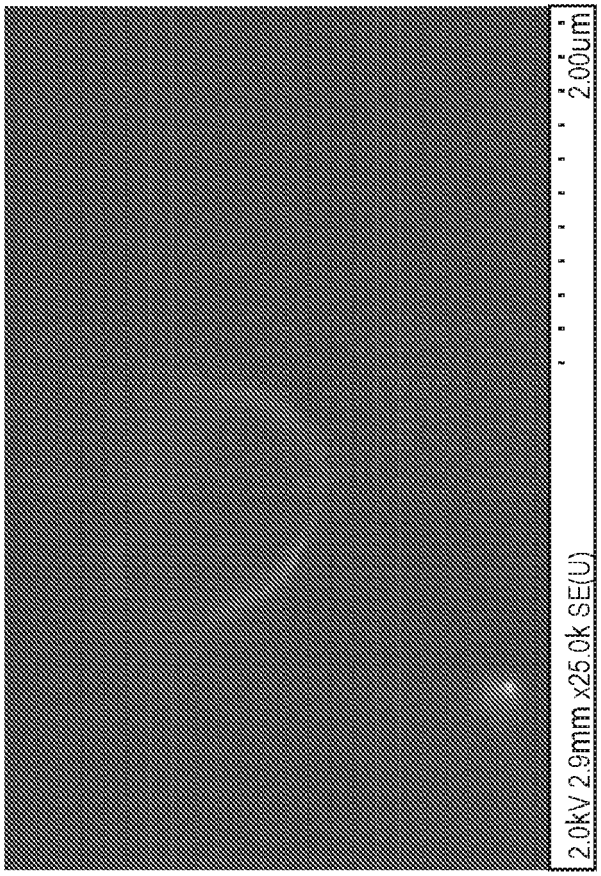


FIG. 224

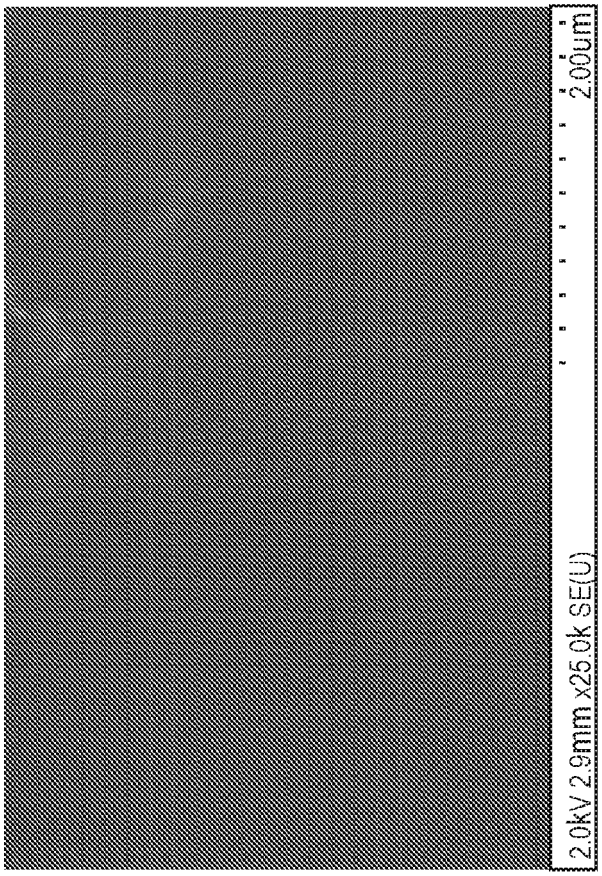


FIG. 225

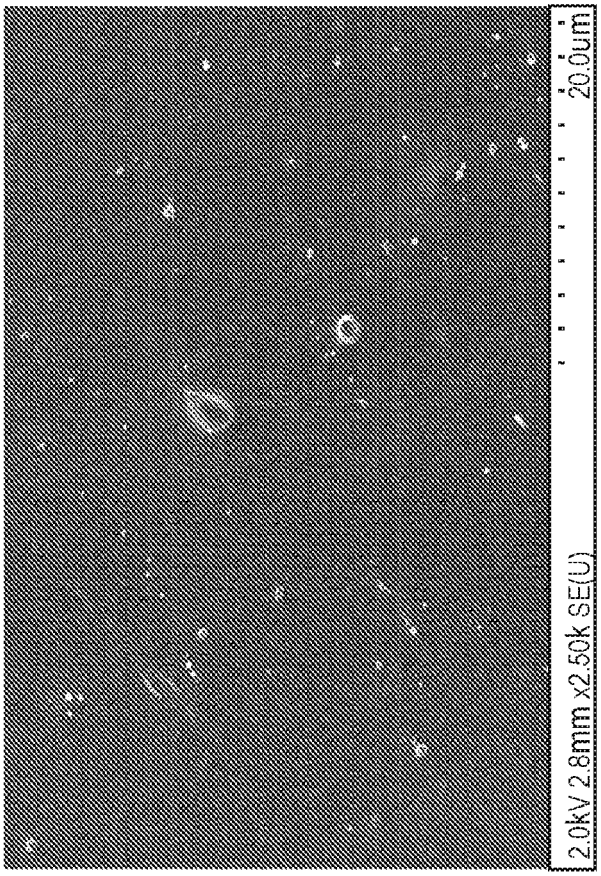


FIG. 226

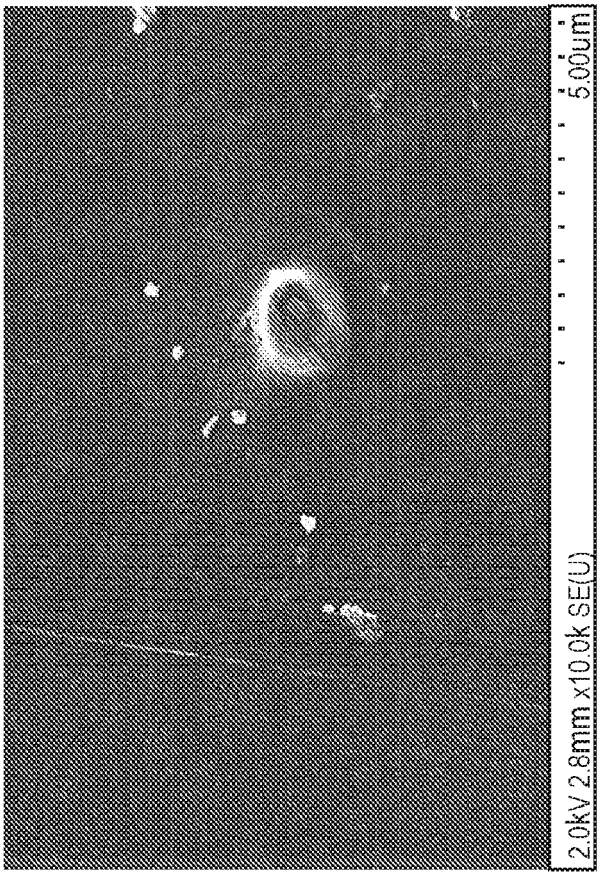


FIG. 227

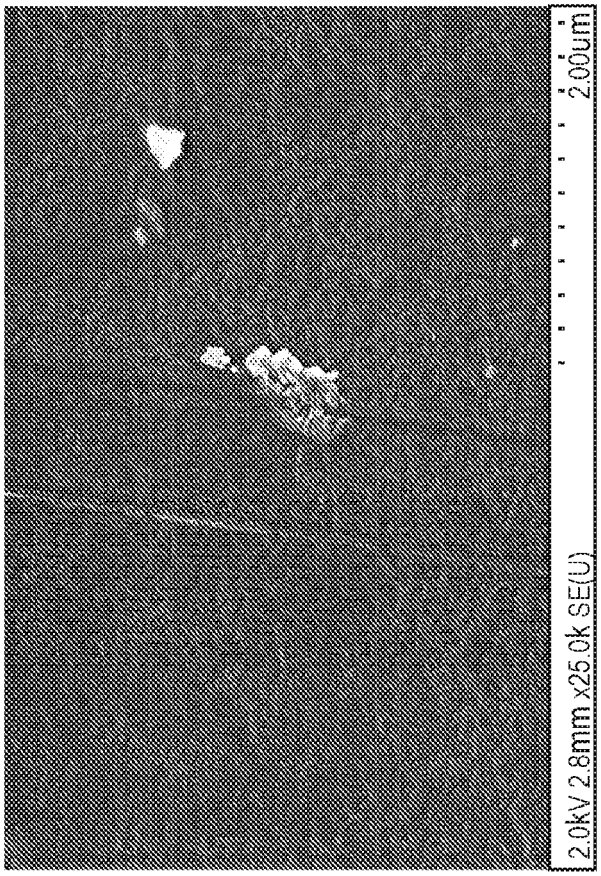


FIG. 228

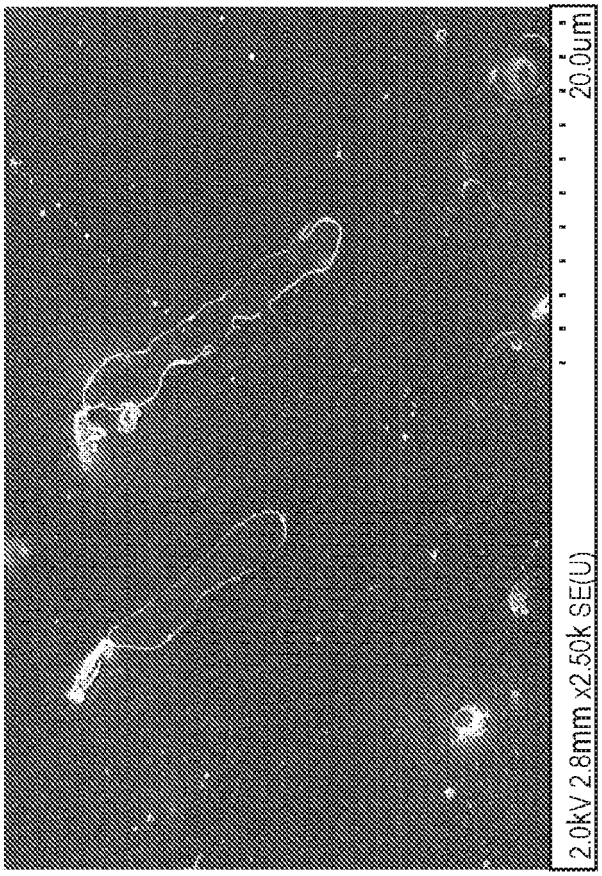


FIG. 229

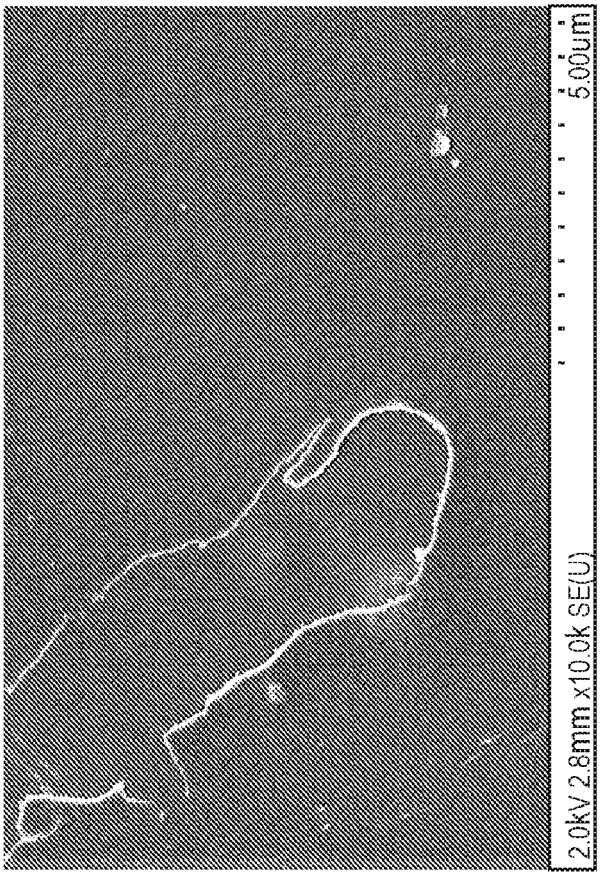


FIG. 230

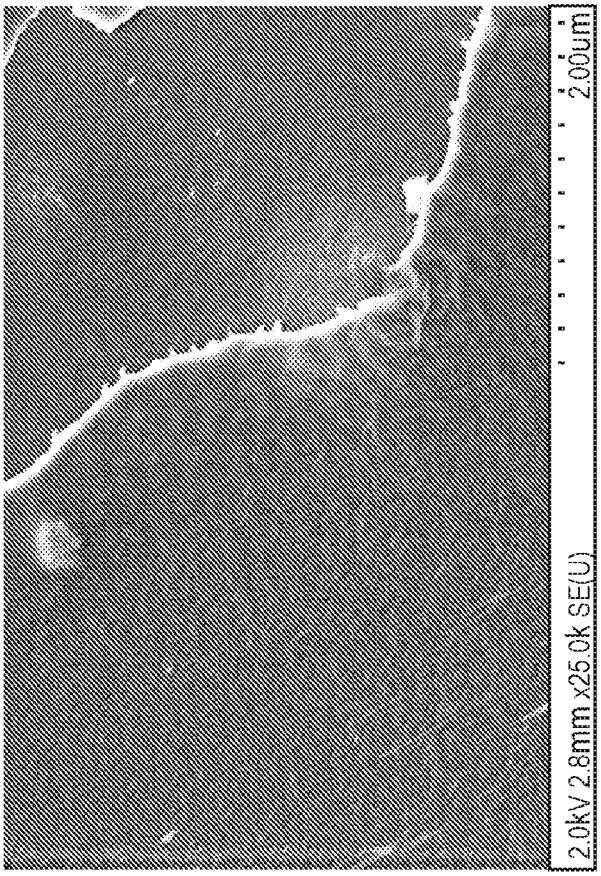


FIG. 231

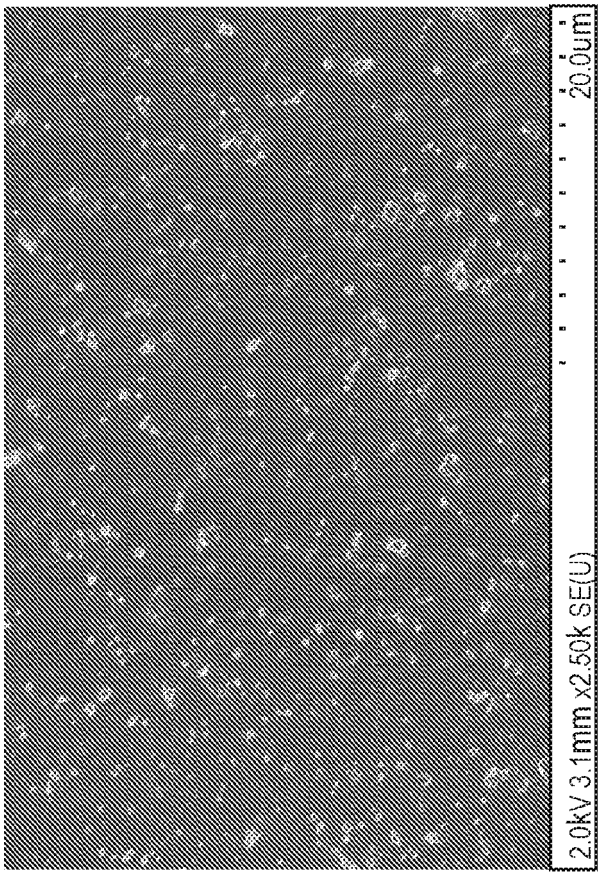


FIG. 232

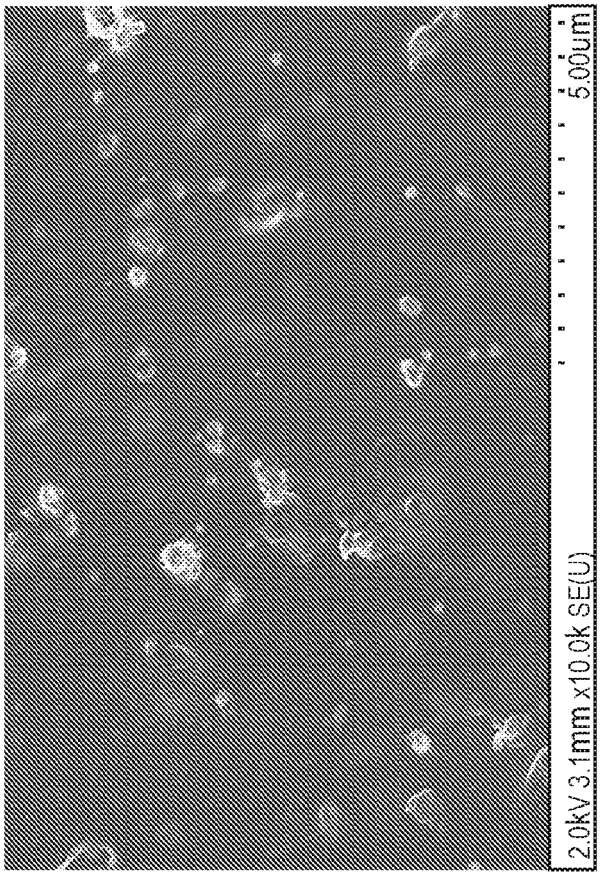


FIG. 233

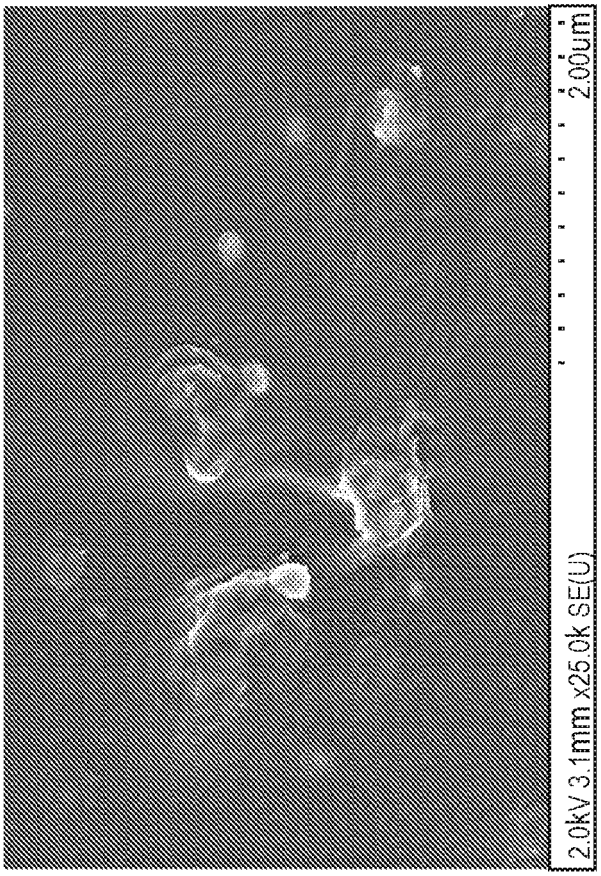


FIG. 234

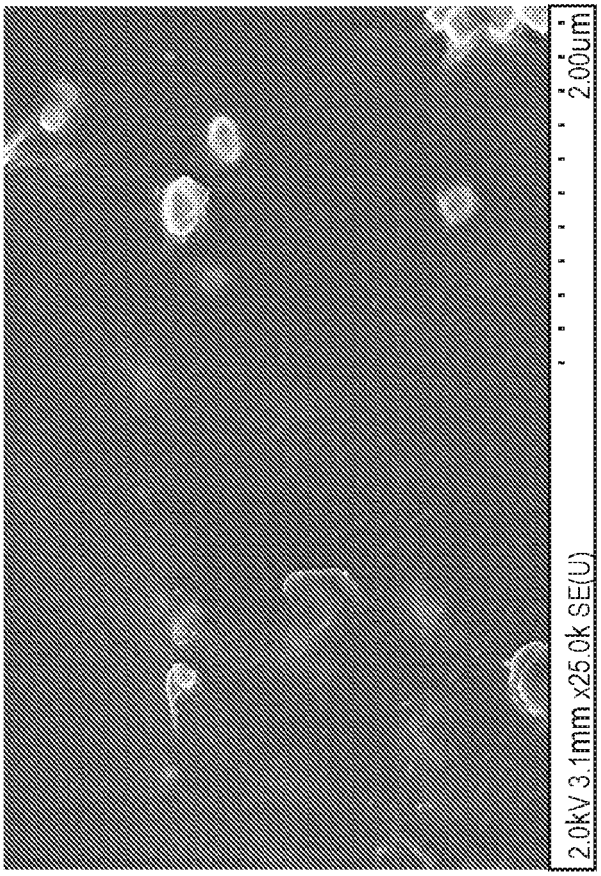


FIG. 235

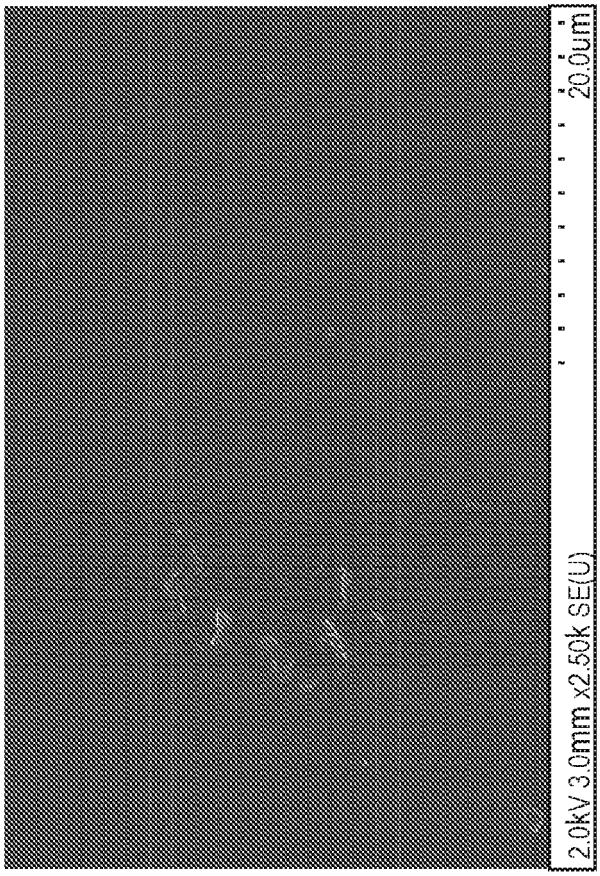


FIG. 236

