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APPENDICES

Appendix A Admicelled Latex Recipe

Table A1 Ingredients of the admicelled rubbers

Sample	SDS (mM)	SDS (g)	Monomer (mM)	Monomer (μL)
A2	16	2.307	20	691.6495
A5	16	2.307	50	1,729.1237
A10	16	2.307	100	3,458.2474
A20	16	2.307	200	6,916.4948
A50	16	2.307	500	17,291.2371
A80	16	2.307	800	27,665.9794
B2	16	2.307	20	791.5334
B5	16	2.307	50	1,978.8335
B10	16	2.307	100	3,957.6670
B20	16	2.307	200	7,915.3340
B50	16	2.307	500	19,788.3349
B80	16	2.307	800	31,661.3358

Note Total volume of the reaction is 500 ml.

A = Pyrrole monomer, B= Thiophene monomer,

Table A2 Calculation of pyrrole content in the admicelled rubbers in gram

Pyrrole (mM)	Pyrrole (g)	Latex cream (g)	Latex After dry (g)	Pyrrole (wt%)	Latex (wt%)
20	0.67	25	18.3075	3.5317	96.4682
50	1.68	25	18.3075	8.4080	91.5919
100	3.35	25	18.3075	15.4729	84.5270
200	6.71	25	18.3075	26.8284	73.1715
500	16.77	25	18.3075	47.8176	52.1823
800	26.84	25	18.3075	59.4647	40.5352
Thiophene (mM)	**Thiophene** (g)	**Latex cream** (g)	**Latex After dry** (g)	**Thiophene** (wt%)	**Latex** (wt%)
20	0.841	25	18.3075	4.3935	95.6065
50	2.104	25	18.3075	10.3113	89.6886
100	4.207	25	18.3075	18.6913	81.3086
200	8.414	25	18.3075	31.4957	68.5043
500	21.035	25	18.3075	53.4755	46.5245
800	33.656	25	18.3075	64.7769	35.2230

Note Total volume of the reaction is 500 ml,DRC of cream put after centrifuge =73.20%.

Table A3 Calculation of content of doping iodine in the system (in gram)

Pyrrole (mM)	Pyrrole (g)	Latex (g)	Latex After dry (g)	I_2 (g)	Pyrrole (wt%)	Latex (wt%)	I_2 (wt%)
20	0.67	25	18.3075	0.6105	3.4204	93.4628	3.1167
50	1.68	25	18.3075	0.6105	8.1561	88.8799	2.9638
100	3.35	25	18.3075	0.6105	15.0440	82.2144	2.7416
200	6.71	25	18.3075	0.6105	26.1823	71.4355	2.3821
500	16.77	25	18.3075	0.6105	46.9905	51.2987	1.7106
800	26.84	25	18.3075	0.6105	58.6564	40.0094	1.3341
Thiopene (mM)	**Thiopene** (g)	**Latex** (g)	**Latex After dry** (g)	I_2 (g)	**Thiophene** (wt%)	**Latex** (wt%)	I_2 (wt%)
20	0.841	25	18.3075	0.6105	4.2563	92.6540	3.0897
50	2.104	25	18.3075	0.6105	10.0086	87.0873	2.9041
100	4.207	25	18.3075	0.6105	18.1924	79.1676	2.6400
200	8.414	25	18.3075	0.6105	30.7844	66.9819	2.2336
500	21.035	25	18.3075	0.6105	52.6493	45.8226	1.5280
800	33.656	25	18.3075	0.6105	64.0164	34.8223	1.1612

Note Total volume of the reaction is 500 ml, DRC of cream put after centrifuge =73.20%.

Iodine doping calculation

						Mol wt (Mw)	Number of [c=c] Dp =Mol wt/ Mw
NR		**50**	g		cis 1,4-polyisoprene	800000	**11428,57143**
					tran 1,4-polyisoprene	410000	**5857,142857**
		0,000121951	mol				
	1	mole has	5857,143	mol			
	0,000121951	mole has	0,714286	mol	of [C=C]		

from reference Dai et al. (1994)

