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APPENDICES

Appendix A Average Fiber Diameter of Poly(lactic acid) fibers

Table A.1 Average aligned fiber diameter of poly(lactic acid) produced from 10% w/v dissolved in chloroform by using applied voltage 15 kV, and 15 cm collecting distance

Point	Fiber diameter (μm)		
	Sample 1	Sample 2	Sample 3
1	0.519	0.790	1.948
2	0.779	0.918	1.837
3	0.909	1.039	1.693
4	0.918	1.223	1.708
5	1.039	1.324	1.773
6	1.071	1.452	1.668
7	1.223	1.558	1.538
8	1.299	1.693	1.569
9	1.333	1.793	1.429
10	1.538	1.972	1.481
11	1.569	2.084	1.142
12	1.693	2.312	1.278
13	1.733	2.561	1.329
14	1.837	2.937	1.039
15	1.972	3.371	0.945
16	2.078	3.573	0.779
17	2.198	1.931	0.697
18	2.223	0.909	1.837
19	2.468	1.039	1.708
20	2.636	1.223	1.766
21	2.961	1.333	1.693
22	3.379	1.538	1.569
23	3.643	1.693	1.558
24	4.354	1.837	1.481
25	1.931	2.078	1.429
26	0.779	2.391	1.452

27	0.790	2.610	1.386
28	0.909	3.249	1.316
29	0.918	3.793	1.333
30	1.039	0.909	1.278
31	1.039	1.071	1.232
32	1.117	1.324	1.117
33	1.223	1.538	1.176
34	1.278	1.703	1.065
35	1.324	1.972	1.039
36	1.386	2.212	1.039
37	1.452	2.610	0.909
38	1.481	3.371	0.945
39	1.558	2.078	0.909
40	1.627	0.909	0.833
41	1.693	1.142	0.779
42	1.708	1.386	0.779
43	1.773	1.569	0.519
44	1.873	1.793	4.612
45	1.972	2.084	4.009
46	2.078	2.468	3.429
47	2.084	3.249	3.319
48	2.212	2.383	2.937
49	2.283	2.937	2.636
50	2.391	1.837	2.561
Average fiber diameter	1.706	1.935	1.590
SD	0.766	0.782	0.836

Sample	Fiber diameter (μm)
1	1.706
2	1.935
3	1.590
Average fiber diameter	1.744
SD	0.795

Table A.2 Average range of aligned fiber diameter of poly(lactic acid) produced from 10% w/v dissolved in chloroform by using applied voltage 15 kV, and 15 cm collecting distance

Range of diameter aligned PLA fibers	Frequency
0.50 - 0.99	14
1.00 - 1.49	25
1.50 - 1.99	21
2.00 - 2.49	18
2.50 - 2.99	9
3.00 - 4.49	6
3.50 - 3.99	3
4.00 - 4.49	4
Total of frequency	100

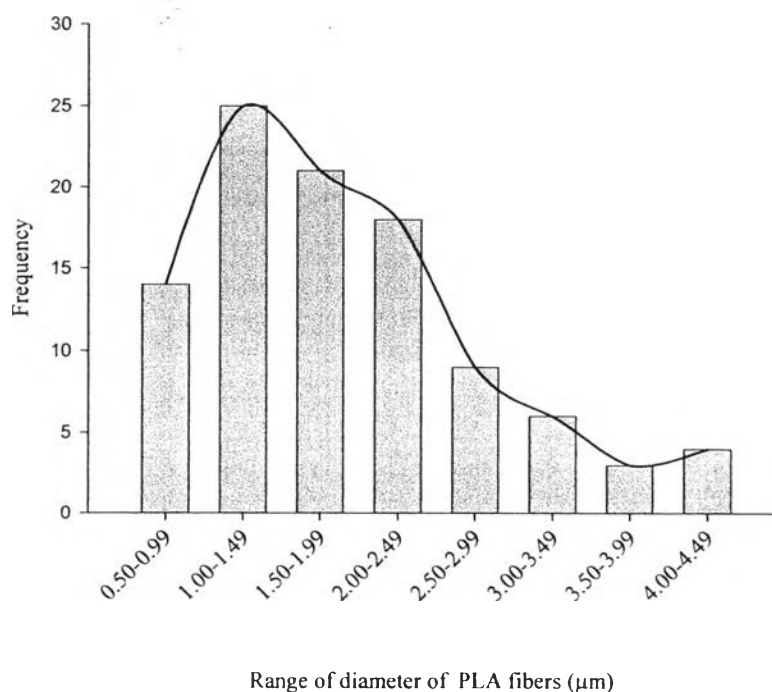


Figure A.1 Average diameter of aligned PLA fibers.

Table A.3 Degree of fiber orientation of poly(lactic acid) aligned fibers produced from 10% w/v dissolved in chloroform by using applied voltage 15 kV, and 15 cm collecting distance

Range of degree (Θ)	Frequency
71-75	2
76-80	7
81-85	14
86-90	90
91-95	3
7 - 75	2
Total of frequency	150

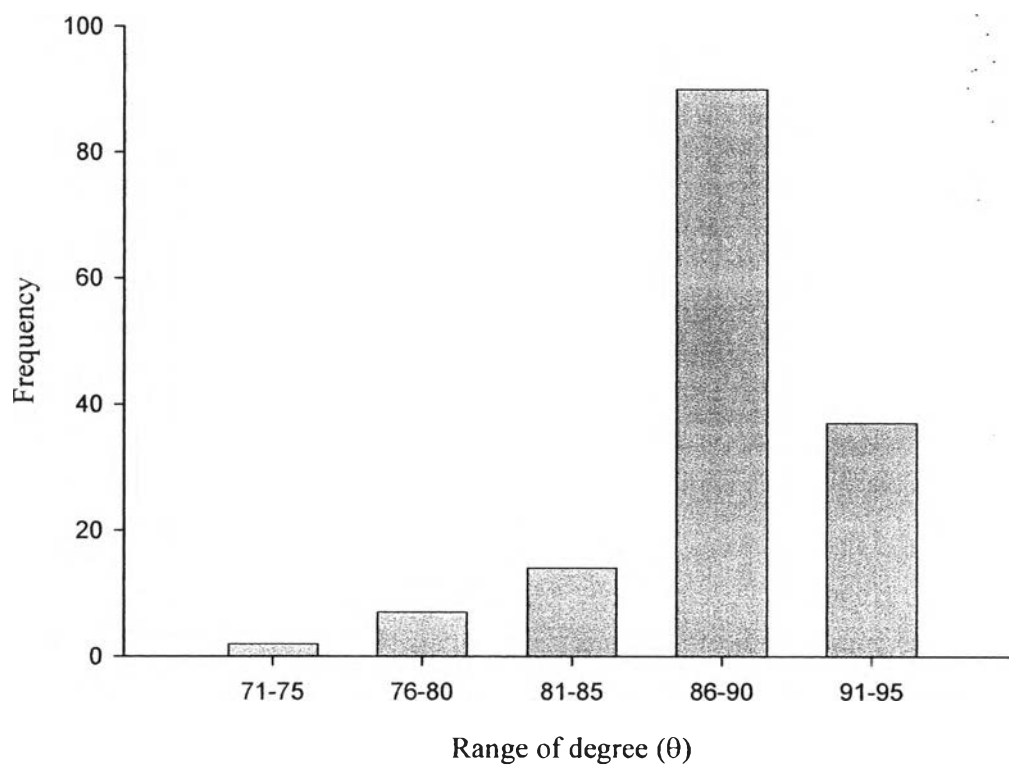


Figure A.2 For degree of fiber orientation in aligned PLA fibers.

Table A.4 Average random fiber diameter of poly(lactic acid) produced from 10% w/v dissolved in chloroform by using applied voltage 15 kV, and 15 cm collecting distance

Point	Fiber diameter (μm)		
	Sample 1	Sample 2	Sample 3
1	0.689	0.806	2.618
2	1.090	1.202	2.731
3	1.321	1.407	2.803
4	1.431	1.444	2.884
5	1.447	1.572	3.029
6	1.587	1.656	3.121
7	1.703	1.717	4.130
8	1.727	1.824	1.090
9	1.851	1.873	1.407
10	1.924	1.950	1.447
11	1.959	1.959	1.656
12	2.000	1.979	1.727
13	2.032	2.031	1.873
14	2.091	2.075	1.959
15	2.138	2.117	2.031
16	2.201	2.167	2.091
17	2.287	2.229	2.167
18	2.355	2.327	2.287
19	2.428	2.390	2.428
20	2.505	2.453	2.538
21	2.637	2.538	2.786
22	2.786	2.731	2.990
23	2.884	2.816	3.461
24	3.084	2.990	1.096
25	3.461	3.121	1.431
26	1.444	2.065	1.582
27	1.572	0.721	1.717
28	1.656	1.090	1.852
29	1.717	1.313	1.959
30	1.824	1.413	2.032
31	1.873	1.441	2.117

32	1.950	1.447	2.222
33	1.979	1.582	2.355
34	2.031	1.656	2.478
35	2.075	1.711	2.731
36	2.117	1.727	2.902
37	2.167	1.828	3.461
38	2.229	1.873	0.828
39	2.327	1.959	1.321
40	2.390	2.031	1.441
41	2.453	2.046	1.572
42	2.538	2.091	1.703
43	2.731	2.128	1.727
44	2.816	2.167	1.852
45	2.990	2.222	1.950
46	3.121	2.287	1.979
47	2.065	2.355	2.032
48	1.550	2.390	2.102
49	1.656	2.450	2.167
50	1.444	2.505	2.268
Average fiber diameter	2.087	1.957	2.163
SD	0.555	0.509	0.668

Sample	Fiber diameter (μm)
1	2.087
2	1.957
3	2.163
Average fiber diameter	2.069
SD	0.577

Appendix B Calibration Curve of Standard DBSA

Procedure:

The standard solution of DBSA in distilled water was prepared from stock solution of 5 mM. in volume metric flask 50 ml. The amounts of DBSA in standard solution were measured by a UV spectrometer at 224 nm.