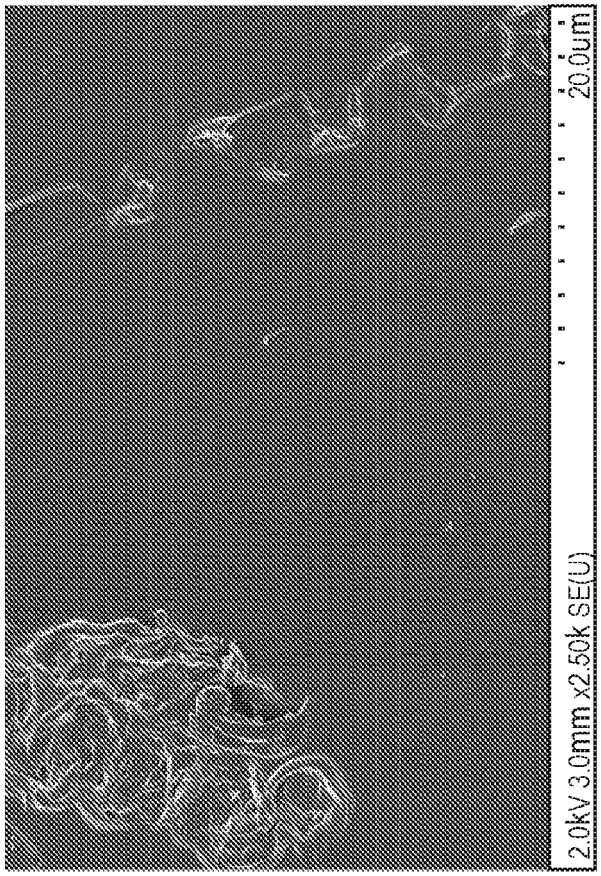


FIG. 237

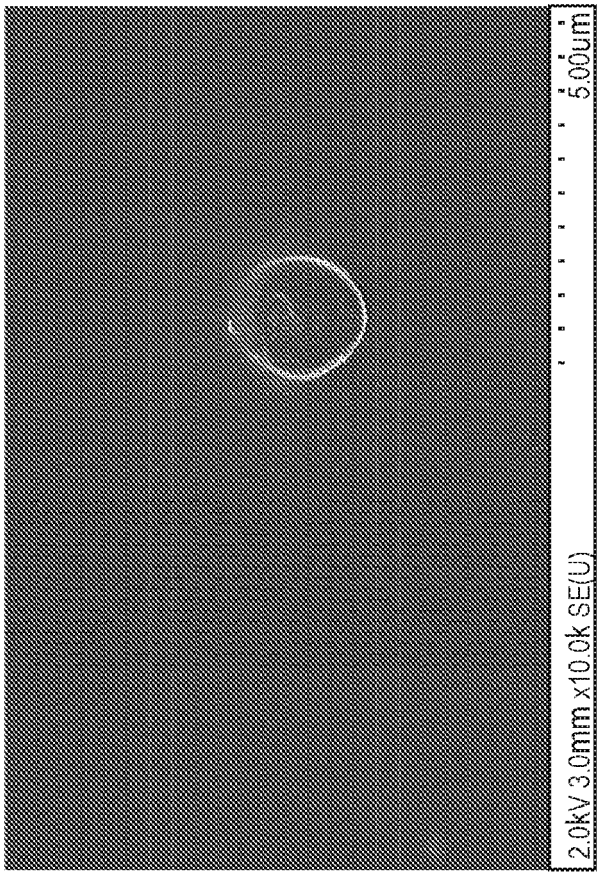


FIG. 238

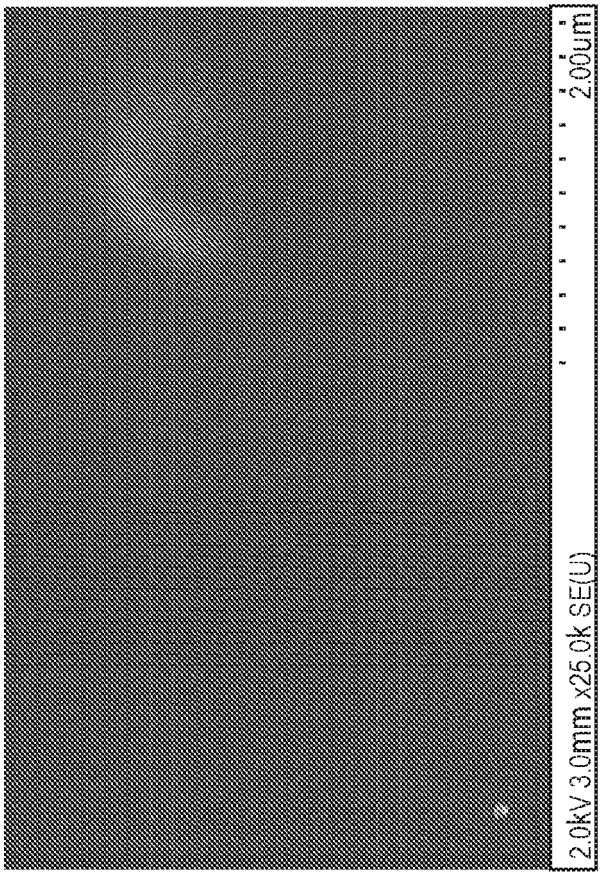


FIG. 239

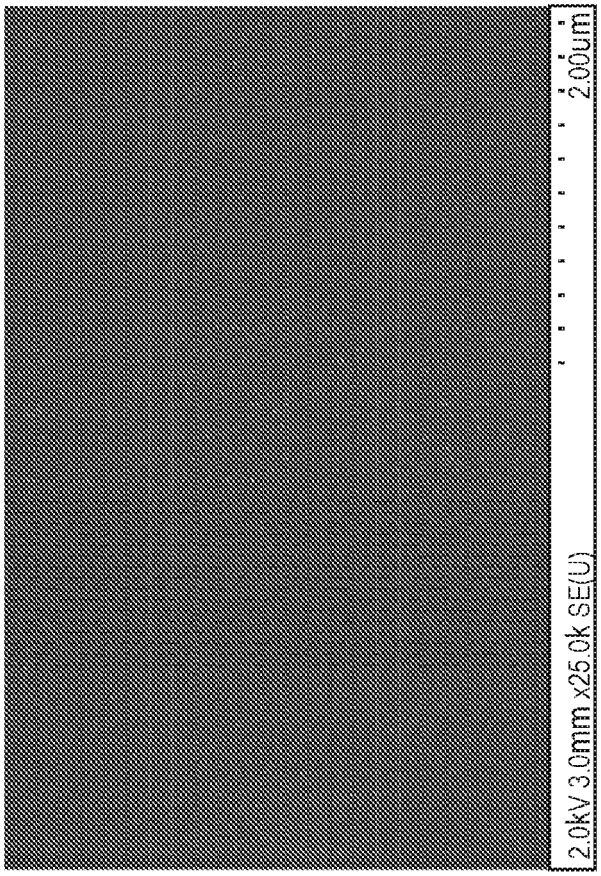


FIG. 240

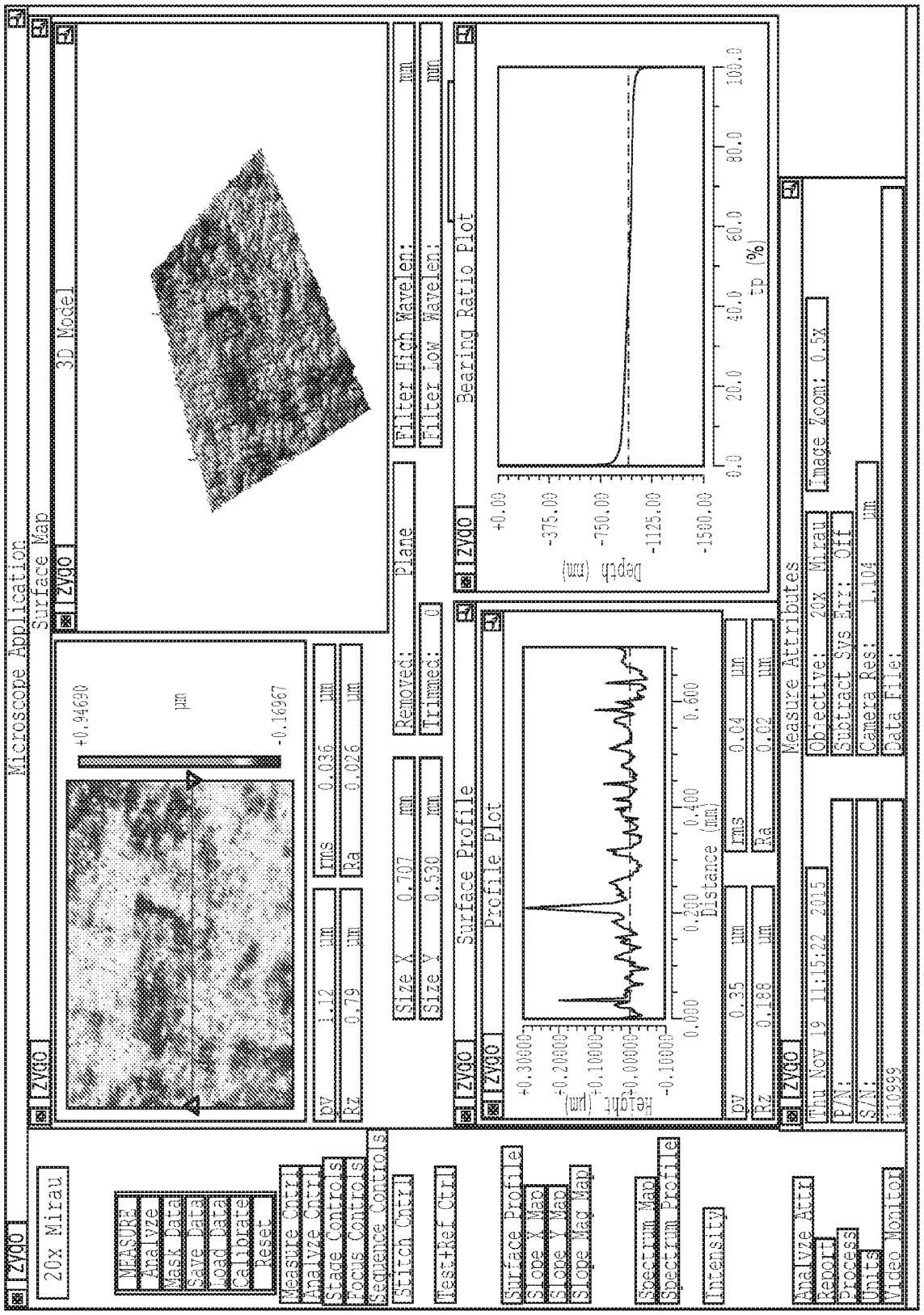

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+0.94690
-0.16967
Size X 0.707 mm
Size Y 0.530 mm
Rms 0.036 um
Ra 0.026 um
Removed: Plane
Trimmed: 0
Filter High Wavelen:
Filter Low Wavelen:
Surface Profile
Profile Plot
Height
Distance (mm)
pv 0.35 um
Rz 0.188 um
Rms 0.04 um
Ra 0.02 um
Bearing Ratio Plot
Depth
Tp (%)
Measure Attributes
Thu Nov 19 11:15:22 2015
PA:
S/N:
L10999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 um
Data File:
Image Zoom: 0.5x