$[C=C]/[I_2]$ 31

I_2 0,023041475 mol

1,221198157 g

So, when

NR(g)	**I_2(g)**
10	0.2442
25	0.6105
50	1.2211

Appendix B Calculation for Volume and Surface Resistivity

Surface resistivity

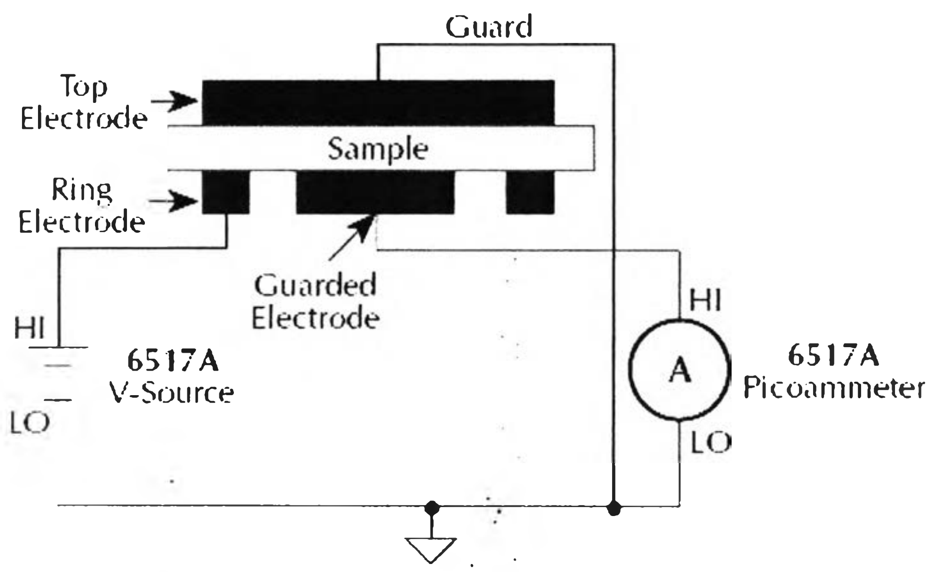


Figure B1 Surface resistivity measurement technique.

$$\rho_s = K_s R$$

ρ_s = surface resistivity (per square)

R = measured resistance in ohms (V/I)

K_s = P/g

where:

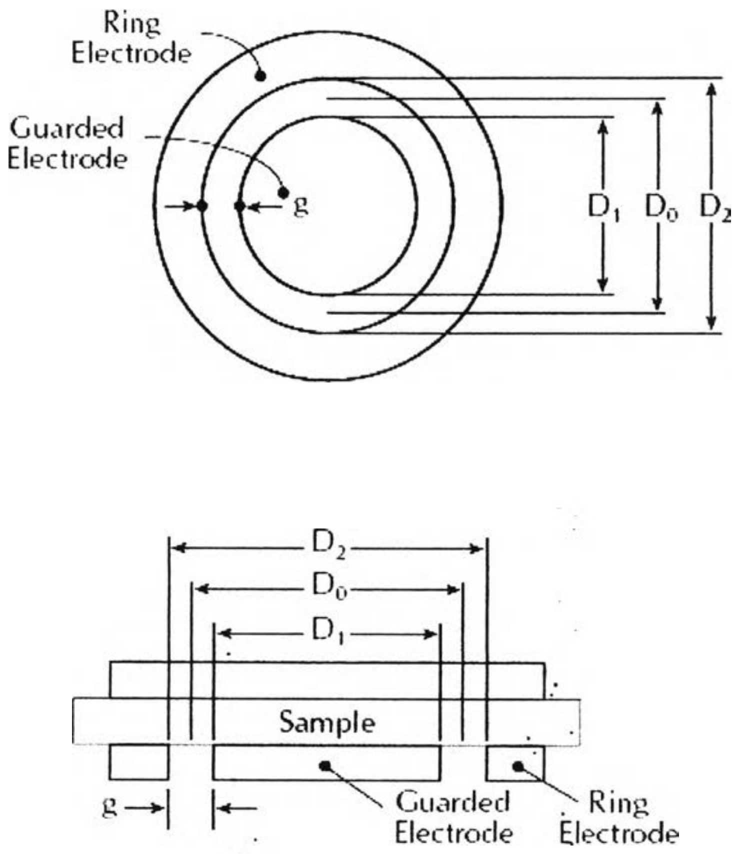
P = the effective perimeter of the guarded electrode (mm)

g = distance between the guarded electrode and the ring electrode(mm).