Calculation of a molar absorptivity of DBSA from the calibration curve

$$A = \epsilon bc$$

When, A = Absorbance

ϵ = The molar absorptivity ($\text{L mol}^{-1} \text{cm}^{-1}$)

c = Concentration of solution (mol/L)

From the equation of calibration curve, the molar extinction coefficient of DBSA is the slope of the calibration curve.

At a wavelength of 224 nm;

$$Y = 13.09x$$

Therefore, the molar absorptivity of DBSA at a wavelength of 224 nm is $13.09 \times 10^3 \text{ L mol}^{-1} \text{cm}^{-1}$

Table B.1 Absorbance value of the standard DBSA

Concentration DBSA (mM)	Absorbance		
	I	II	III
0.008	0.0671	0.0670	0.0670
0.020	0.2642	0.2644	0.2644
0.050	0.6830	0.6833	0.6829
0.070	0.8734	0.8733	0.8731

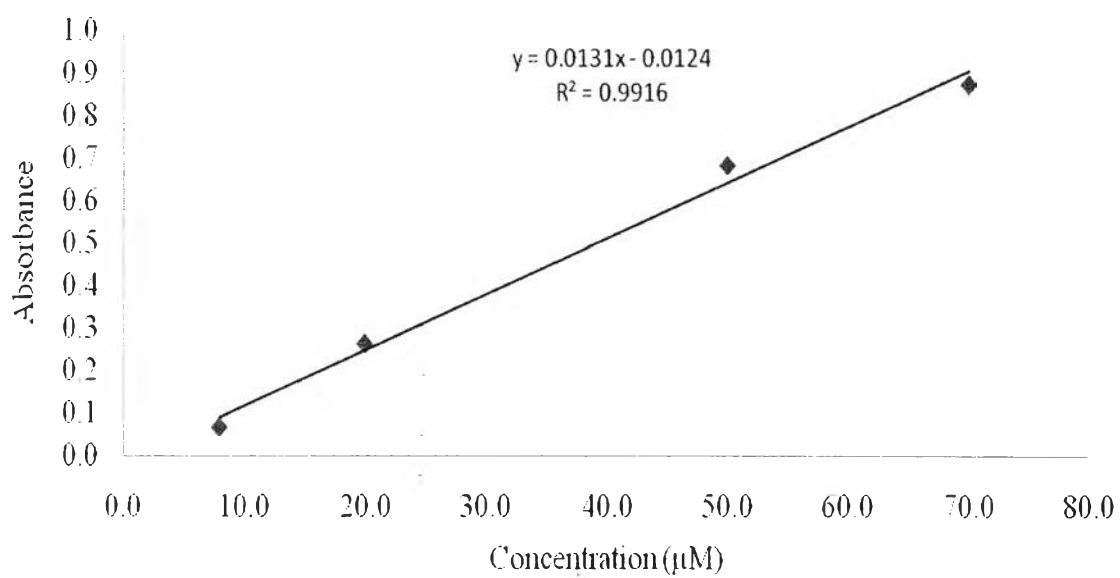


Figure B.1 Calibration curve of the standard DBSA

Appendix C Determination of Surfactant Adsorption Isotherm

Calculation of the amount of adsorbed DBSA on aligned poly (lactic acid) fibers.

$$[\text{DBSA}]_{\text{abs}} = ([\text{DBSA}]_{\text{ini}} - [\text{DBSA}]_{\text{fi}}) \times V/1000$$

Adsorption $\mu\text{mol/g}$ of PLA fibers = $\{([\text{DBSA}]_{\text{ads}} \times 25) / 1000\} / \text{weight of fibers}$.

Table C.1 The equilibrium DBSA concentration

$([\text{DBSA}]_{\text{equi}})$ (μM)	Adsorption of PLA fiber mmol/g
10	0.0073
60	0.0075
80	0.0619
80	0.0350
110	0.0366
110	0.0275
210	0.4513
420	0.4286
840	0.5206
1000	1.8340
1180	1.8420
1320	1.8440
1530	1.8260
1860	1.8370
3520	1.8460
5640	1.8350

Appendix D Average Fiber Diameter of Polypyrrole-coated Poly(lactic acid) fibers

Table D.1 Average aligned fiber diameter of Polypyrrole-coated poly(lactic acid) produced from Admicellar polymerization

Point	Varies condition DBSA : Pyrrole monomer/ Fiber diameter (μm)					
	1:2	1:4	1:6	1:8	1:10	1:12
1	1.327	1.226	0.968	0.994	2.618	2.050
2	1.327	1.226	1.032	1.844	2.881	2.174
3	1.358	1.253	1.226	1.918	3.130	2.174
4	1.532	1.361	1.233	1.988	3.147	2.838
5	1.532	1.369	1.742	2.028	3.147	3.002
6	1.635	1.409	2.584	2.053	3.273	3.106
7	1.828	1.489	2.775	2.195	3.283	3.170
8	1.891	1.915	2.935	2.360	3.321	3.292
9	2.013	2.058	2.968	2.360	3.411	3.321
10	2.091	2.225	3.037	2.360	3.480	3.390
11	2.138	2.374	3.192	2.426	3.482	3.421
12	2.142	2.971	3.226	2.612	3.501	3.436
13	2.350	2.993	3.226	3.543	3.536	3.477
14	2.403	3.097	3.226	3.673	3.782	3.541
15	2.511	3.228	3.226	3.791	4.073	3.560
16	2.519	3.249	3.484	3.791	4.341	3.605
17	2.645	3.347	3.484	3.791	4.347	3.640
18	2.645	3.421	3.505	3.839	4.405	3.851
19	2.896	3.427	3.522	4.161	4.465	3.859
20	2.904	3.463	3.820	4.169	4.467	3.977
21	3.084	3.498	3.861	4.293	4.634	4.014
22	3.182	3.548	3.872	4.293	4.660	4.033
23	3.273	3.613	3.898	4.372	4.719	4.101
24	2.227	3.642	3.990	4.400	5.032	4.224
25	3.836	3.643	4.065	4.400	5.097	4.224
26	3.964	3.711	4.115	4.534	5.159	4.300
27	4.088	3.974	4.138	4.565	5.844	4.568
28	4.214	4.026	4.234	4.602	6.038	4.802
29	4.214	4.582	4.295	4.698	6.043	4.912
30	4.216	4.646	4.403	4.917	6.101	5.165

31	4.216	4.726	4.498	5.047	6.169	5.280
32	4.216	4.839	4.508	5.056	6.231	5.309
33	4.221	4.843	4.516	5.128	6.291	5.323
34	4.270	4.882	4.626	5.235	6.305	5.349
35	4.340	4.974	4.717	5.325	6.352	5.412
36	4.340	5.032	4.818	5.347	6.415	5.546
37	4.369	5.032	4.839	5.401	6.426	5.637
38	4.369	5.032	4.900	5.466	6.529	6.224
39	4.501	5.039	4.938	5.471	6.571	6.584
40	4.591	5.258	4.961	5.545	6.605	6.584
41	5.535	5.429	5.024	5.720	7.723	6.608
42	5.535	5.484	5.032	5.731	4.806	6.708
43	5.660	5.556	5.165	5.844	3.541	6.708
44	5.820	5.691	5.181	5.850	3.882	6.963
45	5.960	5.795	5.187	5.963	4.692	7.516
46	6.101	5.922	5.194	6.087	4.377	7.525
47	6.542	6.041	5.419	6.149	4.100	7.585
48	6.605	6.525	5.493	6.278	4.728	7.644
49	6.866	6.670	5.887	6.412	5.431	7.646
50	7.108	7.309	7.245	6.523	5.836	7.732
Average fiber diameter	3.663	3.921	3.949	4.291	4.769	4.782
SD	1.626	1.566	1.286	1.448	1.272	1.752

Sample	Fiber diameter (μm)	STDV
1:2	3.663	1.626
1:4	3.921	1.566
1:6	3.949	1.286
1:8	4.291	1.448
1:10	4.769	1.272
1:12	4.782	1.752
Average fiber diameter	4.229	1.492