FIG. 241

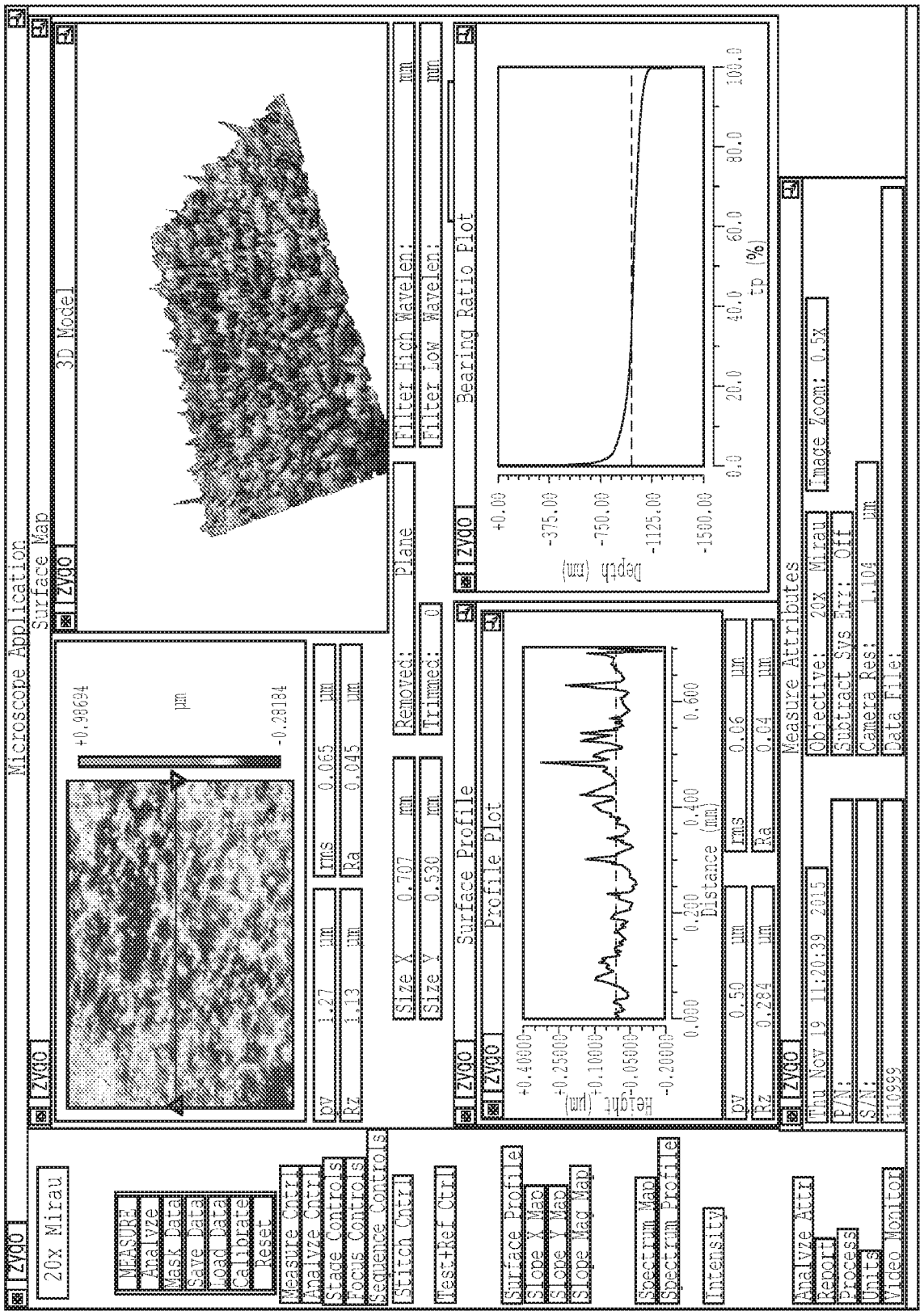

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+0.98694
µm
-0.28184
Sz 1.27 µm
Rz 1.13 µm
Irms 0.065 µm
Ra 0.045 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
Sz 0.50 µm
Rz 0.284 µm
Irms 0.06 µm
Ra 0.04 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 19 11:20:39 2015
PA:
S/N:
L10999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 242

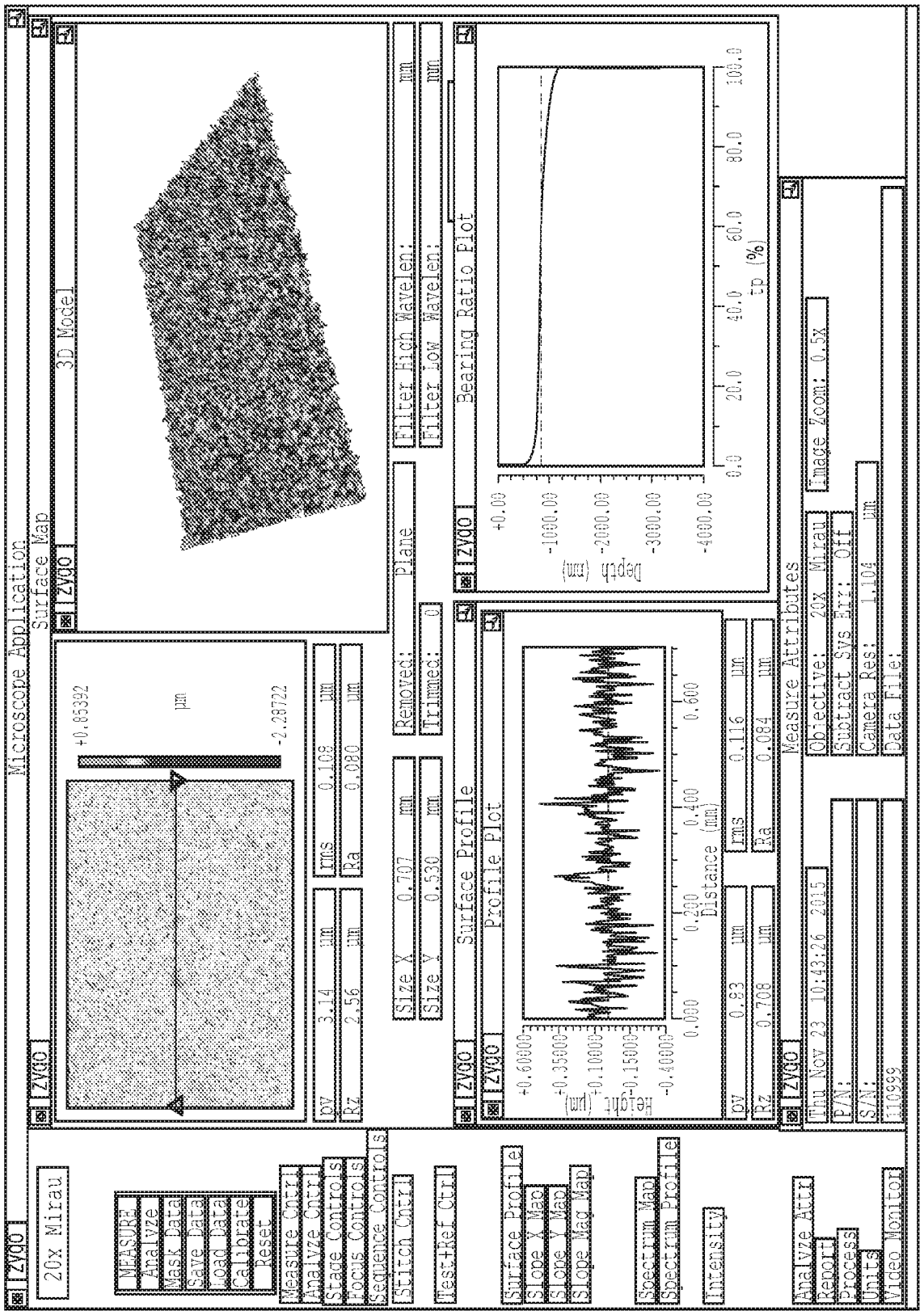

Microscope Application
IZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+0.85392
-2.28722
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen:
Filter Low Wavelen:
Surface Profile
Profile Plot
Distance (mm)
Height
Bearing Ratio Plot
Depth
tp (%)
Measure Attributes
Objective: 20x Mirau
Image Zoom: 0.5x
Subtract Sys Err: Off
Camera Res: 1.104 um
Data File:
PA:
S/N:
Thu Nov 23 10:43:26 2015

FIG. 243

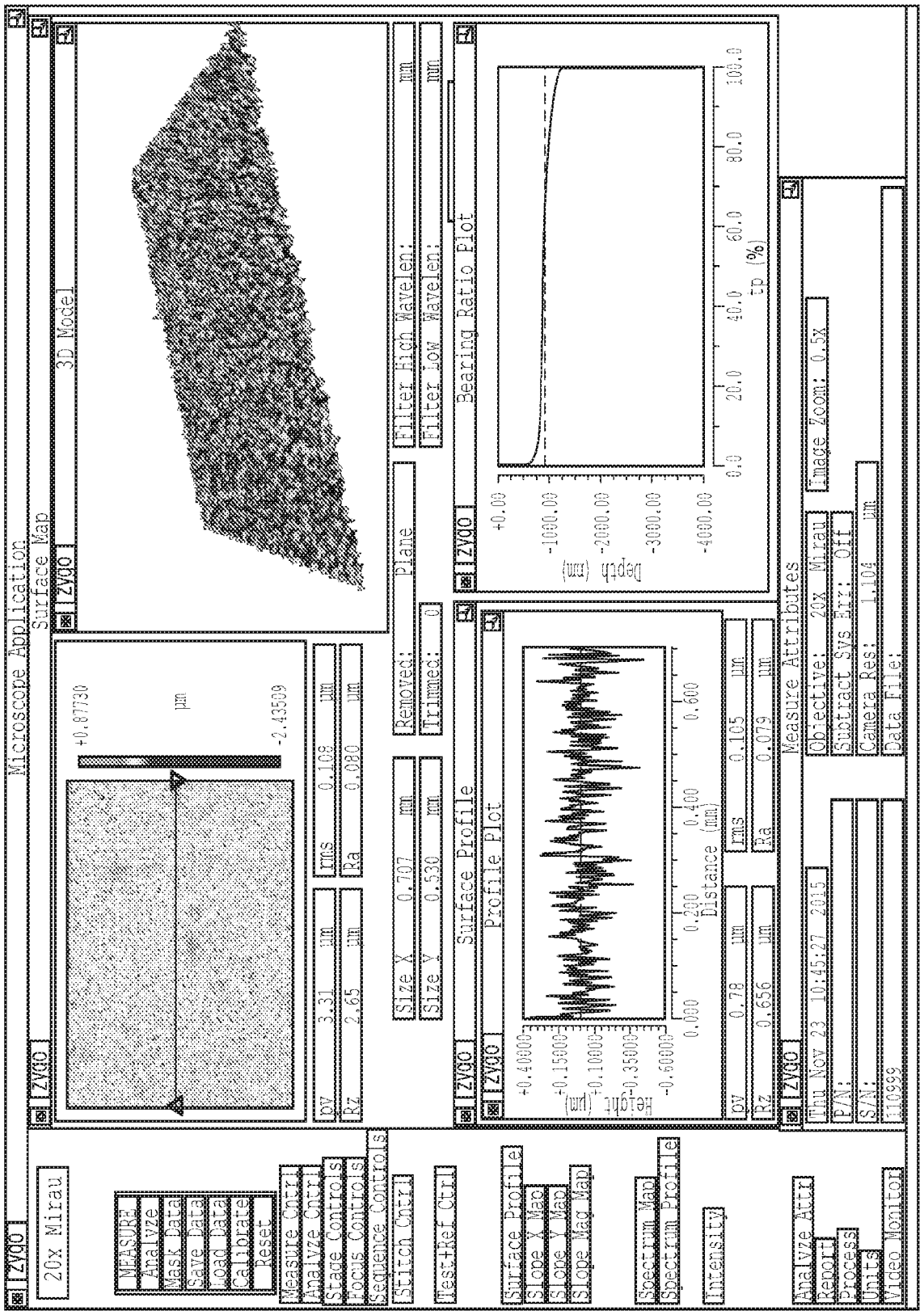

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+0.87730
µm
-2.43509
pv 3.31 µm
Rz 2.65 µm
rms 0.108 µm
Ra 0.080 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
pv 0.78 µm
Rz 0.656 µm
rms 0.105 µm
Ra 0.079 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 10:45:27 2015
PA:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 244

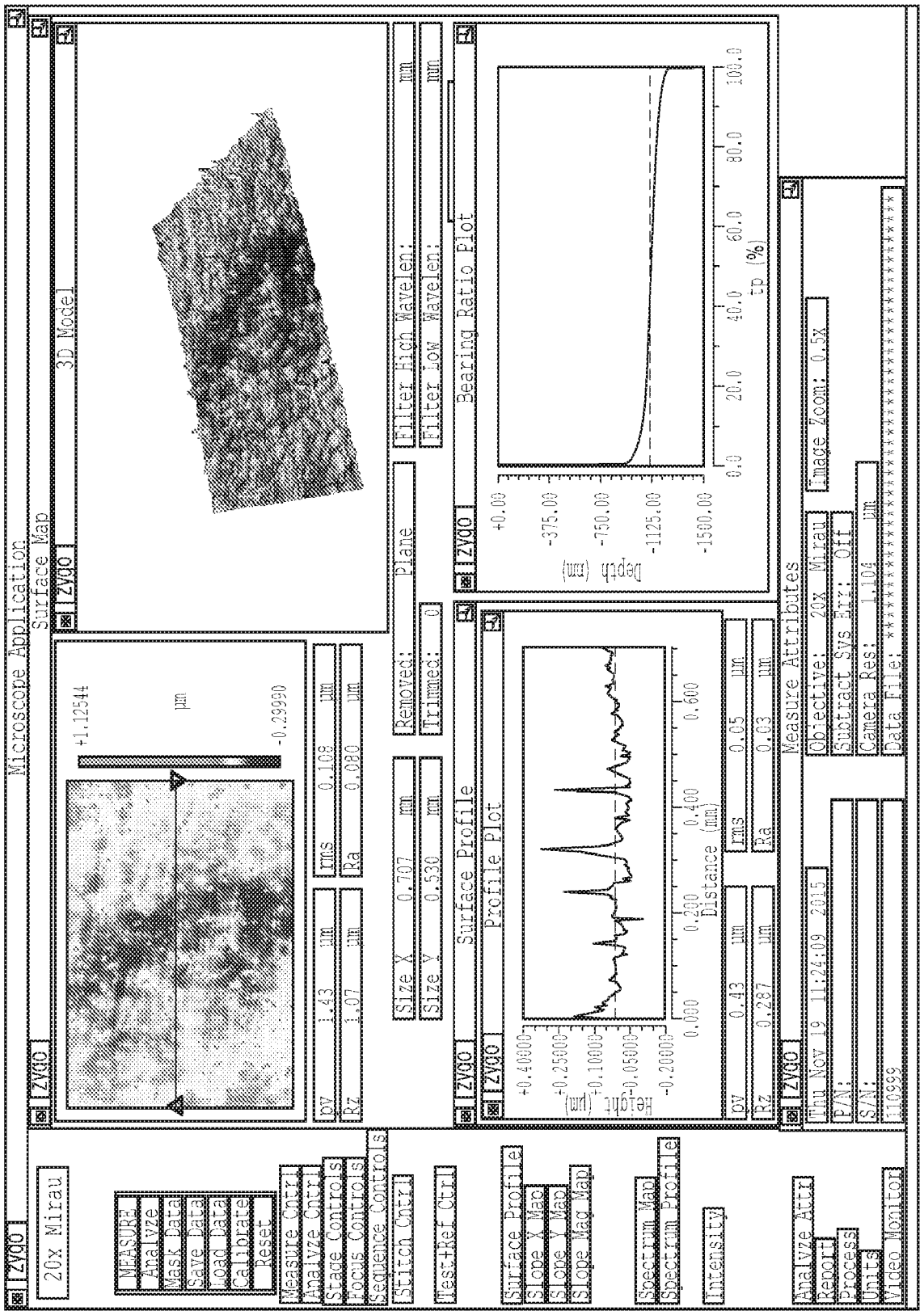

Microscope Application
Surface Map
3D Model
Bearing Ratio Plot
Surface Profile
Profile Plot
Measure Attributes
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Plane
Removed:
Trimmed: 0
Filter High Wavelen:
Filter Low Wavelen:
Size X 0.707 mm
Size Y 0.530 mm
Distance (mm)
Depth (µm)
Tp (%)
Image Zoom: 0.5x
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File: **********
PA:
S/N:
L10999

FIG. 245

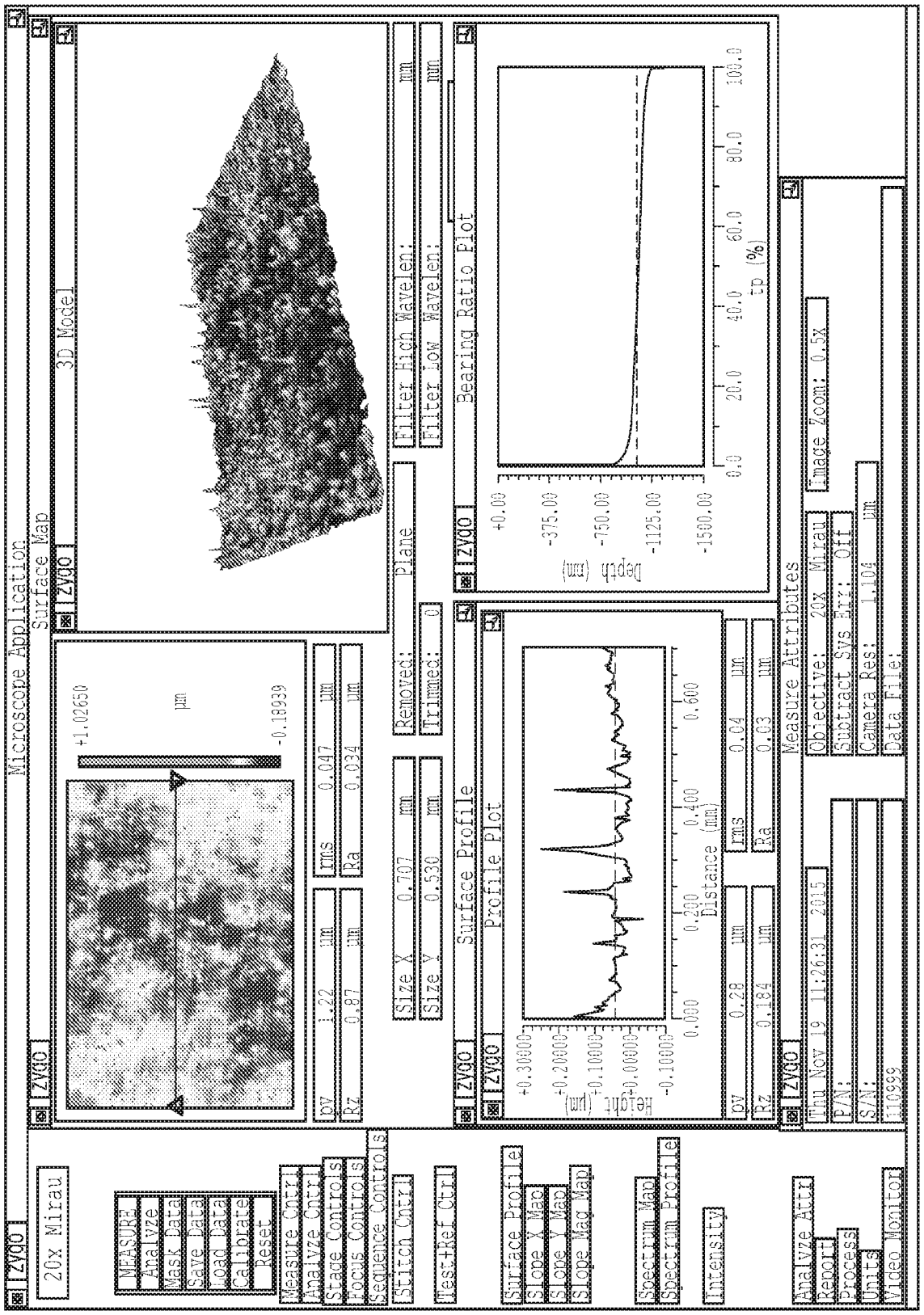

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.02650
-0.18939
µm
pv 1.22 µm
Rz 0.87 µm
Rms 0.047 µm
Ra 0.034 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height
Distance (mm)
Bearing Ratio Plot
Depth
Tp (%)
Measure Attributes
Thu Nov 19 11:26:31 2015
PN:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 246