For circular electrodes:

P = πD_0

$D_0 = D_I + g$



Test Fixture Dimensions (cm)	
	Model 8009
D_1	2.000 in
D_0	2.125 in
D_2	2.250 in
g	0.125 in

Figure B2 Circular electrode dimensions.

Volume Resistivity

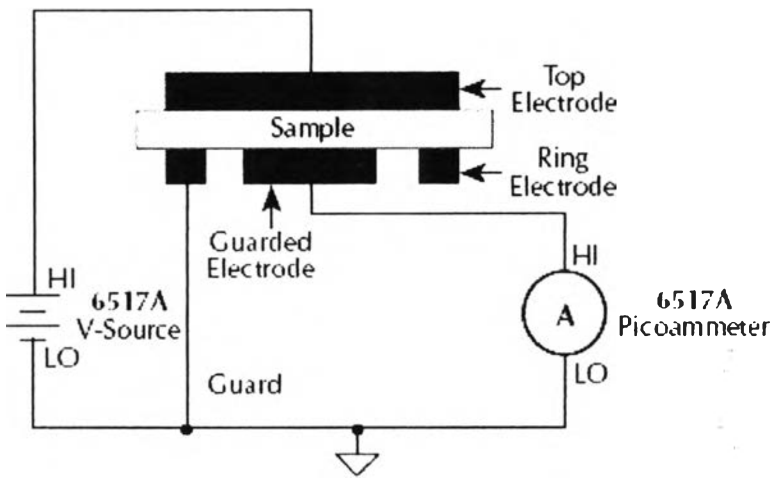


Figure B3 Volume resistivity measurement technique.

$$\rho_v = \frac{K_v}{\tau} R$$

ρ_v = surface resistivity (per square)

K_v = the effective area of the guarded electrode for the particular electrode arrangement employed

τ = average thickness of the sample (mm)

R = measured resistance in ohms (V/I)

For circular electrodes:

$$K_v = \pi(\frac{D_1}{2} + B\frac{g}{2})^2$$

D_1 = outside diameter of guarded electrode

g = distance between the guarded electrode and the ring electrode

B = effective area coefficient, B of 0 is typically used for volume resistivity

Appendix C Data of Particle Size Distribution

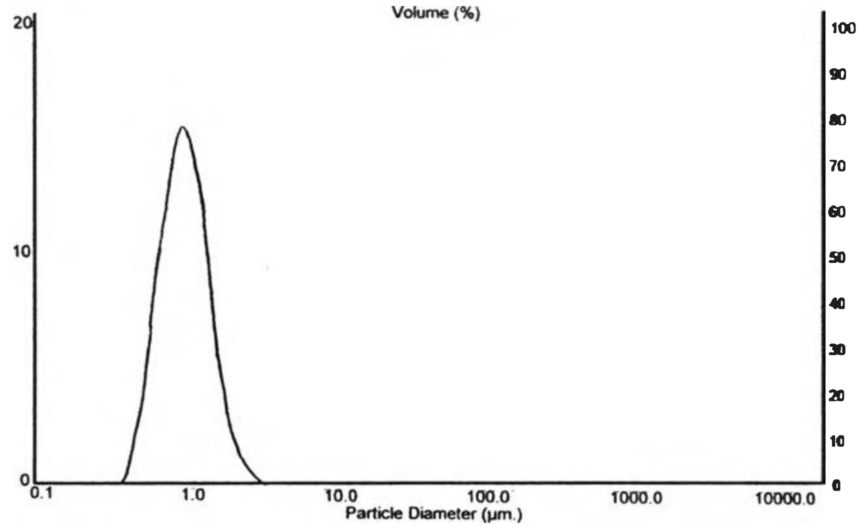


Figure C1 Histogram showing the particle size distribution by volume of the natural rubber latex.