Table D.2 Degree of fiber orientation of Polypyrrole-coated poly(lactic acid) aligned fibers produced from Admicellar polymerization

Range of diameter aligned PPy-coated PLA fiber	Frequency
66-70	2
71-75	6
76-80	41
81-85	27
86-90	63
91-95	46
96-100	15
Total of frequency	200

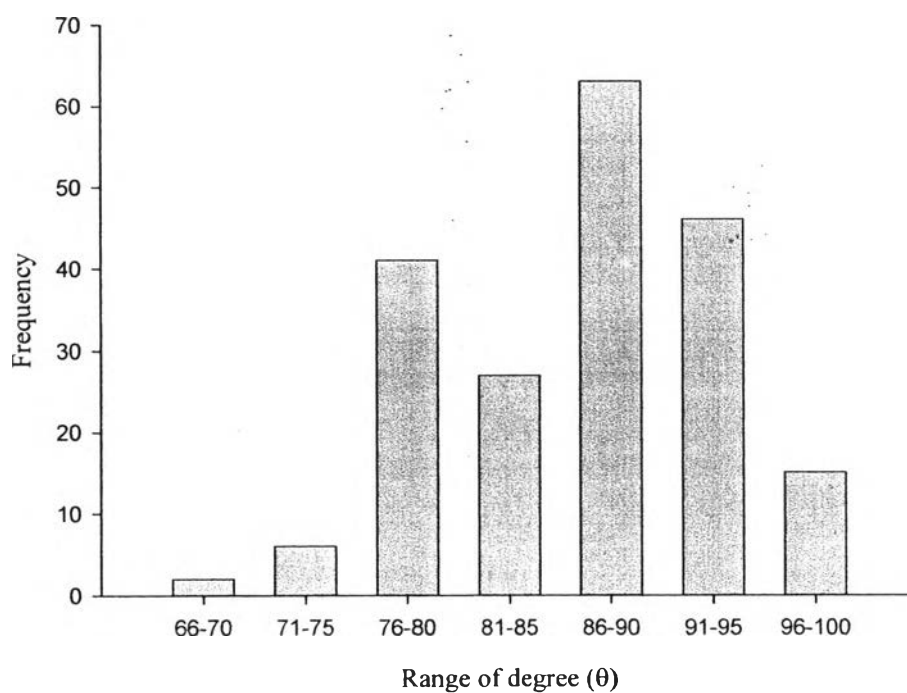


Figure D.1 For degree of fiber orientation in PPy-coated PLA aligned fibers.

Table D.3 Average random fiber diameter of Polyprrole-coated poly(lactic acid) produced from Admicellar polymerization

Point	Varies condition DBSA : Pyrrole monomer/ Fiber diameter (μm)					
	1:2	1:4	1:6	1:8	1:10	1:12
1	4.816	3.685	4.081	4.351	4.921	3.304
2	4.987	4.476	4.661	4.767	5.098	5.037
3	5.110	4.847	4.745	4.848	5.167	5.237
4	5.119	4.884	4.838	4.849	5.323	5.358
5	5.242	5.070	4.907	5.031	5.479	5.605
6	5.320	5.176	4.923	5.110	5.528	5.873
7	5.334	5.410	5.153	5.124	5.596	5.880
8	5.361	5.456	5.155	5.158	5.667	5.882
9	5.364	5.489	5.182	5.219	5.710	5.989
10	5.411	5.661	5.257	5.232	5.715	6.023
11	5.414	5.738	5.269	5.285	5.717	6.040
12	5.429	5.849	5.303	5.337	5.734	6.063
13	5.538	5.980	5.467	5.532	5.778	6.141
14	5.607	6.049	5.520	5.568	5.814	6.164
15	5.703	6.057	5.534	5.660	5.877	6.226
16	5.756	6.175	5.535	5.666	5.890	6.242
17	5.788	6.227	5.625	5.666	5.950	6.381
18	5.812	6.234	5.629	5.666	6.033	6.383
19	5.888	6.260	5.678	5.669	6.072	6.415
20	5.927	6.273	5.709	5.687	6.084	6.453
21	5.964	6.278	5.710	5.749	6.152	6.598
22	5.978	6.309	5.751	5.853	6.282	6.611
23	5.984	6.360	5.845	5.892	6.298	7.010
24	5.986	6.413	5.912	5.965	6.387	7.065
25	5.987	6.448	5.978	6.039	6.389	7.065
26	6.000	5.712	5.988	6.039	6.39	7.123
27	6.043	6.576	5.998	6.164	6.471	7.150
28	6.218	6.626	6.052	6.228	6.487	7.209
29	6.220	6.649	6.121	6.239	6.614	7.232
30	6.223	6.654	6.173	6.245	6.778	7.236
31	6.306	6.666	6.191	6.289	6.783	7.404
32	6.385	6.669	6.228	6.325	6.819	7.427
33	6.385	6.672	6.256	6.440	6.894	7.490

34	6.420	6.995	6.287	6.475	6.926	7.544
35	6.433	7.047	6.407	6.493	6.935	7.575
36	6.486	7.116	6.481	6.587	7.111	7.628
37	6.496	7.129	6.509	6.600	7.218	7.657
38	6.612	7.209	6.510	6.734	7.317	7.682
39	6.624	7.239	6.528	6.958	7.334	7.733
40	6.765	7.242	6.691	7.197	7.366	7.745
41	6.771	7.306	6.696	7.360	7.366	7.810
42	6.780	7.352	6.699	7.361	7.589	8.025
43	6.895	7.425	6.775	7.480	7.627	8.031
44	7.084	7.613	6.917	7.489	7.644	8.065
45	7.269	7.684	6.942	7.960	7.65	8.089
46	7.386	7.746	6.945	8.062	7.654	8.179
47	7.481	8.023	7.092	8.357	7.821	8.427
48	8.339	8.046	7.246	8.481	8.203	8.592
49	9.035	8.134	7.631	8.678	8.267	9.062
50	9.328	9.349	9.071	6.213	10.056	9.494
Average fiber diameter	6.216	6.474	5.996	6.188	6.559	6.933
SD	0.936	1.039	0.869	1.022	0.986	1.127

Sample	Fiber diameter (μm)	STDV
1:2	6.216	0.936
1:4	6.474	1.039
1:6	5.996	0.869
1:8	6.188	1.022
1:10	6.559	0.986
1:12	6.933	1.127
Average fiber diameter	6.389	0.997

Appendix E Average The Geometric Correction Factor (K)

Procedure:

The geometric correction factor was calculated by equation as follow

$$K = \frac{\rho}{R \times t} = \frac{I \times \rho}{V \times t}$$

When, K is the geometric correction factor,

ρ/t is density of silicon wafer (107.373 Ω /Square)

I/V is the slope was measured by varies current (A).

Therefore, the geometric correction factor K is 1.074×10^{-7}

Table E.1 Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)					Average
	1	2	3	4	5	
25	4.15E-09	4.15E-09	4.17E-09	4.22E-09	4.26E-09	4.19E-09
50	4.78E-09	4.67E-09	4.71E-09	4.62E-09	4.74E-09	4.70E-09
75	6.34E-09	6.65E-09	6.13E-09	5.96E-09	5.04E-09	6.02E-09
100	7.72E-09	8.13E-09	7.73E-09	6.06E-09	8.29E-09	7.59E-09
125	8.52E-09	8.10E-09	7.05E-09	8.01E-09	7.64E-09	7.86E-09
150	8.46E-09	9.31E-09	8.70E-09	9.48E-09	1.13E-08	9.45E-09
175	1.13E-08	1.10E-08	1.03E-08	1.05E-08	1.03E-08	1.07E-08
200	1.05E-08	1.06E-08	1.12E-08	1.06E-08	1.13E-08	1.08E-08
225	1.52E-08	1.51E-08	1.52E-08	1.53E-08	1.56E-08	1.53E-08
250	1.60E-08	1.59E-08	1.61E-08	1.52E-08	1.38E-08	1.54E-08
275	1.84E-08	1.77E-08	1.71E-08	1.71E-08	1.76E-08	1.76E-08
300	1.96E-08	1.88E-08	1.86E-08	1.85E-08	1.88E-08	1.89E-08
325	2.13E-08	2.18E-08	2.06E-08	2.12E-08	2.05E-08	2.11E-08
350	2.31E-08	2.29E-08	2.32E-08	2.11E-08	2.15E-08	2.24E-08
375	2.32E-08	2.22E-08	2.24E-08	2.24E-08	2.21E-08	2.25E-08
400	2.48E-08	2.36E-08	2.31E-08	2.29E-08	2.22E-08	2.33E-08
425	2.32E-08	2.22E-08	2.24E-08	2.24E-08	2.21E-08	2.67E-08
450	2.78E-08	2.62E-08	2.60E-08	2.73E-08	2.75E-08	2.70E-08
475	2.97E-08	2.99E-08	2.84E-08	2.81E-08	2.98E-08	2.92E-08
500	3.19E-08	2.98E-08	2.91E-08	2.97E-08	2.99E-08	3.01E-08