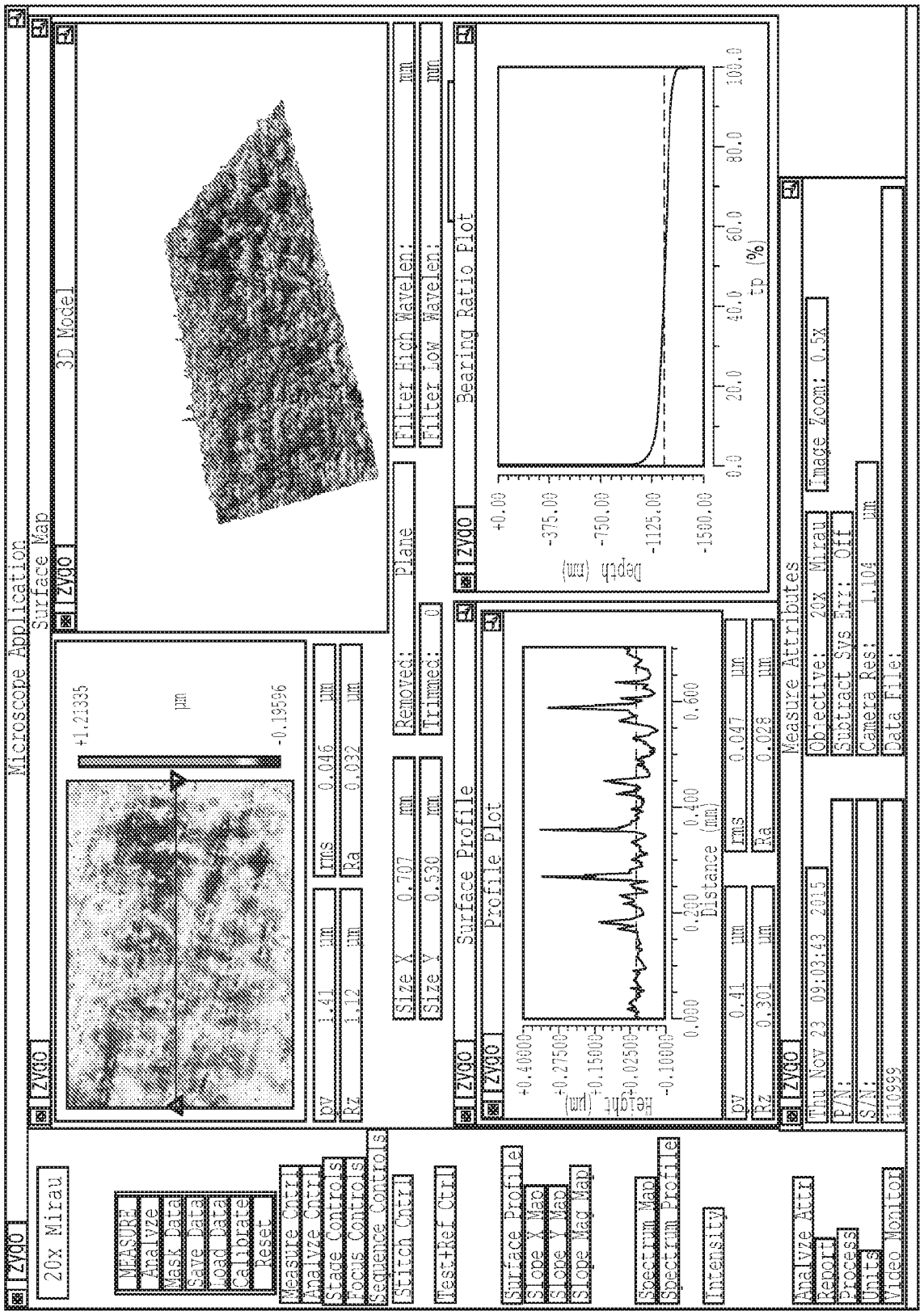

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.21335
µm
-0.19596
pv 1.41 µm
Rz 1.12 µm
Rms 0.046 µm
Ra 0.032 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (mm)
Distance (mm)
pv 0.41 µm
Rz 0.301 µm
Rms 0.047 µm
Ra 0.028 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 09:03:43 2015
PAN:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 247

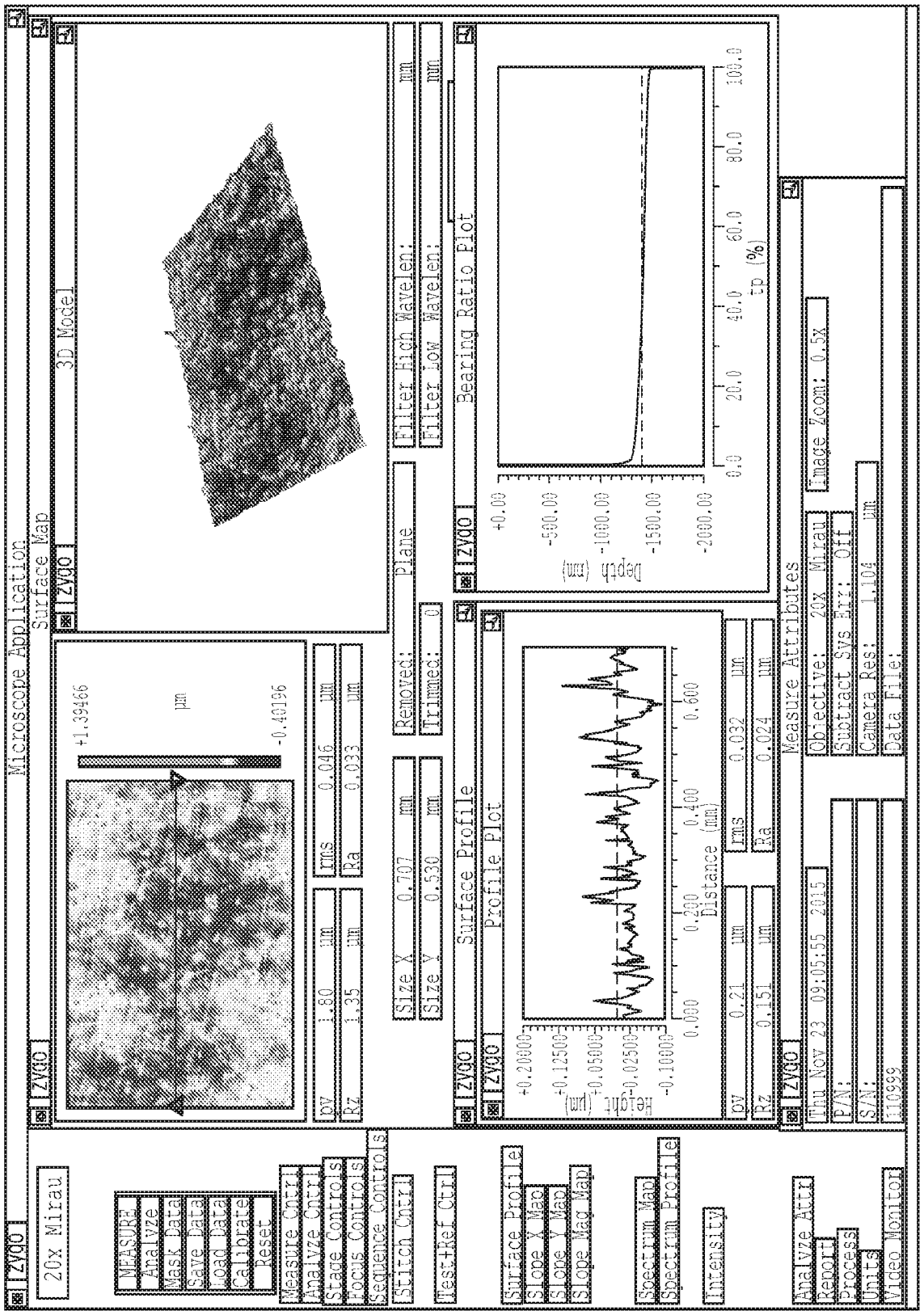

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.39466
µm
-0.40196
pv 1.80 µm
Rz 1.35 µm
Rms 0.046 µm
Ra 0.033 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (mm)
Distance (mm)
pv 0.21 µm
Rz 0.151 µm
Rms 0.032 µm
Ra 0.024 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 09:05:55 2015
PA:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 248

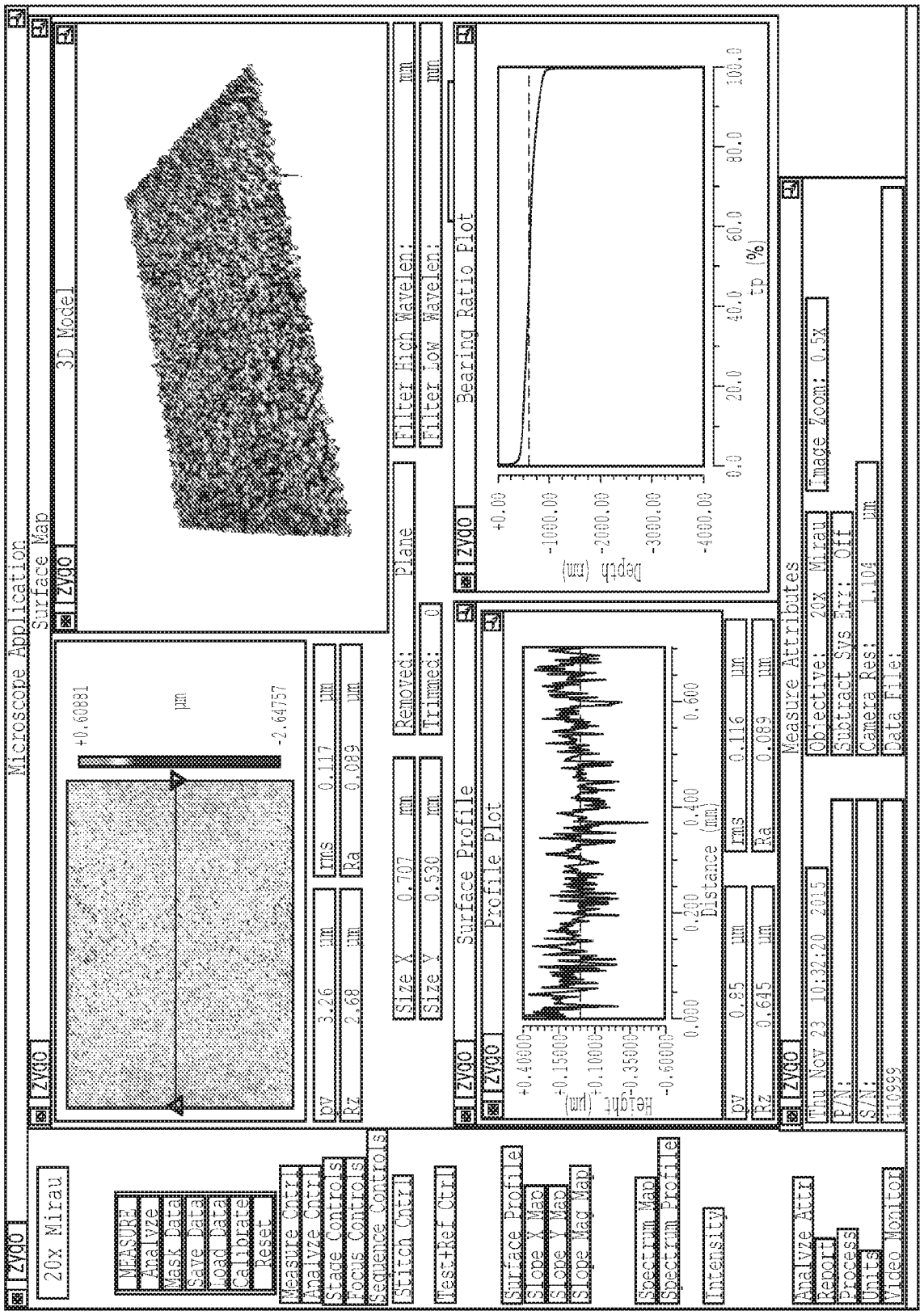

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+0.60881
µm
-2.64757
Sz 3.26 µm
Rz 2.68 µm
Sq 0.117 µm
Ra 0.089 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
Sz 0.85 µm
Rz 0.645 µm
Sq 0.116 µm
Ra 0.089 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 10:32:20 2015
PA:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 249

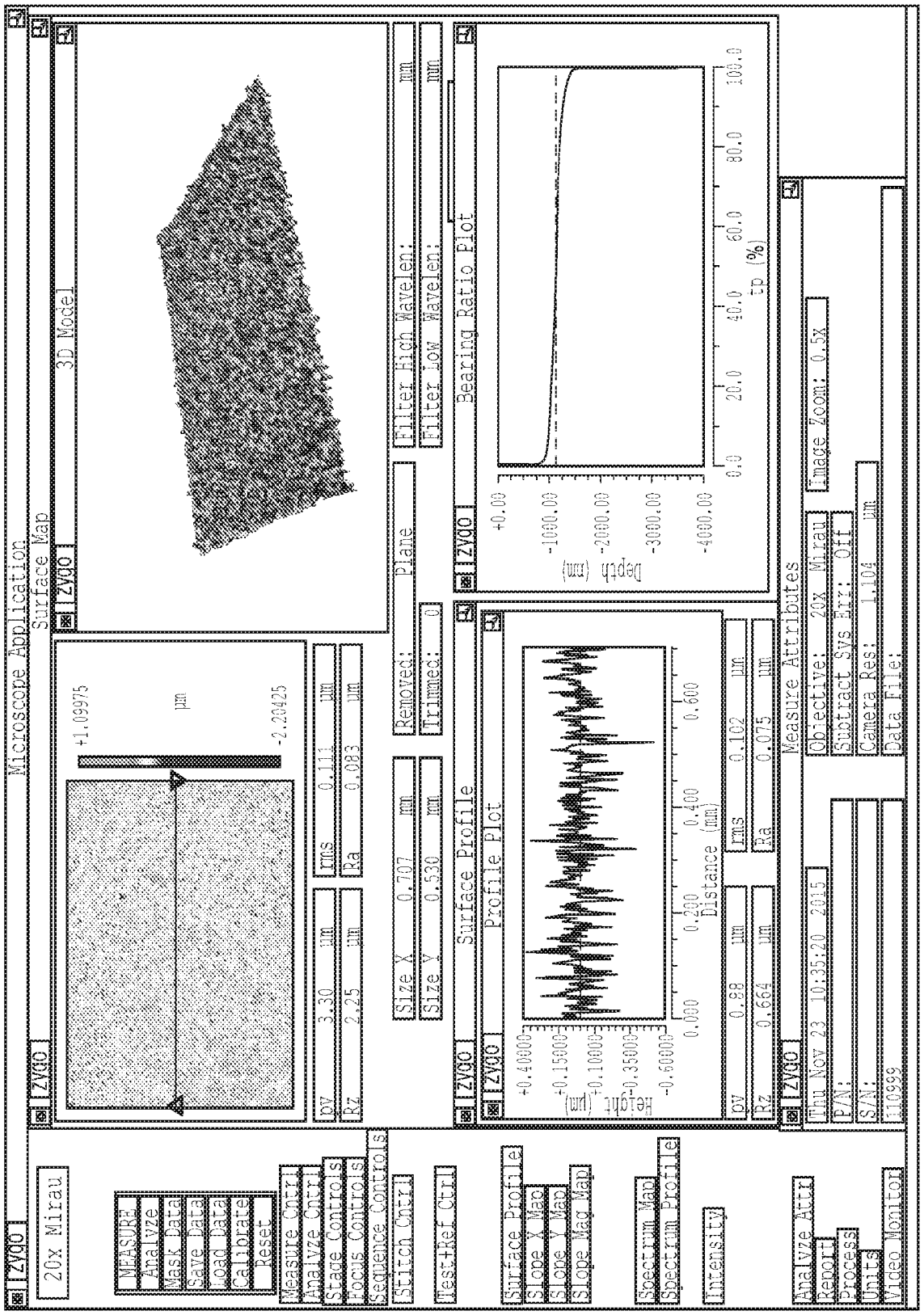

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.09975
µm
-2.20425
pv 3.30 µm
Rz 2.25 µm
Rms 0.111 µm
Ra 0.083 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
pv 0.88 µm
Rz 0.664 µm
Rms 0.102 µm
Ra 0.075 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 10:35:20 2015
PA:
S/N:
L10999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 250