Appendix D Weight of the admicelled rubber

Table D1 Weight of the admicelled rubber (PPY: NR) at anode electrode

Mass at Anode (g)						
PPy conc/ Time (hrs)	20mM	50 mM	100mM	200mM	500mM	800mM
0	0	0	0	0	0	0
1	3.61	3.74	3.887	3.96	4.91	7.73
2	2.48	2.88	2.91	3.21	3.94	6.52
3	2.34	2.4	2.37	3.01	3.532	5.13
4	2.3	2.34	2.4	2.91	3.481	4.94
5	1.37	1.71	2.1	2.64	3.314	4.71
6	1.1	1.41	1.54	2.11	3.15	4.42
7	1.34	1.24	1.52	2.01	2.91	3.91
8	1.21	1.14	1.31	1.84	2.61	3.51
9	1.04	1.24	1.25	1.63	2.51	3.14
10	0.96	0.89	0.93	1.45	2.15	1.3
11	0.66	0.66	0.91	0.977	1.98	
12	0.65	0.85	0.89	0.80	0.99	
13	0.51	0.71	0.802	0.531	0.13	
14	0.54	0.64	0.67	0.31		
15	0.411	0.21	0.59	0.04		
16	0.4	0.4	0.53			
17	0.367	0.31	0.32			
18	0.311	0.31	0.21			
19	0.29	0.301	0.14			
20	0.11	0.21	0.08			
21	0.1	0.11				
22	0.09	0.03				
23	0.09	0.02				
24	0.07	0.04				
25	0.06	0.02				
26	0.045	0.016				
27	0.03	0.012				
28	0.032	0.01				
29	0.03	0.071				
30	0.026	0.03				
31	0.024	0.014				
32	0.21	0.01				
33	0.156					
34	0.141					
35	0.12					
Total (g)	**23.224**	**24.174**	**25.359**	**27.428**	**35.607**	**45.310**

Table D2 The accumulate weight of admicelled rubber (PPY: NR)

Mass at Anode (g)						
PPy conc/ Time (hrs)	20mM	50 mM	100mM	200mM	500mM	800mM
0	0	0	0	0	0	0
1	3.61	3.74	3.887	3.96	4.91	7.73
2	6.09	6.62	6.797	7.17	8.85	14.25
3	8.43	9.02	9.167	10.18	12.382	19.38
4	10.73	11.36	11.567	13.09	15.863	24.32
5	12.1	13.07	13.667	15.73	19.177	29.03
6	13.2	14.48	15.207	17.84	22.327	33.45
7	14.54	15.72	16.727	19.85	25.237	37.36
8	15.75	16.86	18.037	21.69	27.847	40.87
9	16.79	18.1	19.287	23.32	30.357	44.01
10	17.75	18.99	20.217	24.77	32.507	45.31
11	18.41	19.85	21.127	25.747	34.487	
12	19.06	20.7	22.017	26.547	35.477	
13	19.57	21.41	22.819	27.078	35.607	
14	20.11	22.05	23.489	27.388		
15	20.521	22.26	24.079	27.428		
16	20.921	22.66	24.069			
17	21.288	22.97	24.929			
18	21.599	23.28	25.139			
19	21.889	23.581	25.279			
20	21.999	23.791	25.359			
21	22.099	23.901				
22	22.189	23.931				
23	22.279	23.951				
24	22.349	23.991				
25	22.409	24.011				
26	22.454	24.027				
27	22.484	24.039				
28	22.516	24.049				
29	22.546	24.12				
30	22.572	24.15				
31	22.596	24.164				
32	22.806	24.174				
33	22.962					
34	23.103					
35	23.224					
Total (g)	**23.224**	**24.174**	**25.359**	**27.428**	**35.607**	**45.310**

Table D3 Weight of the admicelled rubber (PTh: NR) at anode electrode

Mass at Anode (g)						
PPy conc/ Time (hrs)	20mM	50 mM	100mM	200mM	500mM	800mM
0	0	0	0	0	0	0
1	3.11	3.34	3.45	3.7	4.3	4.45
2	2.878	2.94	3.21	3.41	4.1	4.32
3	2.4	2.41	2.67	3.01	3.91	4.11
4	2.48	2.31	2.5	2.91	3.882	3.98
5	1.77	1.89	2.1	2.64	3.414	3.67
6	1.65	1.41	1.54	2.11	3.25	3.66
7	1.3	1.24	1.52	2.01	2.91	3.41
8	1.24	1.14	1.31	1.44	2.61	3.21
9	1.03	1.24	1.25	1.45	2.51	3.15
10	0.86	0.93	0.93	1.33	2.31	2.91
11	0.76	0.91	0.91	1.2	1.98	2.11
12	0.655	0.85	0.89	1.11	1.49	1.78
13	0.56	0.71	0.74	0.89	1.05	1.38
14	0.54	0.64	0.67	0.7	0.89	1.23
15	0.411	0.53	0.59	0.64	0.41	1.17
16	0.4	0.4	0.43	0.55	0.11	1.16
17	0.367	0.32	0.32	0.4	0.09	1.08
18	0.311	0.31	0.21	0.12	0.08	1.04
19	0.290	0.293	0.294	0.04	0.065	0.4
20	0.11	0.21	0.08	0.019	0.044	0.32
21	0.12	0.11	0.054	0.01	0.011	0.23
22	0.094	0.07	0.04	0.008	0.009	0.1
23	0.081	0.04	0.034	0.007	0.004	0.04
24	0.075	0.031	0.024	0.004	0.001	
25	0.053	0.024	0.022	0.001		
26	0.045	0.018	0.013			
27	0.03	0.012				
28	0.025					
29	0.021					
30	0.011					
31						
32						
33						
34						
35						
Total (g)	**23.677**	**24.238**	**25.801**	**29.709**	**39.430**	**48.910**