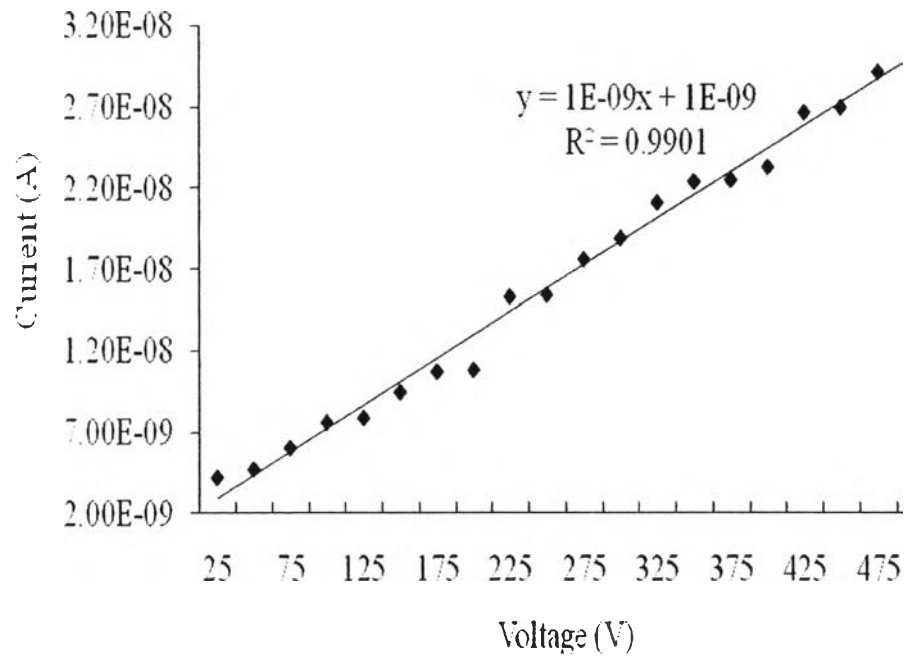


Figure E.1 Calibration curve of the silicon wafer.

Appendix F Average of Surface Conductivity

Procedure:

The surface conductivity of the PPy-coated PLA fiber meshes were measured at vacuum chamber. The applied voltage and the current change in the linear Ohmic regime were converted to the electrical conductivity of PPy-coated PLA fiber meshes using equation as follow

$$\sigma = \frac{1}{\rho} = \frac{1}{R_s \times t} = \frac{I}{K \times V \times t}$$

When, σ is surface conductivity (S/cm)

K is the geometric correction factor (1.074×10^{-7})

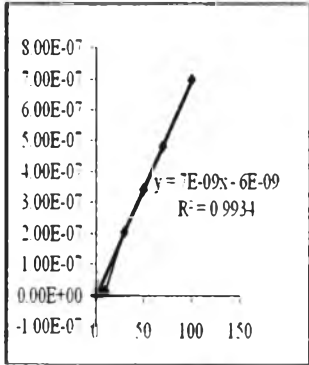
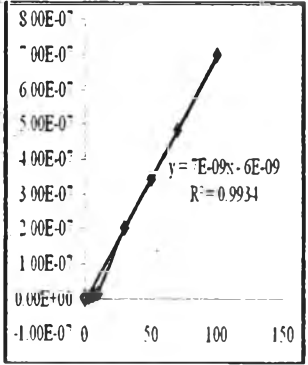
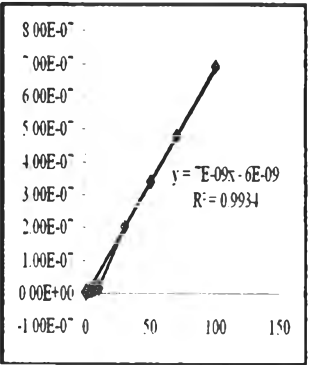
I/V is the slope was measured by varies current (A)

R_s is sheet resistivity (Ω)

t is fiber thickness (cm)

Table F.1 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:4 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.081 cm.	Thickness 0.072 cm.	Thickness 0.066 cm.
0.001	3.60E-09	3.61E-09	3.62E-09
0.003	3.63E-09	3.61E-09	3.60E-09
0.005	3.60E-09	3.62E-09	3.66E-09
0.01	3.69E-09	3.68E-09	3.68E-09
0.03	3.69E-09	3.73E-09	3.78E-09
0.05	3.70E-09	3.75E-09	3.77E-09
0.07	3.70E-09	4.05E-09	4.67E-09
0.1	3.77E-09	3.77E-09	3.78E-09
0.3	4.04E-09	4.05E-09	4.03E-09
0.5	4.26E-09	4.24E-09	4.27E-09
0.7	4.48E-09	4.41E-09	4.80E-09
1	4.85E-09	4.81E-09	4.80E-09

3	5.39E-09	6.44E-09	6.97E-09
5	9.25E-09	9.26E-09	9.44E-09
7	1.22E-08	1.20E-08	1.19E-08
10	1.52E-08	1.50E-08	1.49E-08
30	2.03E-07	2.03E-07	2.03E-07
50	3.43E-07	3.41E-07	3.40E-07
70	4.84E-07	4.81E-07	4.81E-07
100	6.99E-07	6.96E-07	6.93E-07
			
σ (S/cm)	0.805	0.905	0.988

Sample	Conductivity (S/cm)
1	0.805
2	0.905
3	0.988
Average conductivity	0.899
SD	0.092

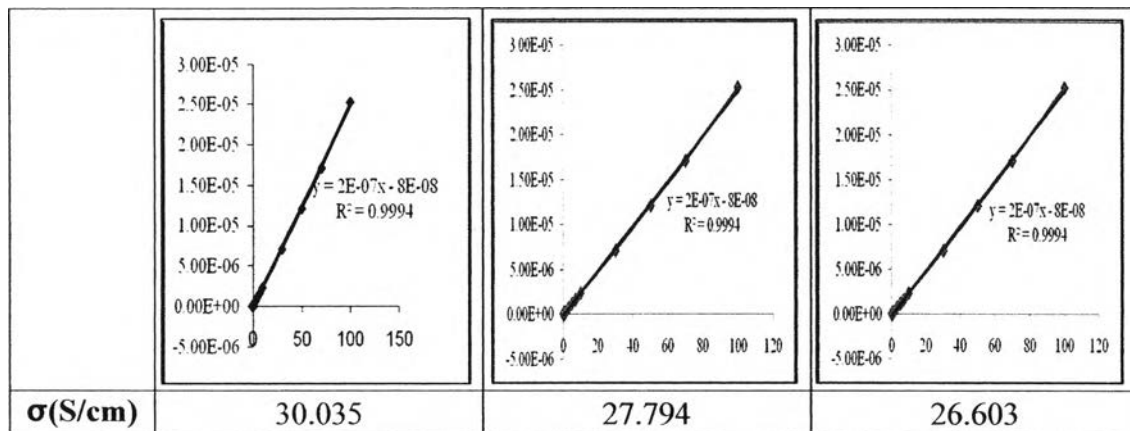
Table F.2 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:6 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.070 cm.	Thickness 0.060 cm.	Thickness 0.061 cm.
0.001	3.66E-09	3.76E-09	3.71E-09
0.003	3.63E-09	3.73E-09	3.68E-09
0.005	3.66E-09	3.69E-09	3.68E-09
0.01	3.70E-09	3.72E-09	3.71E-09
0.03	3.71E-09	3.73E-09	3.72E-09
0.05	3.72E-09	3.80E-09	3.76E-09
0.07	3.72E-09	3.76E-09	3.74E-09
0.1	3.73E-09	3.79E-09	3.76E-09
0.3	3.76E-09	3.84E-09	3.80E-09
0.5	3.81E-09	3.93E-09	3.87E-09
0.7	3.88E-09	4.07E-09	3.98E-09
1	3.95E-09	4.13E-09	4.04E-09
3	4.39E-09	4.98E-08	2.71E-08
5	4.79E-08	5.74E-08	5.27E-08
7	5.23E-08	6.60E-08	5.92E-08
10	5.98E-08	7.71E-08	6.85E-08
30	1.10E-07	1.72E-07	1.41E-07
50	1.60E-07	2.60E-07	2.10E-07
70	2.27E-07	3.58E-07	2.93E-07
100	3.48E-07	3.48E-07	3.47E-07
σ (S/cm)	0.665	0.776	0.611

Sample	Conductivity (S/cm)
1	0.665
2	0.776
3	0.611
Average conductivity	0.684
SD	0.084