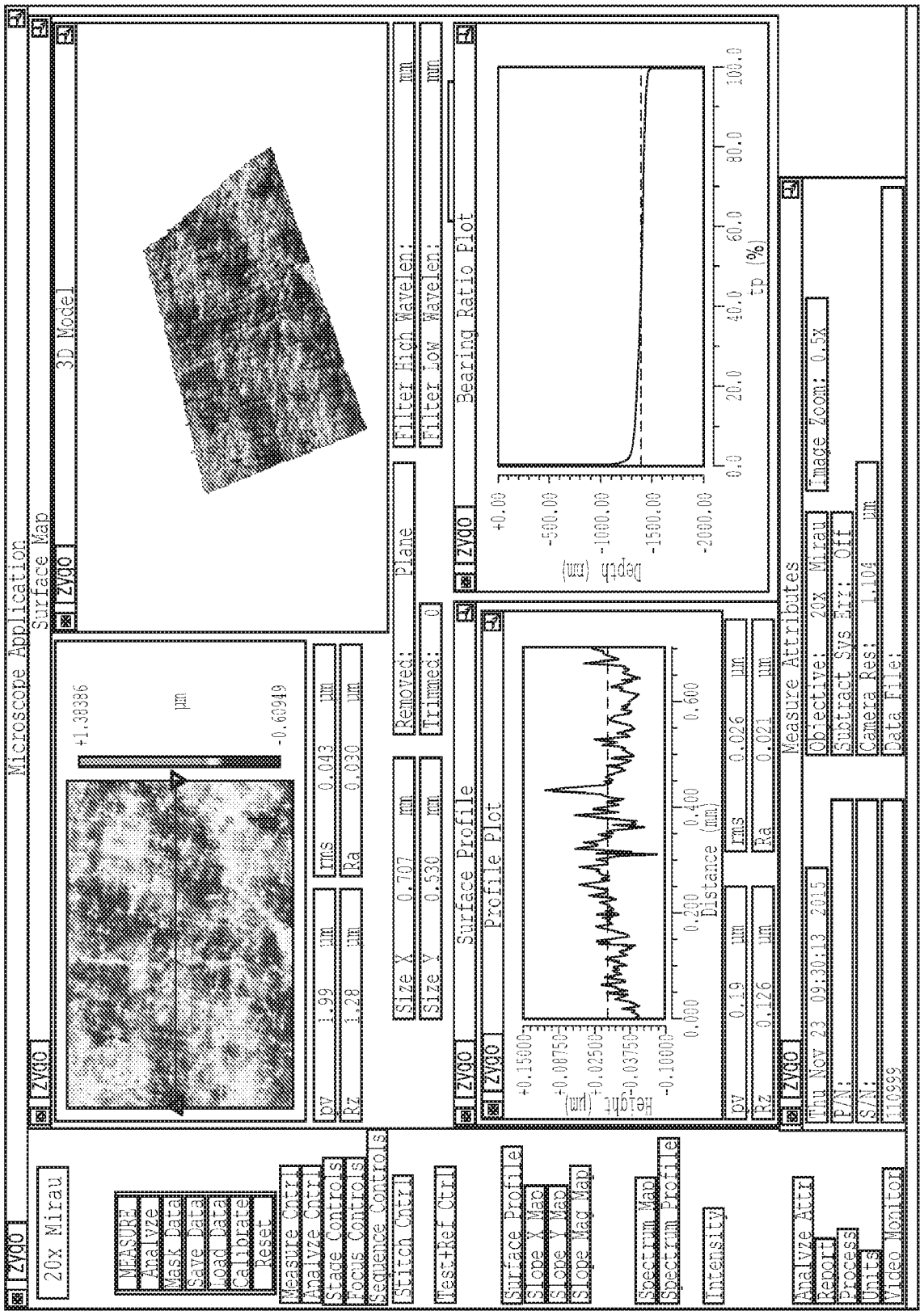

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.38386
µm
-0.60949
pv 1.99 µm
Rz 1.28 µm
Rms 0.043 µm
Ra 0.030 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (mm)
Distance (mm)
pv 0.19 µm
Rz 0.126 µm
Rms 0.026 µm
Ra 0.021 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 09:30:13 2015
PA:
S/N:
L10999
Objective: 20x Mirau
Image Zoom: 0.5x
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:

FIG. 251

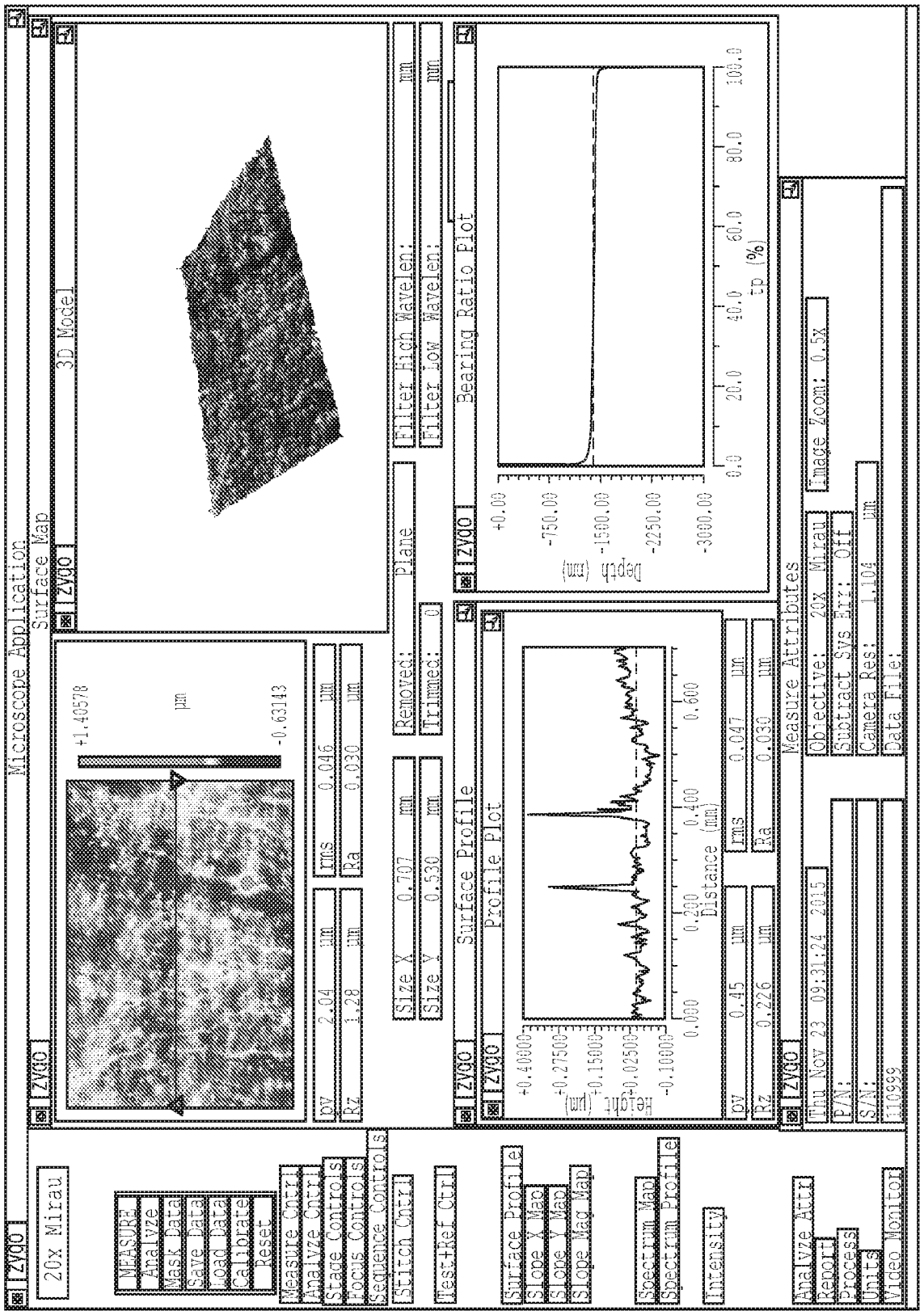

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.40678
-0.63143
μm
Sz 2.04 μm
Rz 1.28 μm
Rms 0.046 μm
Ra 0.030 μm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (mm)
Distance (mm)
Sz 0.45 μm
Rz 0.226 μm
Rms 0.047 μm
Ra 0.030 μm
Measure Attributes
Thu Nov 23 09:31:24 2015
PAN:
S/N:
L10999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 μm
Data File:
Image Zoom: 0.5x
Bearing Ratio Plot
Depth (mm)
tp (%)

FIG. 252

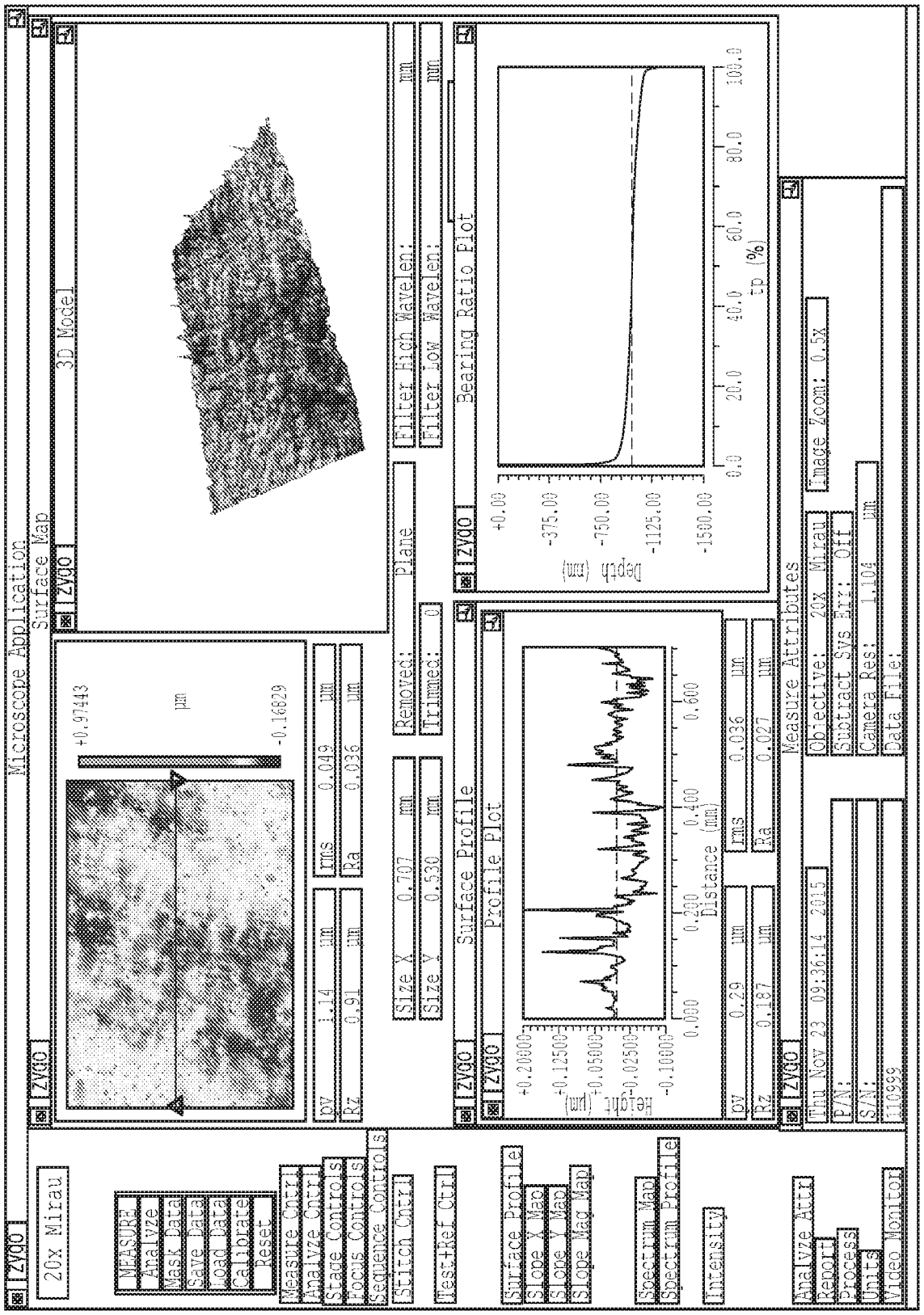

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+0.97443
-0.16829
Size X 0.707 mm
Size Y 0.530 mm
Rms 0.049 um
Ra 0.036 um
pv 1.14 um
Rz 0.91 um
Removed: Plane
Trimmed: 0
Filter High Wavelen:
Filter Low Wavelen:
Surface Profile
Profile Plot
Distance (mm)
Height
Rms 0.036 um
Ra 0.027 um
pv 0.29 um
Rz 0.187 um
Bearing Ratio Plot
Depth
tp (%)
Measure Attributes
Thu Nov 23 09:36:14 2015
PAN:
S/N:
L10999
Objective: 20x Mirau
Image Zoom: 0.5x
Subtract Sys Err: Off
Camera Res: 1.104 um
Data File:

FIG. 253

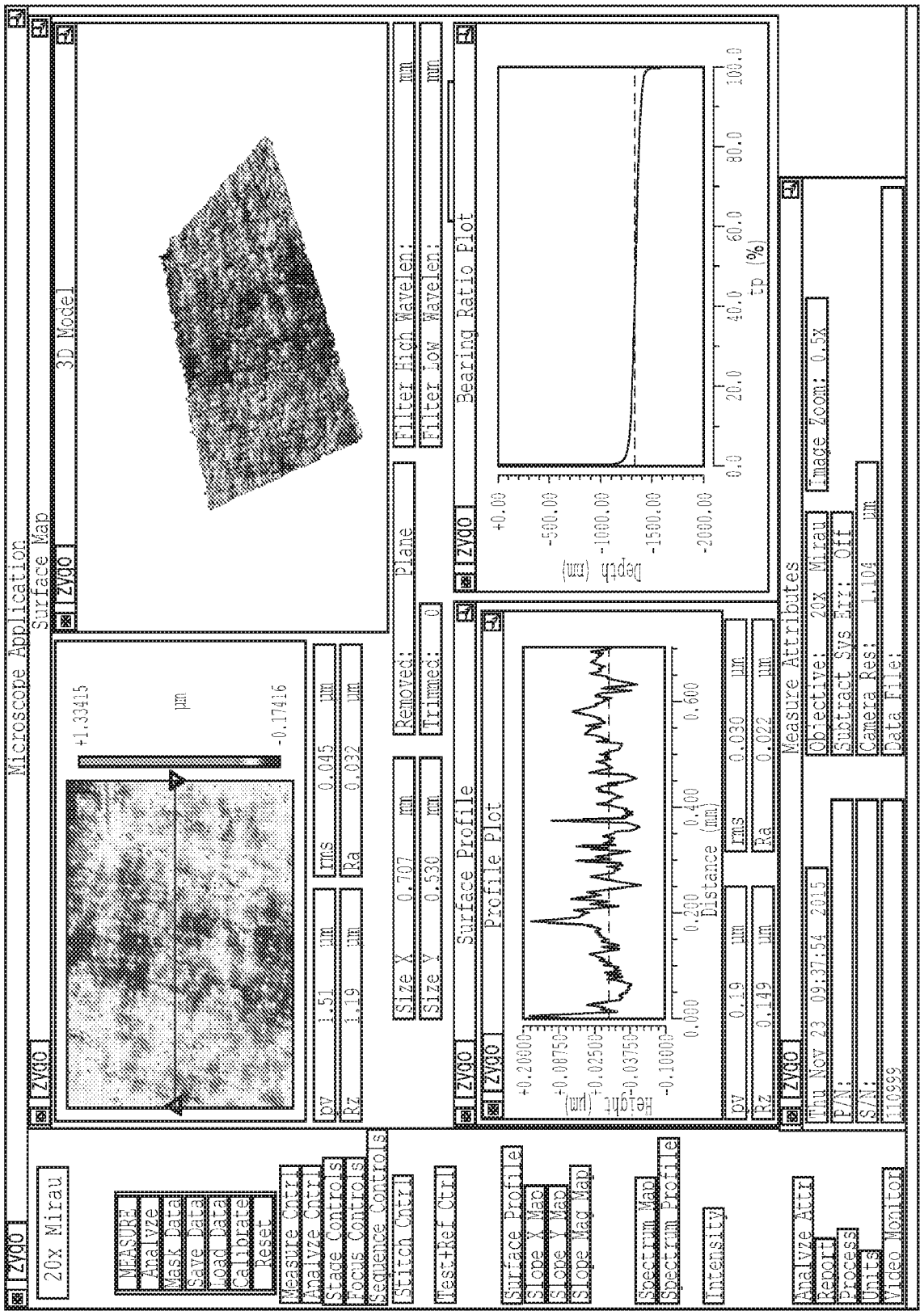

Microscope Application
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.33415
-0.17416
Size X 0.707 mm
Size Y 0.530 mm
Rms 0.045 um
Ra 0.032 um
Rz 1.19 um
Removed: Plane
Trimmed: 0
Filter High Wavelen:
Filter Low Wavelen:
Surface Profile
Profile Plot
Height
Distance (mm)
Rms 0.030 um
Ra 0.022 um
Rz 0.149 um
Bearing Ratio Plot
Depth
tp (%)
Measure Attributes
Thu Nov 23 09:37:54 2015
PA:
S/N:
L10999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 um
Data File:
Image Zoom: 0.5x