Table D4 The accumulate weight of admicelled rubber (PTh: NR)

Mass at Anode (g)						
PPy conc/ Time (hrs)	20mM	50 mM	100mM	200mM	500mM	800mM
0	0	0	0	0	0	0
1	3.11	3.34	3.45	3.70	4.30	4.45
2	5.988	6.28	6.66	7.11	8.40	8.77
3	8.388	8,69	9.33	10.12	12.31	12.88
4	10.868	11	11.83	13.03	16.192	16.86
5	12.638	12.89	13.93	15.67	19.606	20.53
6	14.288	14.3	15.47	17.78	22.856	24.19
7	15.588	15.54	16.99	19.79	25.766	27.60
8	16.828	16.68	18.30	21.23	28.376	30.81
9	17.858	17.92	19.55	22.68	30.886	33.96
10	18.718	18.81	20.48	24.01	33.196	36.87
11	19.478	19.67	21.39	25.21	35.176	38.98
12	20.133	20.52	22.28	26.32	36.666	40.76
13	20,693	21.23	23.02	27.21	37.716	42.14
14	21.233	21.87	23.69	27.91	38.606	43.37
15	21.644	22.40	24.28	28.55	39.016	44.54
16	22.044	22.80	24.71	29.10	39.126	45.70
17	22.411	23.12	25.03	29.50	39.216	46.78
18	22.722	23.43	25.24	29.62	39.296	47.82
19	23.012	23.723	25.534	29.66	39.361	48.22
20	23.122	23.933	25.614	29.679	39.405	48.54
21	23.242	24.043	25.668	29.689	39.416	48.77
22	23.336	24.113	25.708	29.697	39.425	48.87
23	23.417	24.153	25.742	29.704	39.429	48.91
24	23.545	24.184	25.766	29.708	39.430	
25	23.590	24.209	25.788	29.709		
26	23.620	24.226	25.801			
27	23.645	24.238				
28	23.666					
29	23.667					
30						
31						
32						
33						
34						
35						
Total (g)	**23.677**	**24.238**	**25.801**	**29.709**	**39.430**	**48.910**

Table D5 Weight of the admicelled rubber (NR-Monomer-I_2) at anode electrode

Mass at Anode (g)					
Time (hrs)	ENR	EA2 20 mM	EA80 800mM	EB2 20mM	EB80 800mM
0	0	0	0	0	0
1	3.57	3.61	7.61	3.14	5.62
2	3.40	3.30	6.94	2.99	5.11
3	2.69	2.39	6.1	2.67	4.00
4	1.89	2.30	5.92	2.21	3.98
5	1.37	2.21	4.91	1.77	3.67
6	1.1	1.44	4.52	1.65	3.66
7	1.34	1.20	4.43	1.30	3.51
8	1.21	0.92	3.22	1.24	3.28
9	1.04	0.94	2.11	1.03	3.25
10	0.96	0.74		0.86	3.11
11	0.66	0.66		0.76	2.11
12	0.65	0.65		0.655	1.78
13	0.51	0.51		0.56	1.38
14	0.54	0.54		0.54	1.23
15	0.411	0.411		0.411	1.17
16	0.34	0.40		0.35	1.03
17	0.32	0.367		0.32	0.6
18	0.311	0.311		0.311	0.1
19	0.29	0.29		0.29	0.03
20	0.11	0.11		0.11	
21	0.09	0.10		0.12	
22	0.09	0.086		0.094	
23	0.04	0.075		0.084	
24	0.023	0.05		0.053	
25	0.01	0.023		0.041	
26	0.011	0.01		0.045	
27	0.009	0.005		0.002	
28					
29					
30					
31					
32					
33					
34					
35					
Total (g)	**22.996**	**23.649**	**45.76**	**23.606**	**48.62**