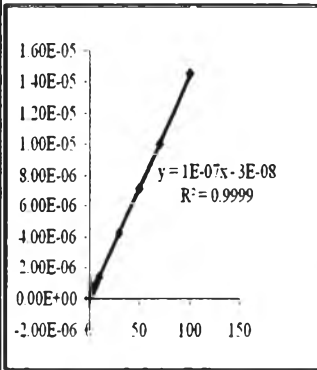
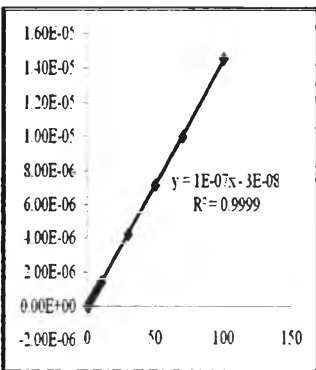
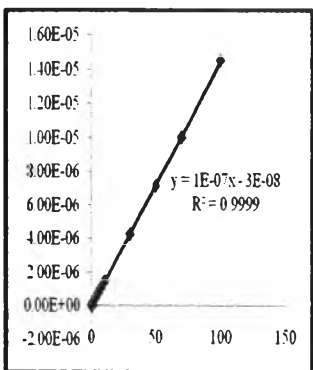
Table F.3 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:8 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.062 cm.	Thickness 0.067 cm.	Thickness 0.070 cm.
0.001	3.63E-09	3.64E-09	3.62E-09
0.003	3.64E-09	3.66E-09	3.65E-09
0.005	3.68E-09	3.69E-09	3.69E-09
0.01	3.76E-09	3.81E-09	3.75E-09
0.03	4.04E-09	4.07E-09	4.03E-09
0.05	4.37E-09	4.41E-09	4.36E-09
0.07	4.80E-09	4.77E-09	4.80E-09
0.1	5.29E-09	5.28E-09	5.30E-09
0.3	8.85E-09	8.84E-09	8.86E-09
0.5	1.27E-08	1.27E-08	1.28E-08
0.7	1.69E-08	1.69E-08	1.69E-08
1	2.30E-07	2.30E-07	2.30E-07
3	6.93E-07	6.94E-07	6.92E-07
5	1.16E-06	1.16E-06	1.16E-06
7	1.60E-06	1.60E-06	1.60E-06
10	2.33E-06	2.33E-06	2.33E-06
30	7.08E-06	7.08E-06	7.08E-06
50	1.21E-05	1.21E-05	1.21E-05
70	1.71E-05	1.71E-05	1.71E-05
100	2.53E-05	2.53E-05	2.53E-05



Sample	Conductivity (S/cm)
1	30.035
2	27.794
3	26.603
Average conductivity	28.144
SD	1.743

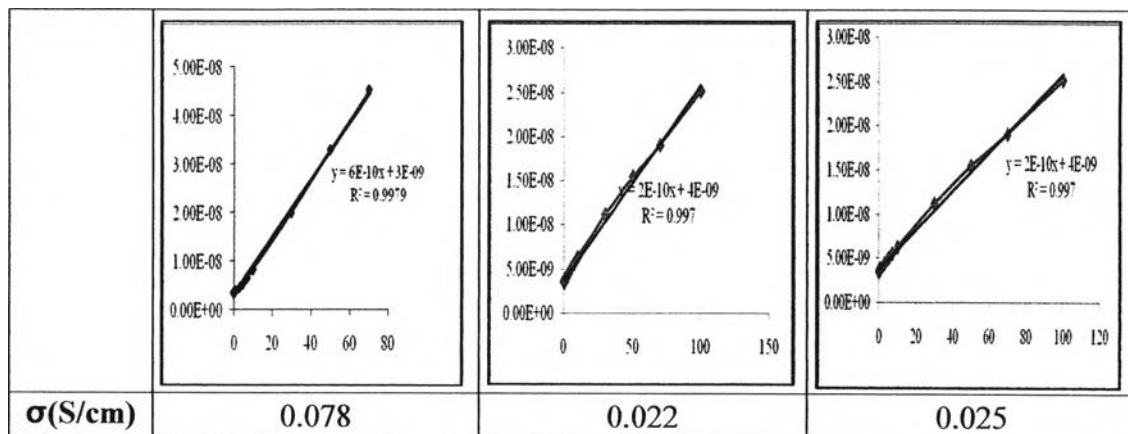
Table F.4 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:10 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.048 cm.	Thickness 0.068 cm.	Thickness 0.063 cm.
0.001	3.94E-09	3.78E-09	3.66E-09
0.003	3.66E-09	3.69E-09	3.65E-09
0.005	3.71E-09	3.72E-09	3.68E-09
0.01	3.82E-09	3.79E-09	3.88E-09
0.03	4.19E-09	4.75E-09	3.97E-09
0.05	4.27E-09	4.25E-09	4.25E-09
0.07	4.63E-09	4.63E-09	4.63E-09
0.1	5.00E-09	4.99E-09	4.99E-09
0.3	7.79E-09	7.81E-09	7.81E-09
0.5	1.07E-08	1.07E-08	1.07E-08
0.7	1.38E-08	1.39E-08	1.39E-08
1	1.58E-08	1.81E-08	1.81E-08
3	4.18E-07	4.19E-07	4.19E-07
5	6.97E-07	6.97E-07	6.97E-07
7	9.77E-07	9.77E-07	9.77E-07
10	1.40E-06	1.40E-06	1.40E-06
30	4.23E-06	4.23E-06	4.23E-06
50	7.13E-06	7.13E-06	7.13E-06
70	1.00E-05	1.00E-05	1.00E-05
100	1.45E-05	1.45E-05	1.45E-05
			
σ (S/cm)	19.398	13.693	14.779

Sample	Conductivity (S/cm)
1	19.398
2	13.693
3	14.779
Average conductivity	19.957
SD	3.029

Table F.5 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:12 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

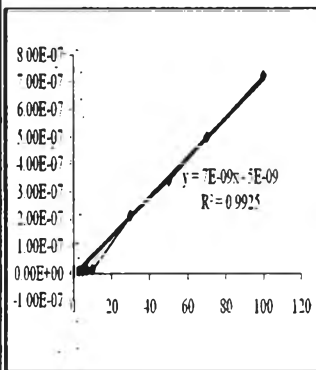
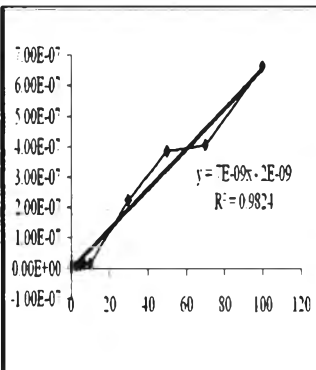
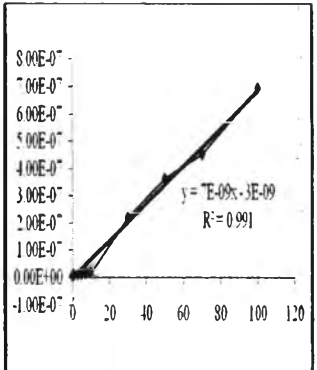
Voltage	Current (A)		
	1	2	3
	Thickness 0.072 cm.	Thickness 0.086 cm.	Thickness 0.075 cm.
0.001	3.35E-09	3.54E-09	3.56E-09
0.003	3.54E-09	3.57E-09	3.54E-09
0.005	3.57E-09	3.52E-09	3.50E-09
0.01	3.57E-09	3.57E-09	3.55E-09
0.03	3.52E-09	3.56E-09	3.56E-09
0.05	3.49E-09	3.59E-09	3.57E-09
0.07	3.52E-09	3.61E-09	3.62E-09
0.1	3.52E-09	3.64E-09	3.63E-09
0.3	3.56E-09	3.70E-09	3.70E-09
0.5	3.71E-09	3.75E-09	3.78E-09
0.7	3.69E-09	3.78E-09	3.80E-09
1	3.82E-09	3.88E-09	3.86E-09
3	4.47E-09	4.44E-09	4.43E-09
5	5.29E-09	5.02E-09	5.02E-09
7	6.44E-09	5.55E-09	5.55E-09
10	8.18E-09	6.30E-09	6.30E-09
30	1.99E-08	1.12E-08	1.12E-08
50	3.29E-08	1.55E-08	1.55E-08
70	4.52E-08	1.91E-08	1.91E-08
100	2.57E-07	2.52E-08	2.52E-08



Sample	Conductivity (S/cm)
1	0.078
2	0.022
3	0.025
Average conductivity	0.042
SD	0.032