FIG. 254

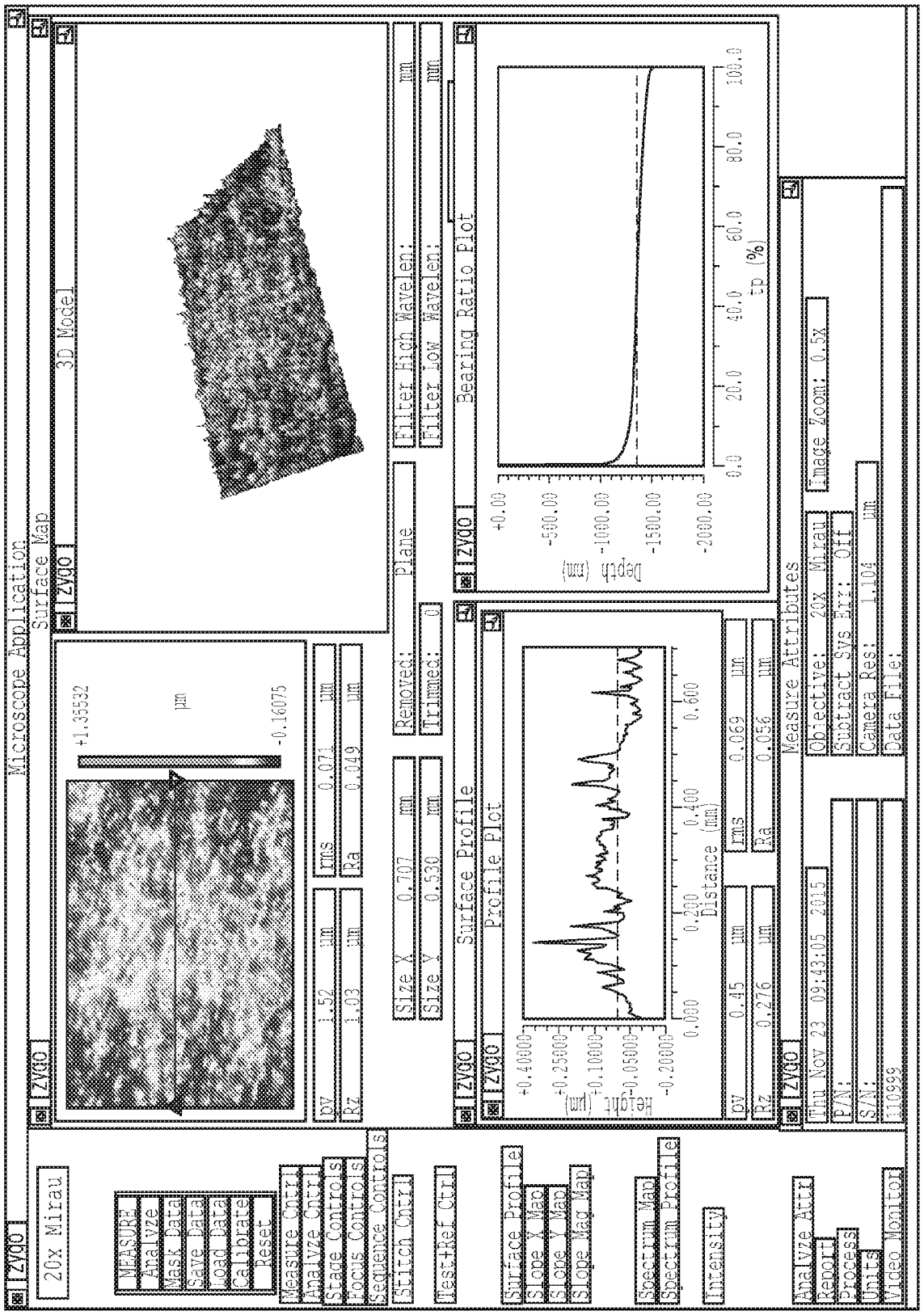

Microscope Application
Surface Map
3D Model
Bearing Ratio Plot
Surface Profile
Profile Plot
Measure Attributes
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Filter High Wavelen:
Filter Low Wavelen:
Plane
Removed:
Trimmed:
Size X 0.707 mm
Size Y 0.530 mm
pv 1.52 um
Rz 1.03 um
Rms 0.071 um
Ra 0.049 um
pv 0.45 um
Rz 0.276 um
Rms 0.069 um
Ra 0.056 um
Thu Nov 23 09:43:05 2015
PA:
S/N:
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 um
Data File:
Image Zoom: 0.5x
Depth (um)
tp (%)
Distance (mm)
Height (um)

FIG. 255

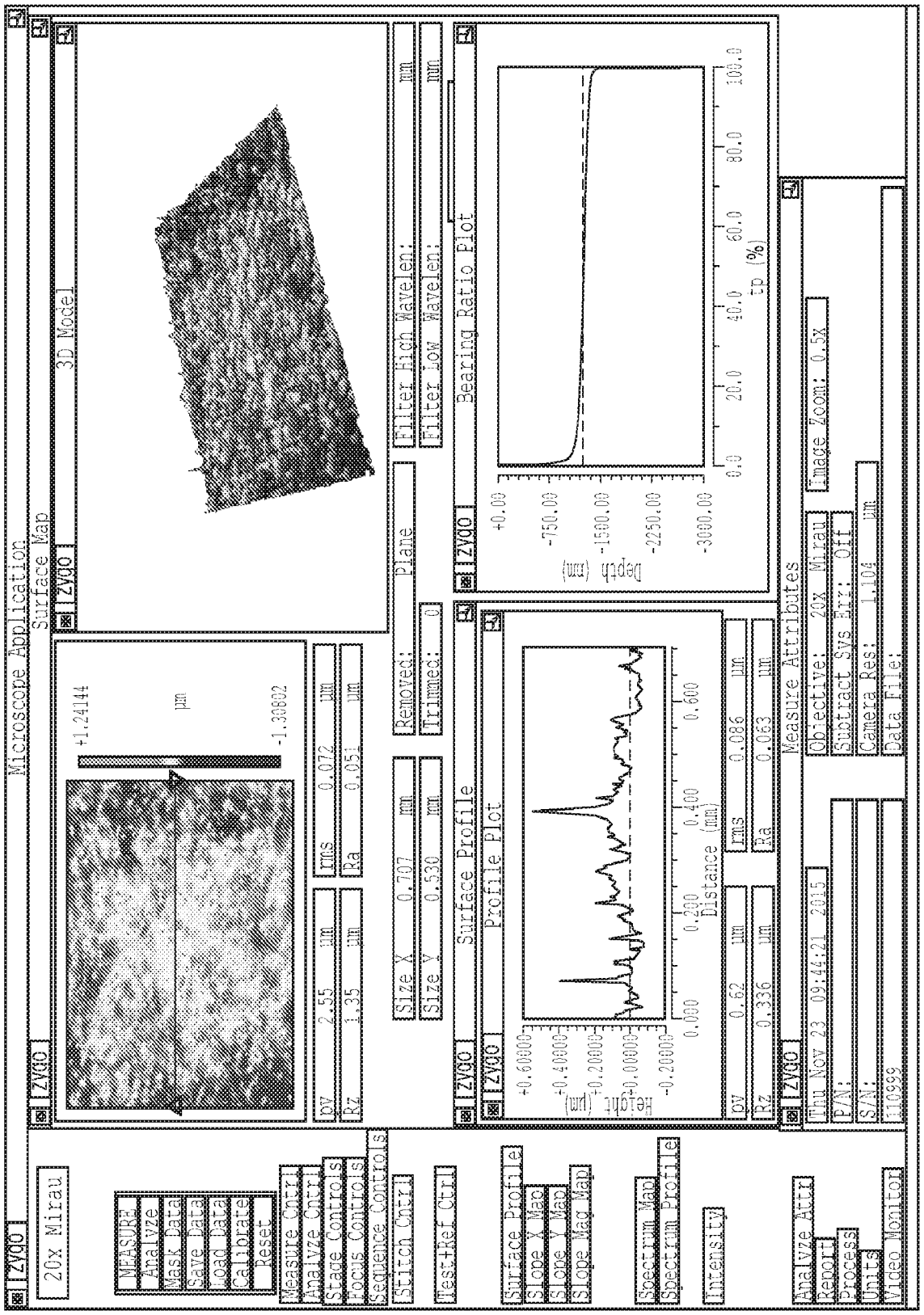

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.24144
-1.30802
μm
pv 2.55 μm
Rz 1.35 μm
Irms 0.072 μm
Ra 0.051 μm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (μm)
Distance (mm)
pv 0.62 μm
Rz 0.336 μm
Irms 0.086 μm
Ra 0.063 μm
Bearing Ratio Plot
Depth (μm)
tp (%)
Measure Attributes
Thu Nov 23 09:44:21 2015
PAN:
S/N:
L10999
Objective: 20x Mirau
Suptract Sys Err: Off
Camera Res: 1.104 μm
Data File:
Image Zoom: 0.5x

FIG. 256

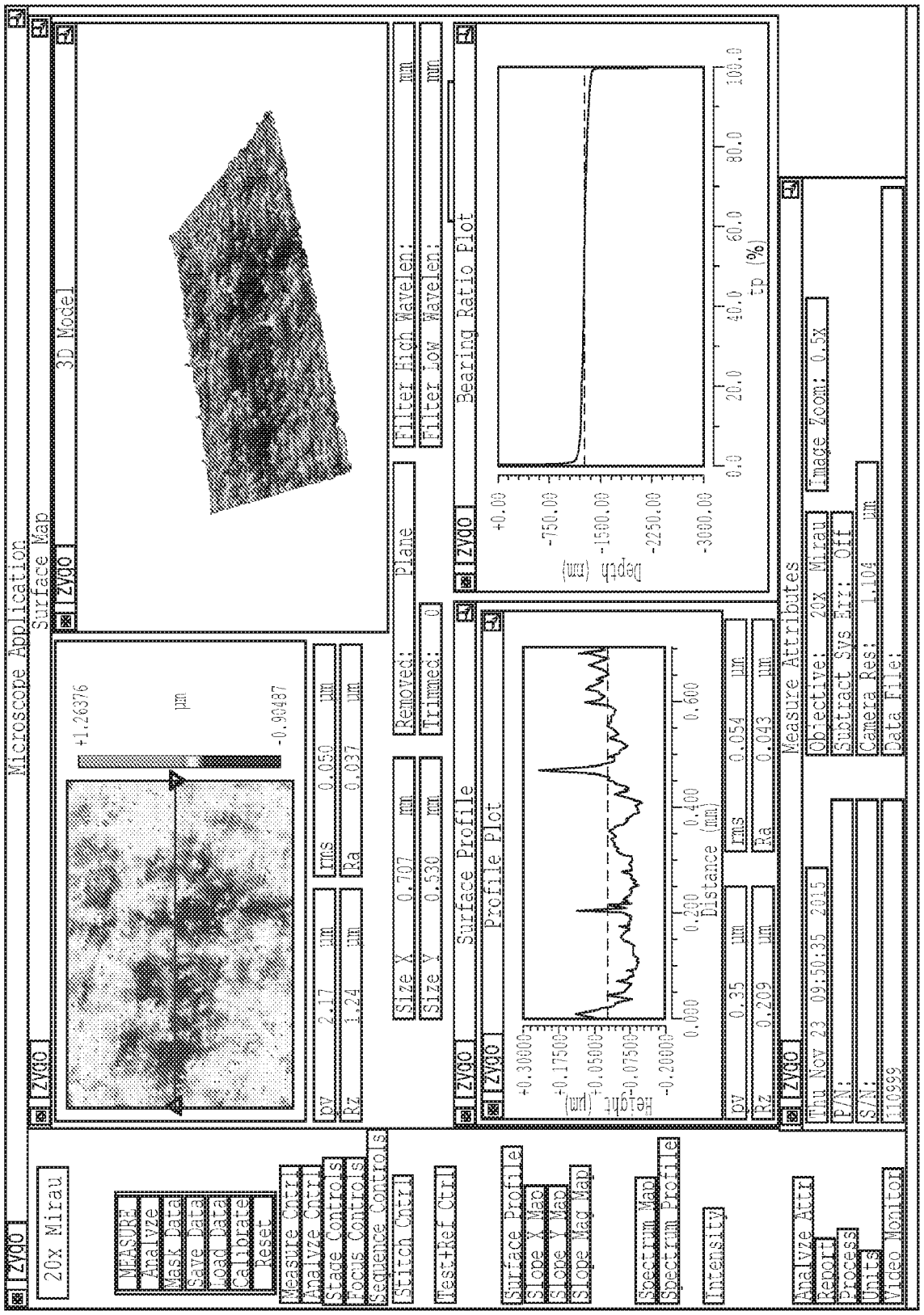

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.26376
µm
-0.90487
pv 2.17 µm
Rz 1.24 µm
Rms 0.050 µm
Ra 0.037 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
pv 0.35 µm
Rz 0.209 µm
Rms 0.054 µm
Ra 0.043 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 09:50:35 2015
PAN:
S/N:
L10999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 257

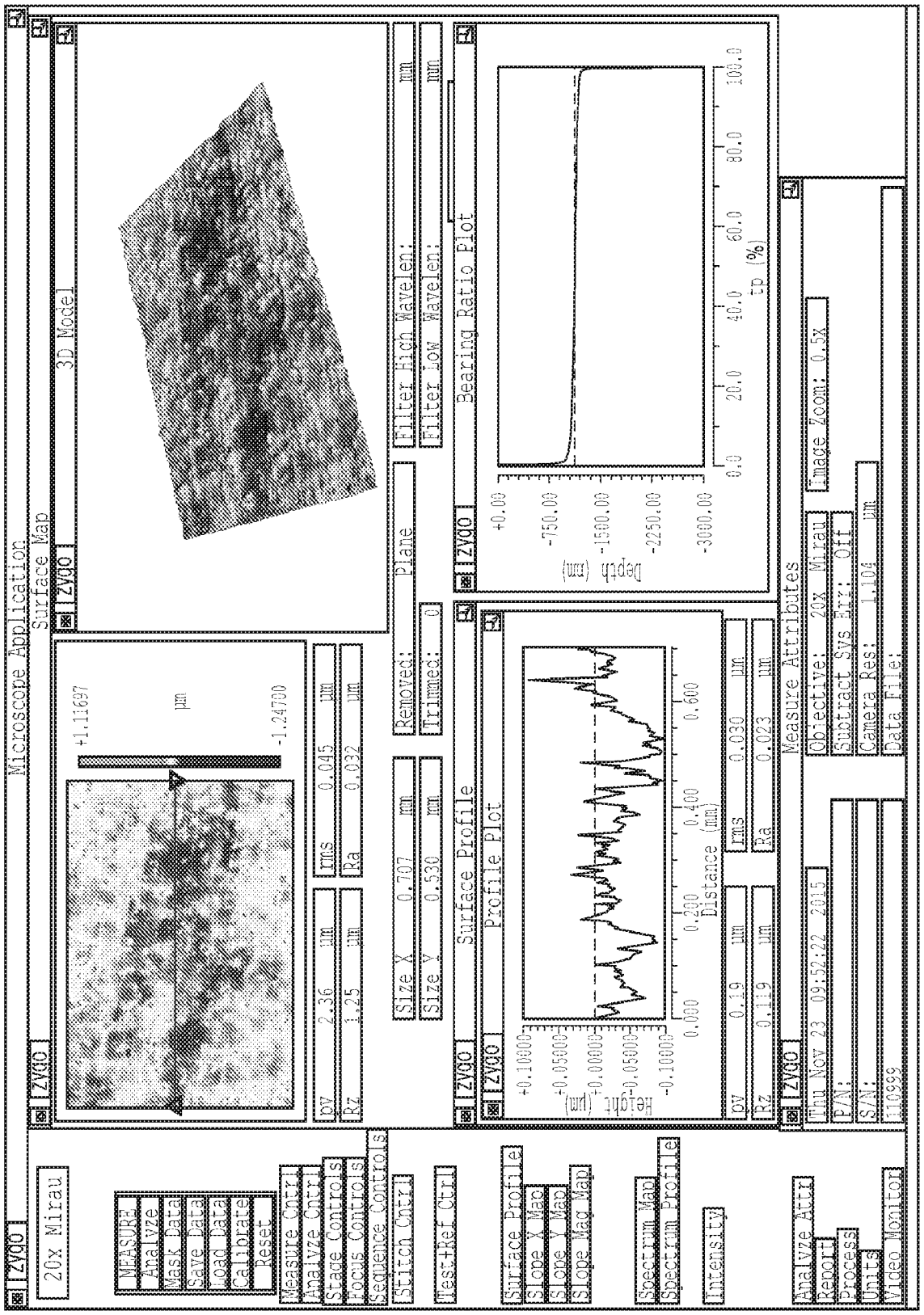

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.11697
µm
-1.24700
pv 2.36 µm
Rz 1.25 µm
Rms 0.045 µm
Ra 0.032 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
pv 0.19 µm
Rz 0.119 µm
Rms 0.030 µm
Ra 0.023 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 09:52:22 2015
PA:
S/N:
L10999
Objective: 20x Mirau
Image Zoom: 0.5x
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:

FIG. 258

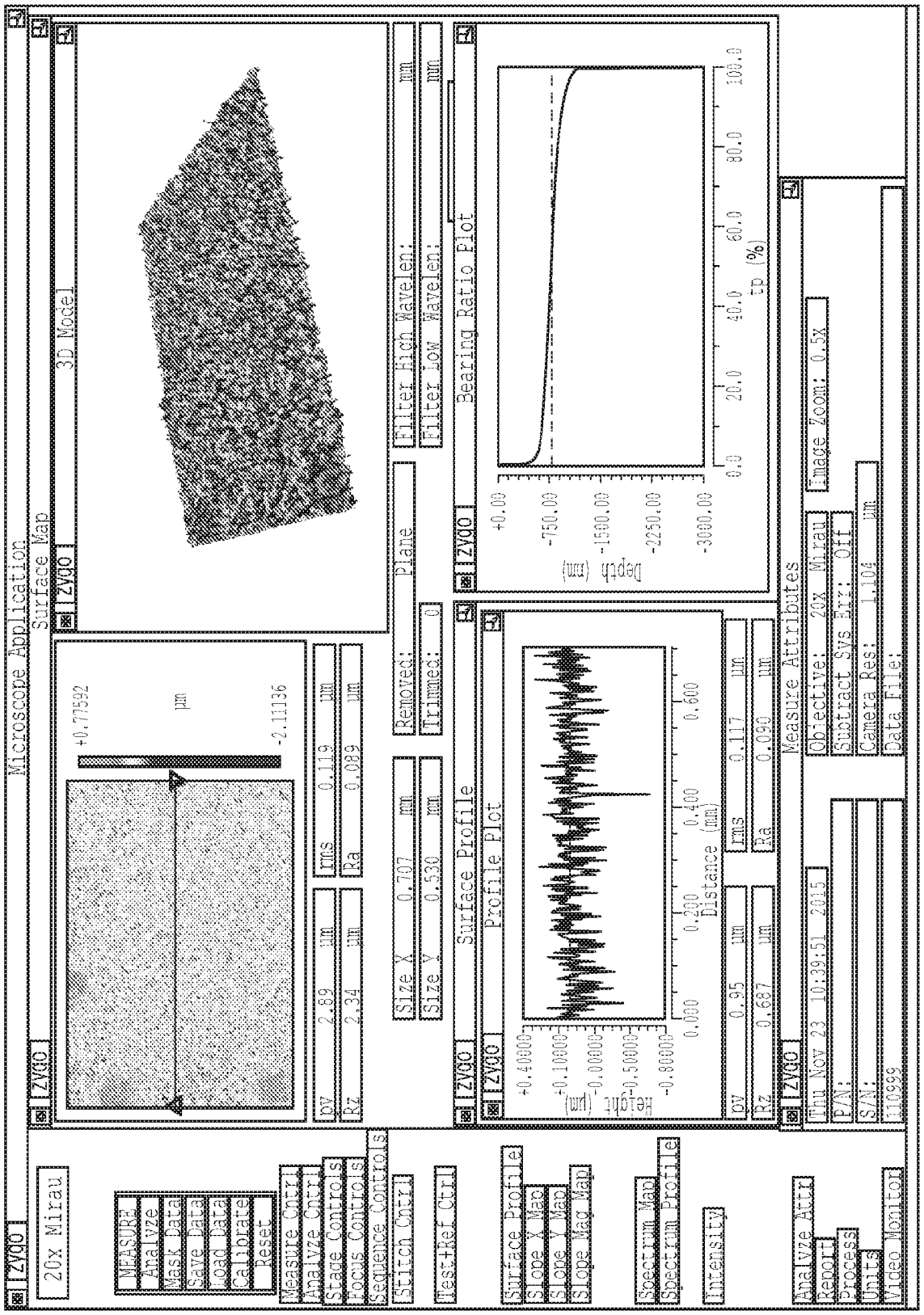

Microscope Application
Surface Map
3D Model
Filter High Wavelen:
Filter Low Wavelen:
Plane
Removed:
Trimmed:
Bearing Ratio Plot
Depth (µm)
tp (%)
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
Measure Attributes
Objective: 20x Mirau
Image Zoom: 0.5x
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Thu Nov 23 10:39:51 2015
PA:
S/N:
110999
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor

FIG. 259

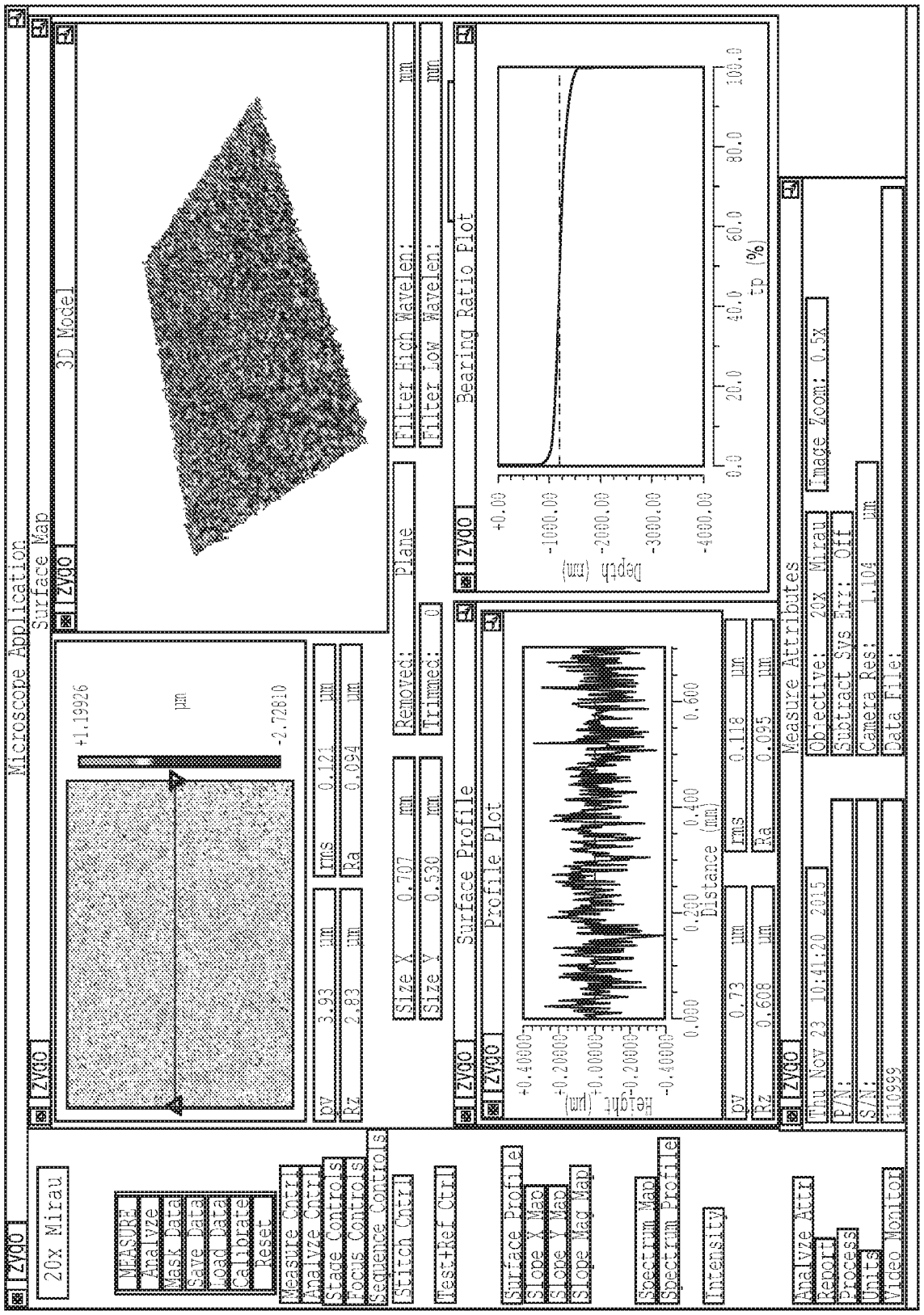

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.19926
µm
-2.72810
pv 3.93 µm
Rz 2.83 µm
Rms 0.121 µm
Ra 0.094 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (µm)
Distance (mm)
pv 0.73 µm
Rz 0.608 µm
Rms 0.118 µm
Ra 0.095 µm
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 10:41:20 2015
PA:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 260

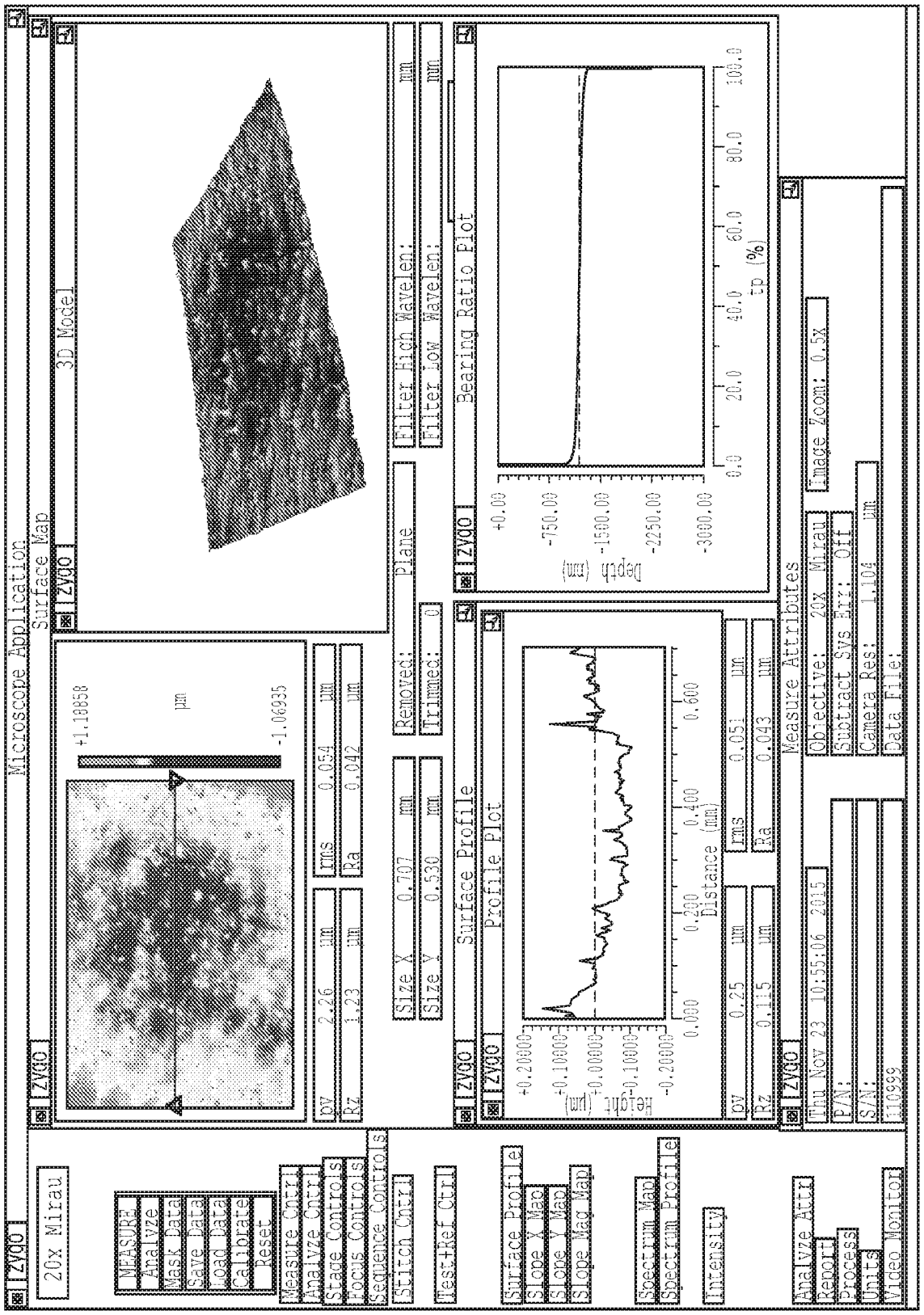

Microscope Application
Surface Map
3D Model
Bearing Ratio Plot
Surface Profile
Profile Plot
Measure Attributes
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Plane
Filter High Wavelen:
Filter Low Wavelen:
Image Zoom: 0.5X
Subtract Sys Err: Off
Camera Res: 1.104 um
Data File:
Distance (mm)
Depth (um)
tp (%)

FIG. 261

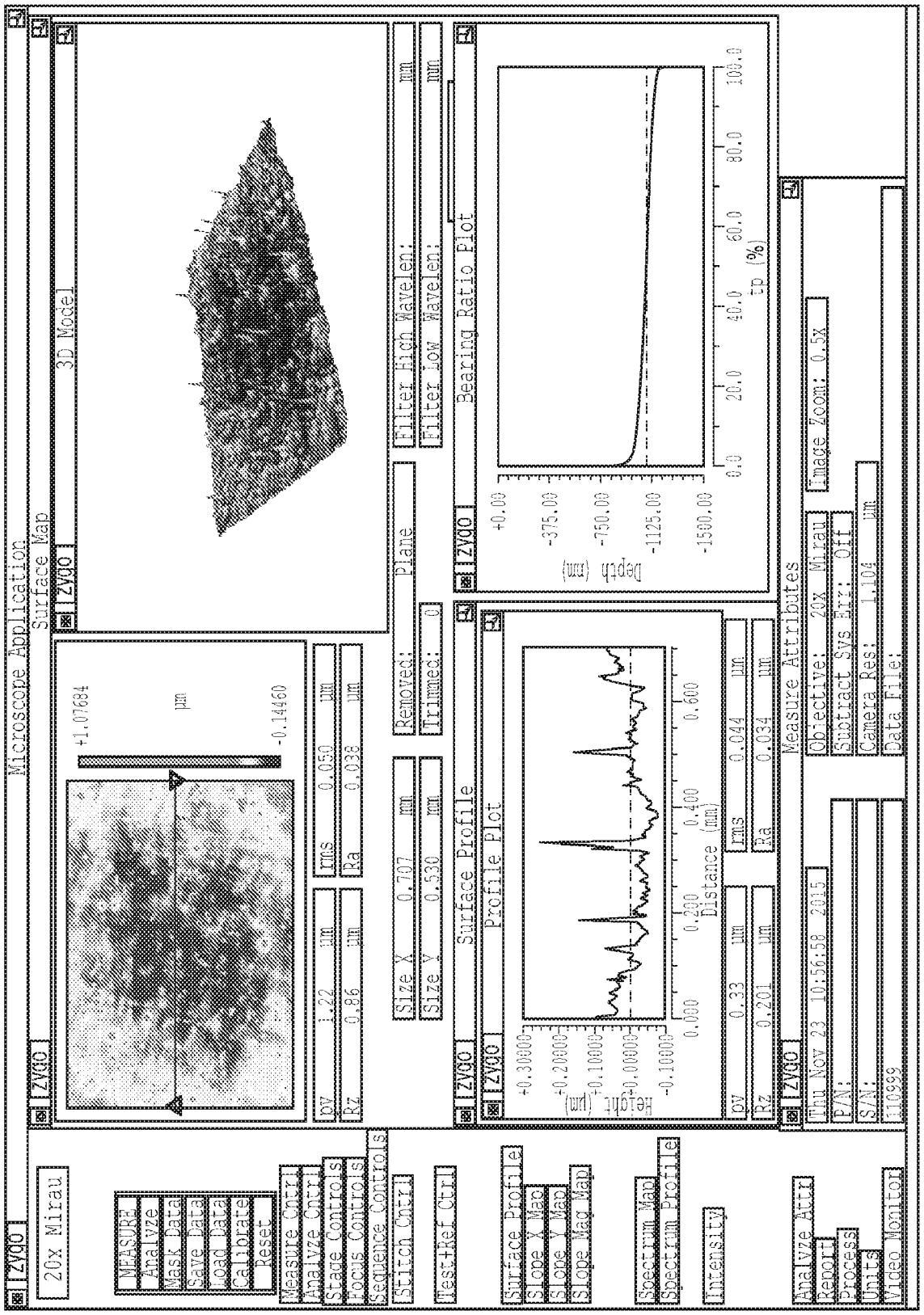

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.07684
µm
-0.14460
pv 1.22 µm
Rz 0.86 µm
Rms 0.050 µm
Ra 0.038 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height
Distance (mm)
pv 0.33 µm
Rz 0.201 µm
Rms 0.044 µm
Ra 0.034 µm
Measure Attributes
Thu Nov 23 10:56:58 2015
PAN:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x
Bearing Ratio Plot
Depth (µm)
tp (%)

FIG. 262

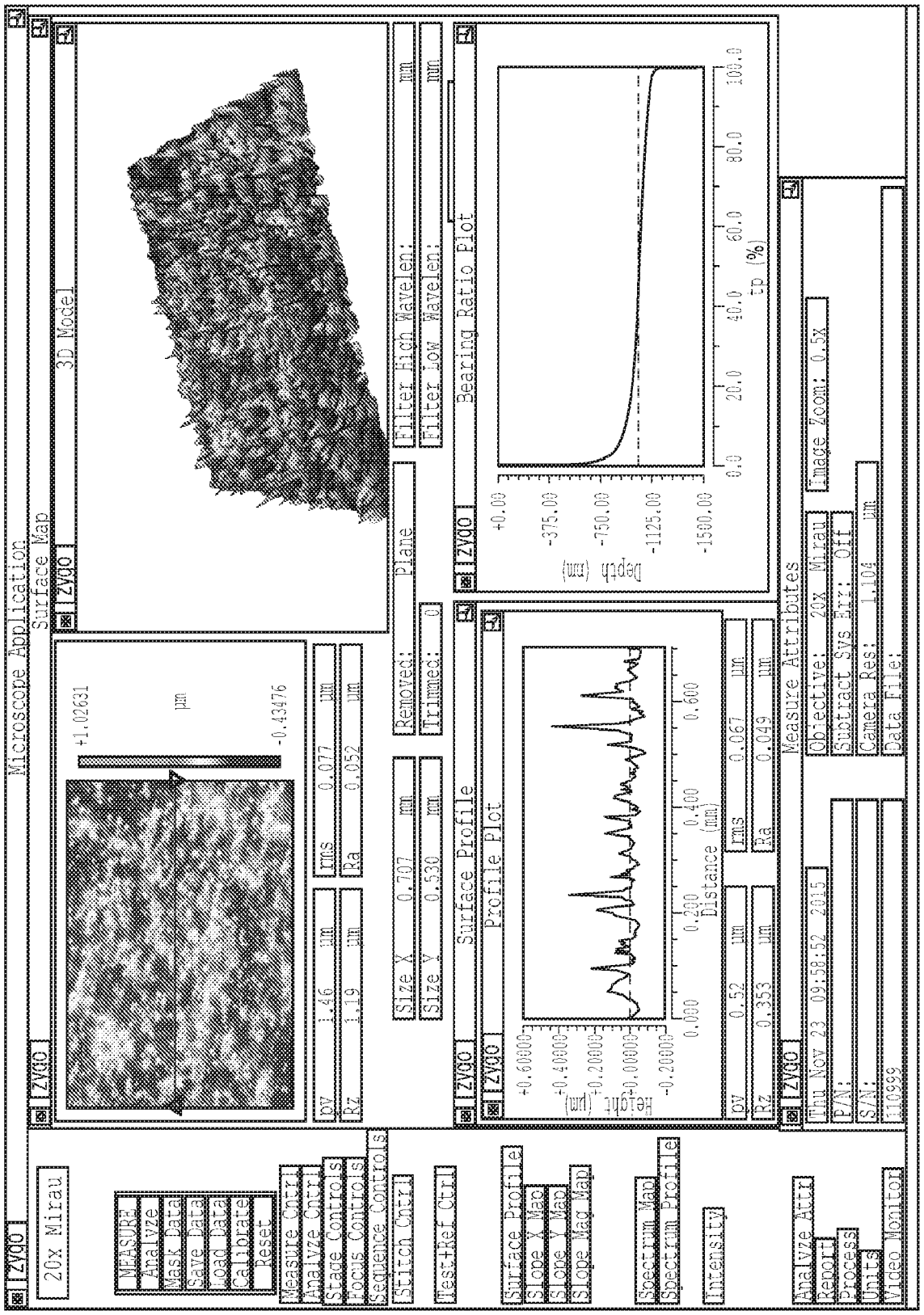

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.02631
µm
-0.43476
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Distance (mm)
Height (µm)
Bearing Ratio Plot
Depth (µm)
tp (%)
Measure Attributes
Thu Nov 23 09:58:52 2015
PN:
S/N:
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 263