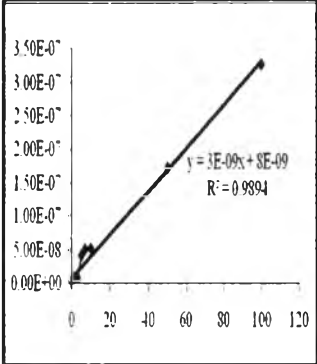
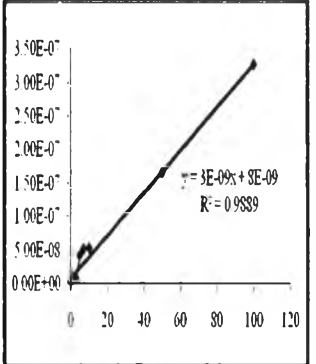
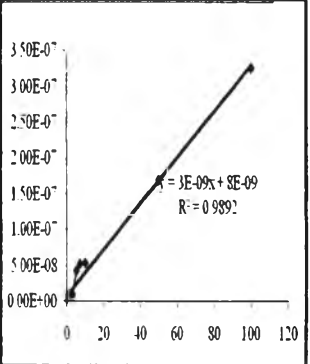
Table F.6 PPy-coated random PLA fibers at DBSA:pyrrole is 1:4 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.105 cm.	Thickness 0.100 cm.	Thickness 0.108 cm.
0.001	3.37E-09	3.35E-09	3.36E-09
0.003	3.51E-09	3.53E-09	3.52E-09
0.005	3.72E-09	3.84E-09	3.78E-09
0.01	4.38E-09	3.92E-09	4.15E-09
0.03	4.64E-09	4.32E-09	4.48E-09
0.05	5.31E-09	4.72E-09	5.02E-09
0.07	6.38E-09	5.36E-09	5.87E-09
0.1	7.37E-09	6.30E-09	6.84E-09
0.3	7.33E-09	7.21E-09	7.27E-09
0.5	7.26E-09	7.26E-09	7.26E-09
0.7	7.30E-09	7.32E-09	7.31E-09
1	8.61E-09	8.29E-09	8.45E-09

3	8.88E-09	8.59E-09	8.74E-09
5	9.32E-09	9.27E-09	9.30E-09
7	1.23E-08	1.46E-08	1.35E-08
10	1.43E-08	1.58E-08	1.51E-08
30	2.13E-07	2.25E-07	2.19E-07
50	3.40E-07	3.85E-07	3.63E-07
70	4.98E-07	4.05E-07	4.52E-07
100	7.23E-07	6.64E-07	6.94E-07
			
σ (S/cm)	0.621	0.652	0.603

Sample	Conductivity (S/cm)
1	0.621
2	0.652
3	0.603
Average conductivity	0.625
SD	0.025

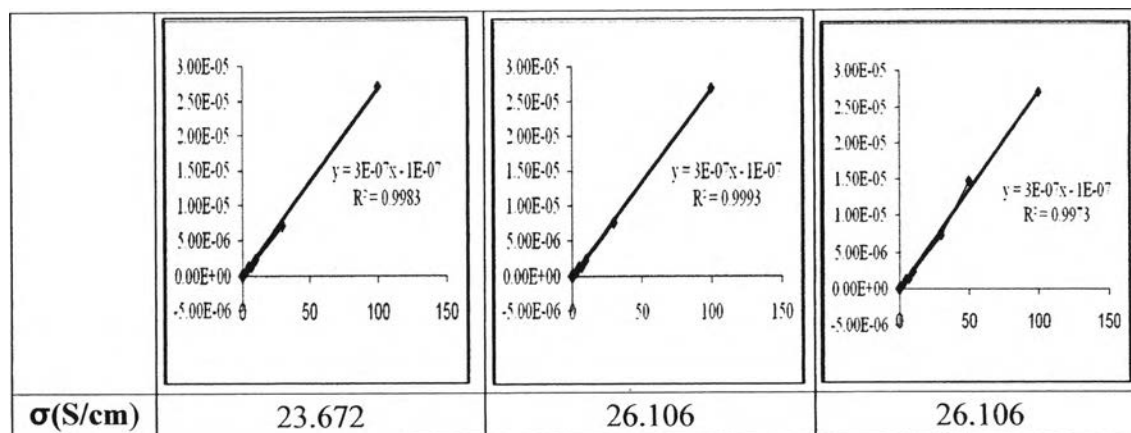
Table F.7 PPy-coated random PLA fibers at DBSA:pyrrole is 1:6 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.177 cm.	Thickness 0.108 cm.	Thickness 0.176 cm.
0.001	3.23E-09	3.09E-09	3.16E-09
0.003	3.49E-09	3.21E-09	3.35E-09
0.005	3.57E-09	3.52E-09	3.55E-09
0.01	3.92E-09	3.84E-09	3.88E-09
0.03	4.25E-09	4.26E-09	4.26E-09
0.05	4.48E-09	4.72E-09	4.60E-09
0.07	4.81E-09	4.94E-09	4.88E-09
0.1	5.30E-09	5.24E-09	5.27E-09
0.3	5.73E-09	5.85E-09	5.79E-09
0.5	6.31E-09	6.25E-09	6.28E-09
0.7	7.53E-09	7.22E-09	7.38E-09
1	8.31E-09	7.83E-09	8.07E-09
3	9.37E-09	8.98E-09	9.18E-09
5	4.25E-08	4.24E-08	4.25E-08
7	5.20E-08	5.24E-08	5.22E-08
10	5.29E-08	5.35E-08	5.32E-08
30	1.57E-07	1.46E-07	1.52E-07
50	1.73E-07	1.66E-07	1.70E-07
70	2.08E-07	2.91E-07	2.50E-07
100	3.26E-07	3.25E-07	3.26E-07
			
σ (S/cm)	0.158	0.259	0.159

Sample	Conductivity (S/cm)
1	0.158
2	0.259
3	0.158
Average conductivity	0.192
SD	0.058

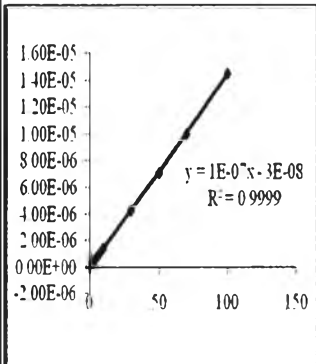
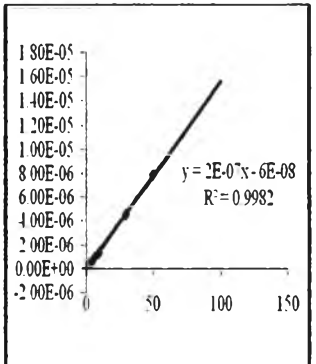
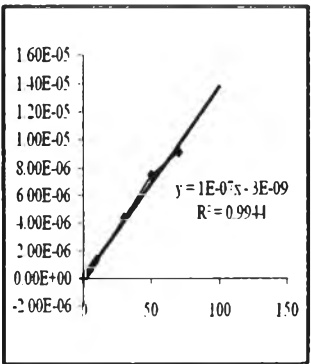
Table F.8 PPy-coated random PLA fibers at DBSA:pyrrole is 1:8 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.118 cm.	Thickness 0.107 cm.	Thickness 0.107 cm.
0.001	3.24E-09	3.26E-09	3.25E-09
0.003	3.29E-09	3.24E-09	3.27E-09
0.005	3.19E-09	3.19E-09	3.19E-09
0.01	3.19E-09	3.18E-09	3.19E-09
0.03	4.16E-09	4.19E-09	4.18E-09
0.05	4.18E-09	4.22E-09	4.20E-09
0.07	4.26E-09	4.27E-09	4.27E-09
0.1	5.28E-09	5.28E-09	5.28E-09
0.3	8.23E-09	8.24E-09	8.24E-09
0.5	1.20E-09	1.22E-08	6.70E-09
0.7	6.18E-08	6.19E-08	6.19E-08
1	2.24E-07	2.24E-07	2.24E-07
3	6.24E-07	6.29E-07	6.27E-07
5	1.38E-06	1.33E-06	1.36E-06
7	1.34E-06	1.35E-06	1.35E-06
10	2.34E-06	2.32E-06	2.33E-06
30	7.10E-06	7.58E-06	7.34E-06
50	1.92E-05	1.02E-05	1.47E-05
70	1.34E-05	1.25E-05	1.30E-05
100	2.71E-05	2.69E-05	2.70E-05



Sample	Conductivity (S/cm)
1	23.672
2	26.106
3	26.106
Average conductivity	25.295
SD	1.405

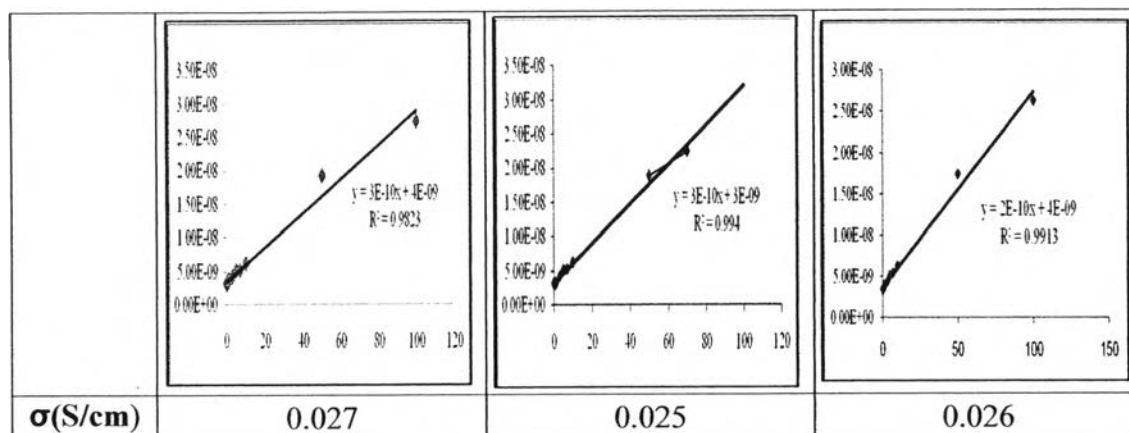
Table F.9 PPy-coated random PLA fibers at DBSA:pyrrole is 1:10 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.108 cm.	Thickness 0.107 cm.	Thickness 0.100 cm.
0.001	3.78E-09	3.13E-09	3.46E-09
0.003	3.69E-09	3.25E-09	3.47E-09
0.005	3.72E-09	3.68E-09	3.70E-09
0.01	3.79E-09	3.87E-09	3.83E-09
0.03	4.75E-09	4.15E-09	4.45E-09
0.05	5.25E-09	4.47E-09	4.86E-09
0.07	7.63E-09	4.75E-09	6.19E-09
0.1	8.39E-09	5.16E-09	6.78E-09
0.3	8.81E-09	7.18E-09	8.00E-09
0.5	1.07E-08	1.16E-08	1.12E-08
0.7	1.39E-08	1.22E-08	1.31E-08
1	1.81E-08	1.32E-08	1.57E-08
3	4.19E-07	4.32E-07	4.26E-07
5	6.97E-07	6.26E-07	6.62E-07
7	9.77E-07	9.27E-07	9.52E-07
10	1.40E-06	1.30E-06	1.35E-06
30	4.23E-06	4.55E-06	4.39E-06
50	7.13E-06	7.91E-06	7.52E-06
70	1.00E-05	8.31E-06	9.16E-06
100	1.45E-05	8.55E-06	1.15E-05
			
σ (S/cm)	8.620	17.404	9.311

Sample	Conductivity (S/cm)
1	8.620
2	17.404
3	9.311
Average conductivity	11.778
SD	4.884

Table F.10 PPy-coated random PLA fibers at DBSA:pyrrole is 1:12 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

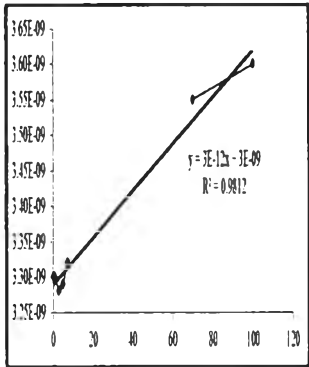
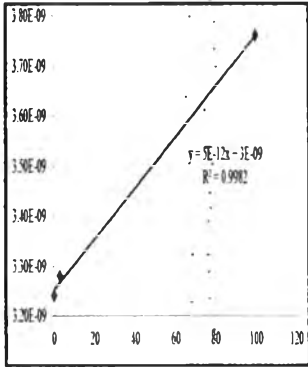
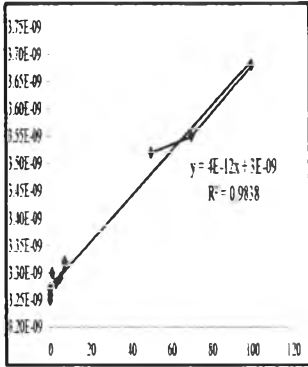
Voltage	Current (A)		
	1	2	3
	Thickness 0.105 cm.	Thickness 0.112 cm.	Thickness 0.107 cm.
0.001	3.24E-09	3.54E-09	3.39E-09
0.003	3.25E-09	3.57E-09	3.41E-09
0.005	3.29E-09	3.52E-09	3.41E-09
0.01	3.33E-09	3.57E-09	3.45E-09
0.03	3.25E-09	3.56E-09	3.41E-09
0.05	3.20E-09	3.59E-09	3.40E-09
0.07	3.23E-09	3.61E-09	3.42E-09
0.1	3.30E-09	3.64E-09	3.47E-09
0.3	3.32E-09	3.70E-09	3.51E-09
0.5	3.62E-09	3.75E-09	3.69E-09
0.7	3.63E-09	3.78E-09	3.71E-09
1	3.90E-09	3.88E-09	3.89E-09
3	4.27E-09	4.44E-09	4.36E-09
5	5.28E-09	5.02E-09	5.15E-09
7	5.31E-09	5.55E-09	5.43E-09
10	6.31E-09	6.30E-09	6.31E-09
30	1.59E-08	1.12E-08	1.36E-08
50	1.93E-08	1.55E-08	1.74E-08
70	1.24E-08	1.91E-08	1.58E-08
100	2.74E-08	2.52E-08	2.63E-08



Sample	Conductivity (S/cm)
1	0.027
2	0.025
3	0.026
Average conductivity	0.026
SD	0.001

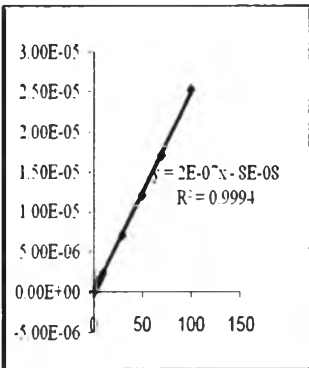
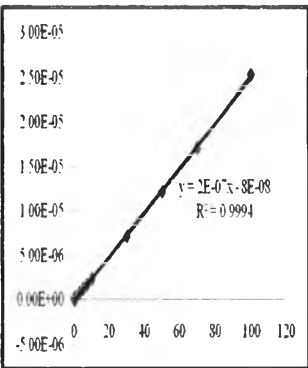
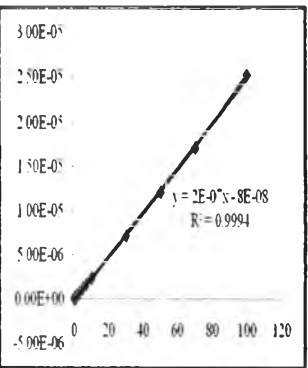
Table F.11 Laminin coated on (PPy-coated aligned PLA fibers) at DBSA:pyrrole is 1:8 by admicellar polymerization. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.118 cm.	Thickness 0.107 cm.	Thickness 0.107 cm.
0.001	3.22E-09	3.29E-09	3.26E-09
0.003	3.24E-09	3.37E-09	3.31E-09
0.005	3.30E-09	3.24E-09	3.27E-09
0.01	3.25E-09	3.00E-09	3.13E-09
0.03	3.14E-09	3.15E-09	3.15E-09
0.05	3.26E-09	3.21E-09	3.24E-09
0.07	3.11E-09	3.12E-09	3.12E-09
0.1	3.24E-09	3.20E-09	3.22E-09
0.3	3.21E-09	3.18E-09	3.20E-09
0.5	3.23E-09	3.25E-09	3.24E-09
0.7	3.24E-09	3.34E-09	3.29E-09

1	3.30E-09	3.20E-09	3.25E-09
3	3.28E-09	3.28E-09	3.28E-09
5	3.29E-09	3.29E-09	3.29E-09
7	3.32E-09	3.40E-09	3.36E-09
10	3.40E-09	3.40E-09	3.40E-09
30	3.50E-09	3.45E-09	3.48E-09
50	3.52E-09	3.46E-09	3.49E-09
70	3.55E-09	3.48E-09	3.52E-09
100	3.60E-09	3.76E-09	3.68E-09
			
σ (S/cm)	1.32E-03	2.07E-03	1.70E-03

Sample	Conductivity (S/cm)
1	1.32E-03
2	2.07E-03
3	1.70E-03
Average conductivity	1.70E-03
SD	0.38E-03