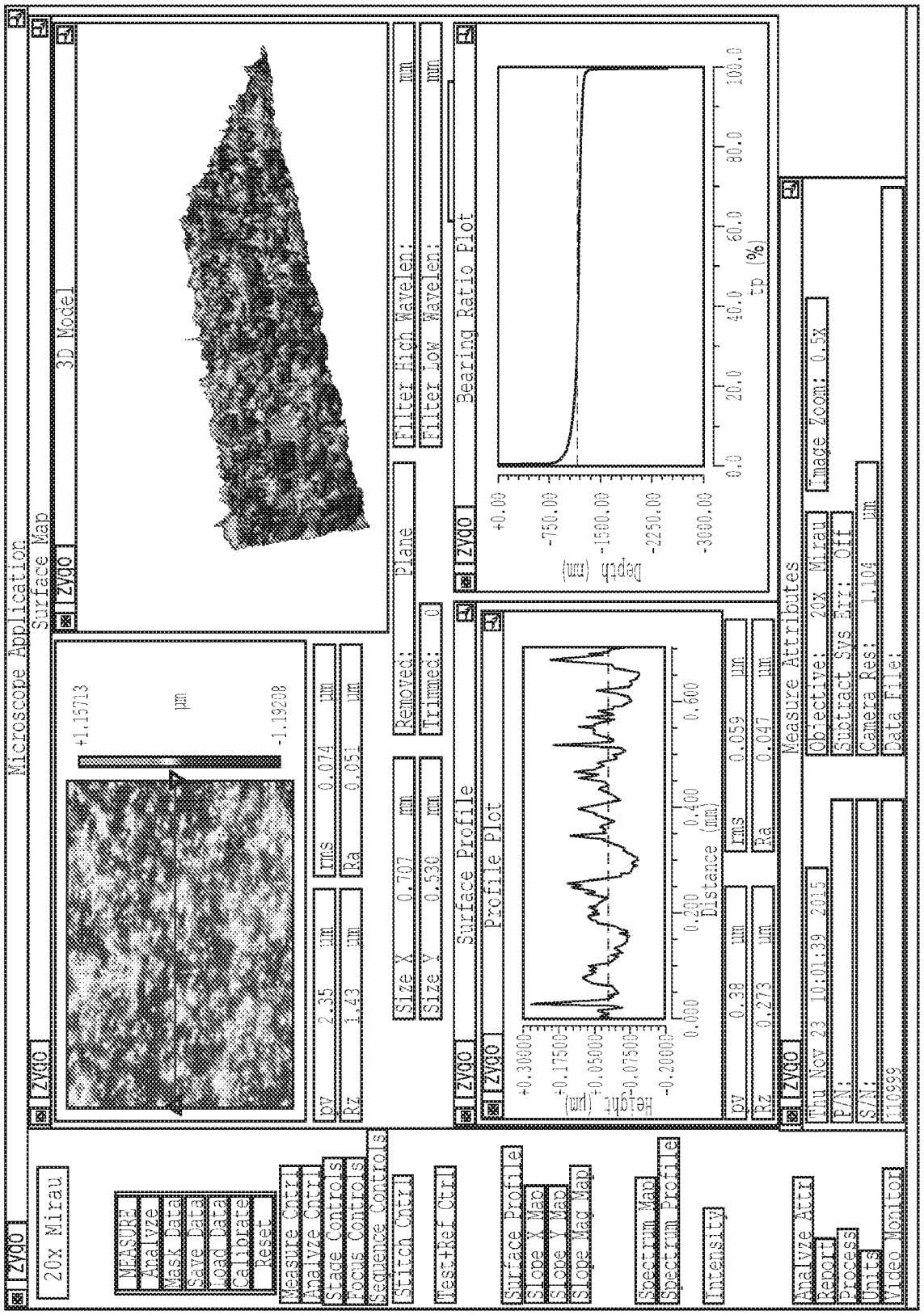

Microscope Application
ZYGO
20x Mirau
MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset
Measure Ctrl
Analyze Ctrl
Stage Controls
Focus Controls
Sequence Controls
Stitch Ctrl
Test+Ref Ctrl
Surface Profile
Slope X Map
Slope Y Map
Slope Mag Map
Spectrum Map
Spectrum Profile
Intensity
Analyze Attr
Report
Process
Units
Video Monitor
Surface Map
3D Model
+1.15713
-1.19208
µm
pv 2.35 µm
Rz 1.43 µm
Rms 0.074 µm
Ra 0.051 µm
Size X 0.707 mm
Size Y 0.530 mm
Removed: Plane
Trimmed: 0
Filter High Wavelen: mm
Filter Low Wavelen: mm
Surface Profile
Profile Plot
Height (mm)
Distance (mm)
pv 0.38 µm
Rz 0.273 µm
Rms 0.059 µm
Ra 0.047 µm
Bearing Ratio Plot
Depth (mm)
tp (%)
Measure Attributes
Thu Nov 23 10:01:39 2015
PA:
S/N:
110999
Objective: 20x Mirau
Subtract Sys Err: Off
Camera Res: 1.104 µm
Data File:
Image Zoom: 0.5x

FIG. 264

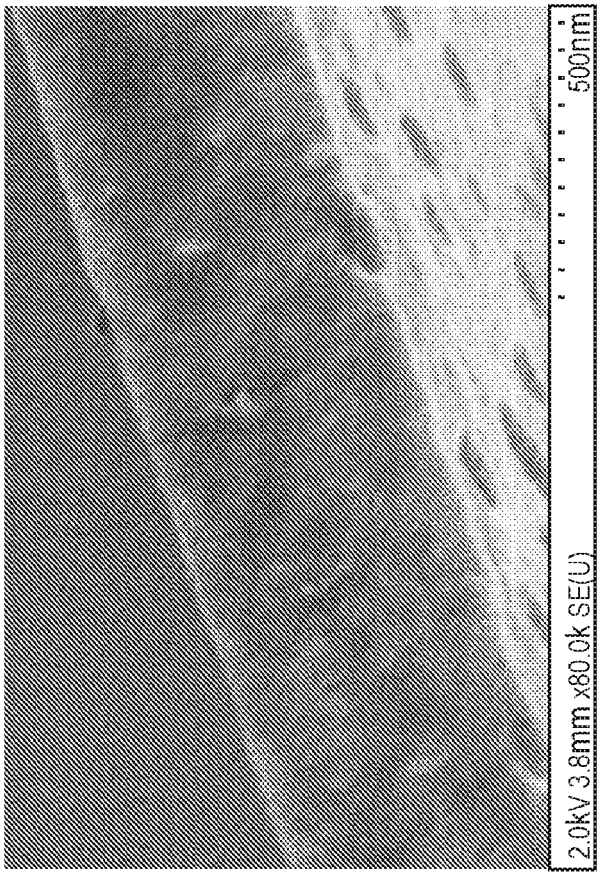


FIG. 265

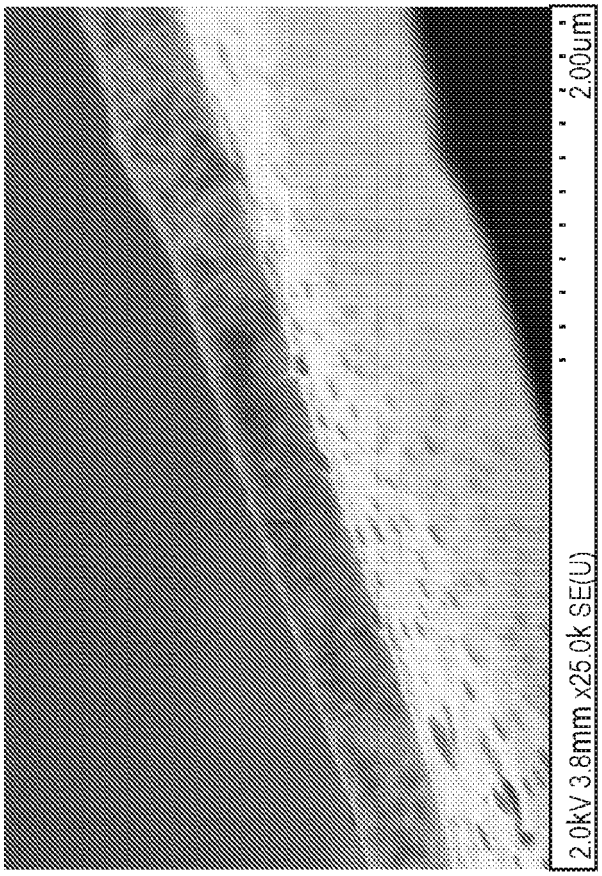


FIG. 266

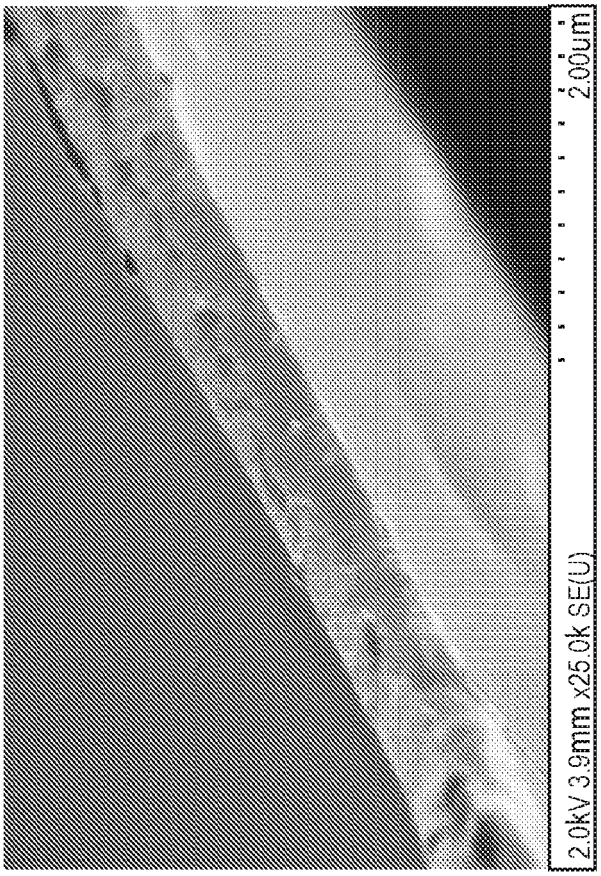


FIG. 267

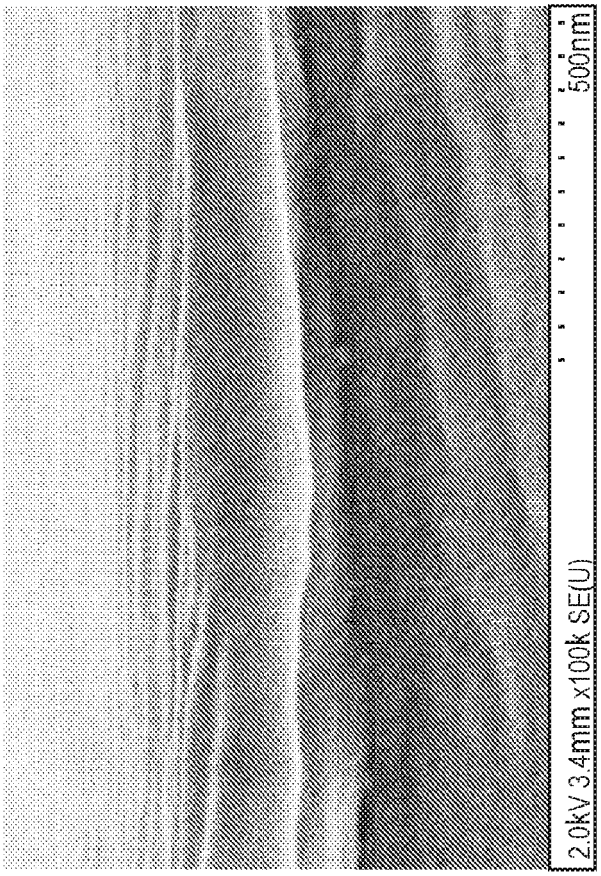


FIG. 268

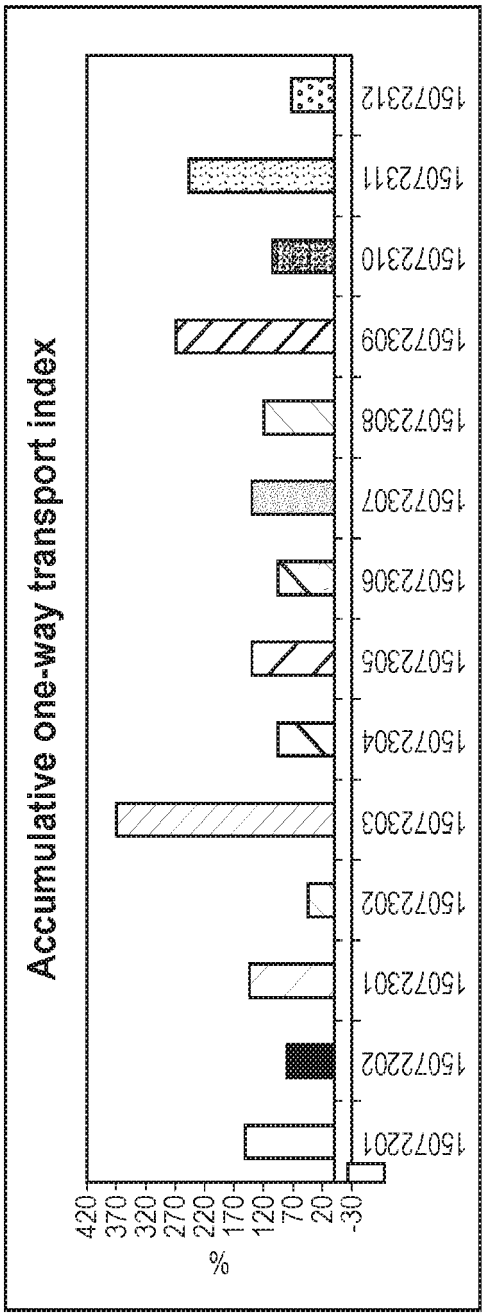

Accumulative one-way transport index
420
370
320
270
220
170
120
70
20
-30
%
15072201
15072202
15072301
15072302
15072303
15072304
15072305
15072306
15072307
15072308
15072309
15072310
15072311
15072312

FIG. 269

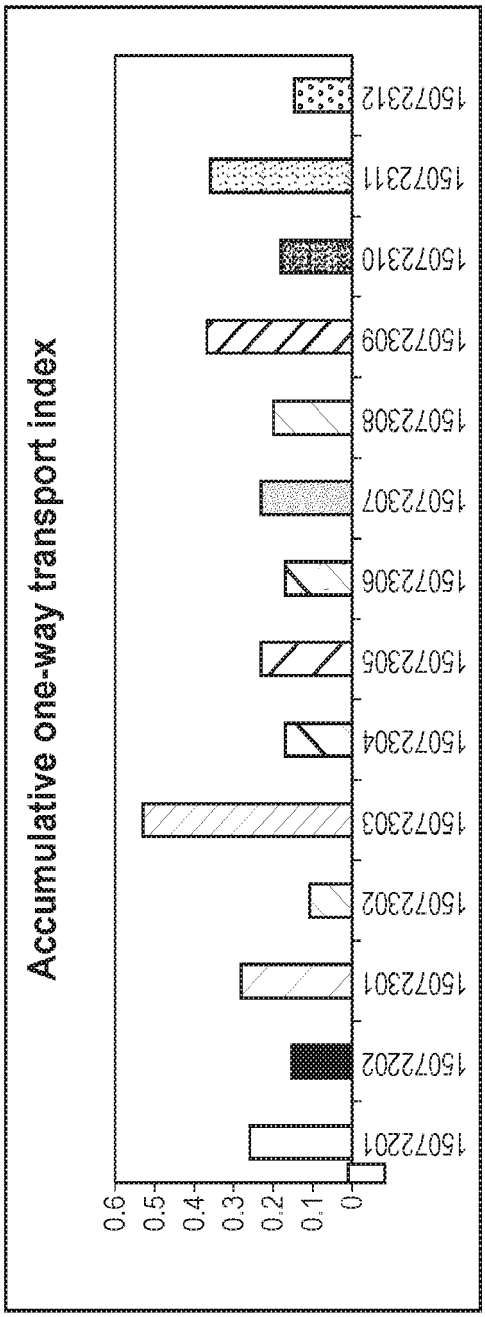

Accumulative one-way transport index
0.6
0.5
0.4
0.3
0.2
0.1
0
150722201
150722202
150723301
150723302
150723303
150723304
150723305
150723306
150723307
150723308
150723309
150723310
150723311
150723312

FIG. 270