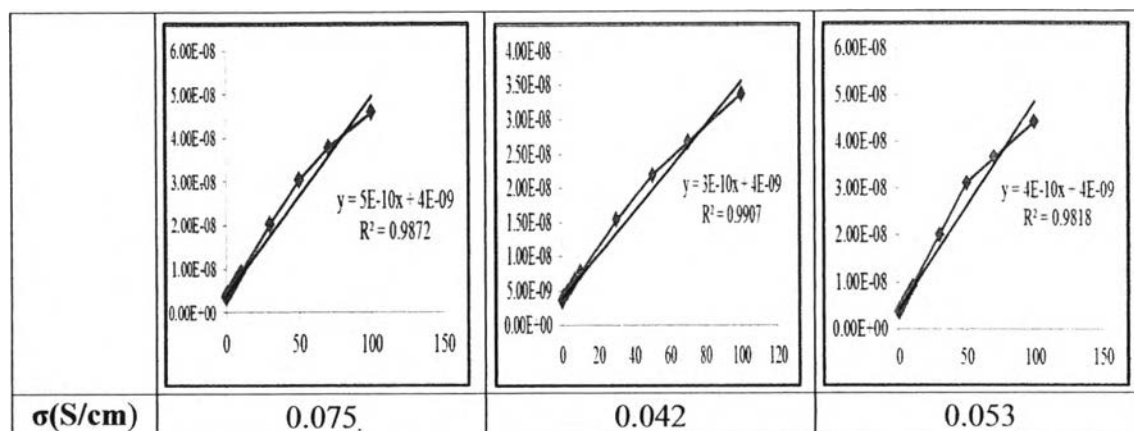
Table F.12 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:8 by admicellar polymerization measured in time 1 day. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.062 cm.	Thickness 0.067 cm.	Thickness 0.070 cm.
0.001	3.63E-09	3.64E-09	3.62E-09
0.003	3.64E-09	3.66E-09	3.65E-09
0.005	3.68E-09	3.69E-09	3.69E-09
0.01	3.76E-09	3.81E-09	3.75E-09
0.03	4.04E-09	4.07E-09	4.03E-09
0.05	4.37E-09	4.41E-09	4.36E-09
0.07	4.80E-09	4.77E-09	4.80E-09
0.1	5.29E-09	5.28E-09	5.30E-09
0.3	8.85E-09	8.84E-09	8.86E-09
0.5	1.27E-08	1.27E-08	1.28E-08
0.7	1.69E-08	1.69E-08	1.69E-08
1	2.30E-07	2.30E-07	2.30E-07
3	6.93E-07	6.94E-07	6.92E-07
5	1.16E-06	1.16E-06	1.16E-06
7	1.60E-06	1.60E-06	1.60E-06
10	2.33E-06	2.33E-06	2.33E-06
30	7.08E-06	7.08E-06	7.08E-06
50	1.21E-05	1.21E-05	1.21E-05
70	1.71E-05	1.71E-05	1.71E-05
100	2.53E-05	2.53E-05	2.53E-05
			
σ (S/cm)	30.035	27.794	26.603

Sample	Conductivity (S/cm)
1	0.665
2	0.776
3	0.611
Average conductivity	0.684
SD	0.084

Table F.13 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:8 by admicellar polymerization measured in time 1 month. Values of measured current (A) at varies applied voltage (V)

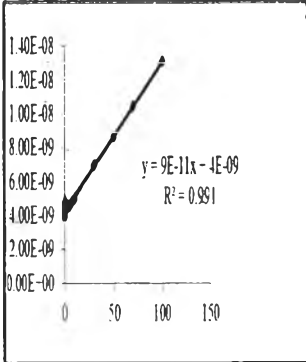
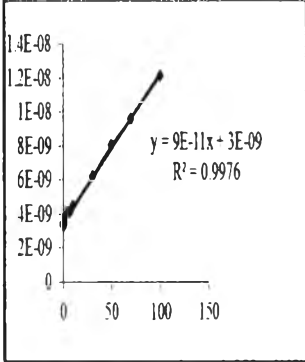
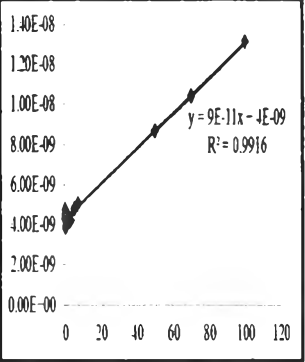
Voltage	Current (A)		
	1	2	3
	Thickness 0.062 cm.	Thickness 0.067 cm.	Thickness 0.070 cm.
0.001	3.65E-09	3.59E-09	3.68E-09
0.003	3.59E-09	3.59E-09	3.58E-09
0.005	3.65E-09	3.59E-09	3.63E-09
0.01	3.57E-09	3.62E-09	3.58E-09
0.03	3.66E-09	3.69E-09	3.65E-09
0.05	3.67E-09	3.66E-09	3.66E-09
0.07	3.67E-09	3.65E-09	3.67E-09
0.1	3.66E-09	3.64E-09	3.66E-09
0.3	3.80E-09	3.77E-09	3.80E-09
0.5	3.90E-09	3.82E-09	3.90E-09
0.7	4.05E-09	4.01E-09	4.05E-09
1	4.21E-09	4.06E-09	4.21E-09
3	5.33E-09	4.86E-09	5.33E-09
5	6.36E-09	5.65E-09	6.36E-09
7	7.48E-09	6.52E-09	7.48E-09
10	9.08E-09	7.70E-09	9.08E-09
30	2.03E-08	1.54E-08	2.01E-08
50	3.04E-08	2.19E-08	3.11E-08
70	3.78E-08	2.67E-08	3.66E-08
100	4.58E-08	3.37E-08	4.42E-08



Sample	Conductivity (S/cm)
1	0.075
2	0.042
3	0.053
Average conductivity	0.057
SD	0.017

Table F.14 PPy-coated aligned PLA fibers at DBSA:pyrrole is 1:8 by admicellar polymerization measured in time 2 months. Values of measured current (A) at varies applied voltage (V)

Voltage	Current (A)		
	1	2	3
	Thickness 0.062 cm.	Thickness 0.067 cm.	Thickness 0.070 cm.
0.001	4.55E-09	3.50E-09	4.55E-09
0.003	4.72E-09	3.46E-09	4.30E-09
0.005	4.65E-09	3.37E-09	4.25E-09
0.01	4.60E-09	3.30E-09	4.73E-09
0.03	4.10E-09	3.32E-09	4.46E-09
0.05	4.47E-09	3.51E-09	4.41E-09
0.07	4.31E-09	3.30E-09	4.20E-09
0.1	3.87E-09	3.32E-09	3.84E-09
0.3	4.43E-09	3.37E-09	4.59E-09
0.5	4.43E-09	3.36E-09	4.54E-09
0.7	4.80E-09	3.41E-09	3.96E-09

1	4.39E-09	3.52E-09	4.51E-09
3	4.49E-09	3.87E-09	4.22E-09
5	4.54E-09	4.05E-09	4.80E-09
7	4.72E-09	4.12E-09	5.01E-09
10	4.99E-09	4.46E-09	5.12E-09
30	6.98E-09	6.21E-09	6.35E-09
50	8.65E-09	8.04E-09	8.66E-09
70	1.04E-08	9.62E-09	1.04E-08
100	1.31E-08	1.21E-08	1.31E-08
			
$\sigma(\text{S/cm})$	0.014	0.013	0.012

Sample	Conductivity (S/cm)
1	0.014
2	0.013
3	0.012
Average conductivity	0.013
SD	0.001

Appendix G Indirect Cytotoxicity

Table G.1 Indirect cytotoxicity test, the mitochondrial metabolic activity (MTT assay) of Neuro 2a cultured for 1 day in the extracted media.

Time (1 day)	Neuro 2a cell				
	Control	PLA AF	PPy-coated PLA AF	PLA RF	PPy-coated PLA RF
1	0.4482	0.5305	0.4155	0.4472	0.4552
2	0.3925	0.5226	0.4576	0.4427	0.4524
3	0.4624	0.4504	0.4493	0.4468	0.4484
4	0.4473	0.4592	0.4552	0.4462	0.4386
5	0.4572	0.4644	0.4514	0.4421	0.4553
Average	0.4415	0.4761	0.4458	0.4450	0.4500
SD	0.0281	0.0367	0.0172	0.0024	0.0070

Table G.2 Indirect cytotoxicity test, the mitochondrial metabolic activity (MTT assay) of Neuro 2a cultured for 3 days in the extracted media.

Time (3 days)	Neuro 2a cell				
	Control	PLA AF	PPy-coated PLA AF	PLA RF	PPy-coated PLA RF
1	0.5200	0.5773	0.5227	0.7320	0.5743
2	0.7734	0.8676	0.5782	0.6741	0.5336
3	0.6126	0.6717	0.5933	0.6768	0.5372
4	0.6596	0.5971	0.6753	0.6476	0.5195
5	0.7156	0.5870	0.6175	0.6495	0.5635
Average	0.6562	0.6601	0.5974	0.6760	0.5456
SD	0.0971	0.1218	0.0558	0.0341	0.0226

Appendix H Real Time Polymerase Chain Reaction (RT-PCR)

Table H.1 Expression relative to GAPDH (c-Fos gene) in rat hippocampal neural stem cell on electrical stimulation 2 hours cultured on the surfaces of laminin coated on (PPy-coated aligned PLA fiber meshes)

Time (2 hours)	Expression relative to GAPDH	
	0 mV	100 mV
1	1.0000	8.9619
2	0.9830	8.9880
3	0.9149	7.7312
Average	0.9660	8.5604
SD	0.0450	0.7182

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Proceedings:

1. Sudwilai, T.; Ng, J.J.; Israsena, N.; and Supaphol, P. (2011, April 26) Polypyrrole-coated poly(lactic acid) electrospun fibrous scaffold: effect of the coating layer on electrical conductivity and neural cell growth. Proceedings of the 2nd Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

Presentations:

1. Sudwilai, T.; Ng, J.J.; Israsena, N.; and Supaphol, P. (2011, April 26) Polypyrrole-coated poly(lactic acid) electrospun fibrous scaffold: effect of the coating layer on electrical conductivity and neural cell growth. Paper presented at the 2nd Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.