Table D6 The accumulate weight of admicelled rubber (NR-Monomer-I_2)

Mass at Anode (g)					
Time (hrs)	ENR	EA2 20 mM	EA80 800mM	EB2 20mM	EB80 800mM
0	0	0	0	0	0
1	3.57	3.61	7.61	3.14	5.62
2	6.97	6.91	14.55	6.13	10.73
3	9.66	9.30	20.65	8.8	14.73
4	11.55	11.60	26.57	11.01	18.71
5	12.92	13.81	31.48	12.78	22.38
6	14.02	15.25	36	14.43	26.04
7	15.36	16.45	40.43	15.73	29.55
8	16.57	17.37	43.65	16.97	32.83
9	17.61	18.31	45.76	18.00	36.08
10	18.57	19.05		18.86	39.19
11	19.23	19.71		19.62	41.30
12	19.88	20.36		20.275	43.08
13	20.39	20.87		20.835	44.46
14	20.93	21.41		21.375	45.69
15	21.341	21.821		21.786	46,86
16	21.681	22.221		22.136	47.89
17	22.001	22.588		22.456	48.49
18	22.312	22.899		22.767	48.59
19	22.602	23.189		23.057	48.62
20	22.712	23.299		23.167	
21	22.802	23.399		23.287	
22	22.892	23.485		23.381	
23	22.932	23.560		23.465	
24	22.955	23.61		23.518	
25	22.965	23.633		23.559	
26	22.976	23.643		23.604	
27	22.985	23.648		23.606	
28	22.989	23.649			
29	22,99				
30	22.991				
31	22.992				
32	22.993				
33	22.994				
34	22.995				
35	22.996				
Total (g)	**22.996**	**23.649**	**45.76**	**23.606**	**48.62**

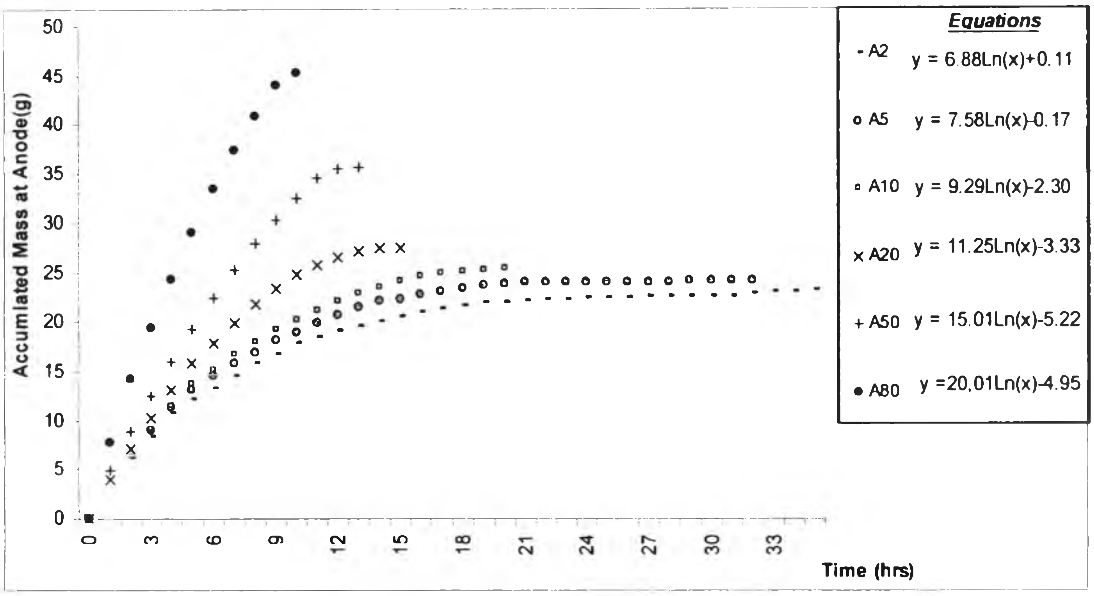


Figure D1 Accumulate weight equation of admicelled rubber (PPy: NR).

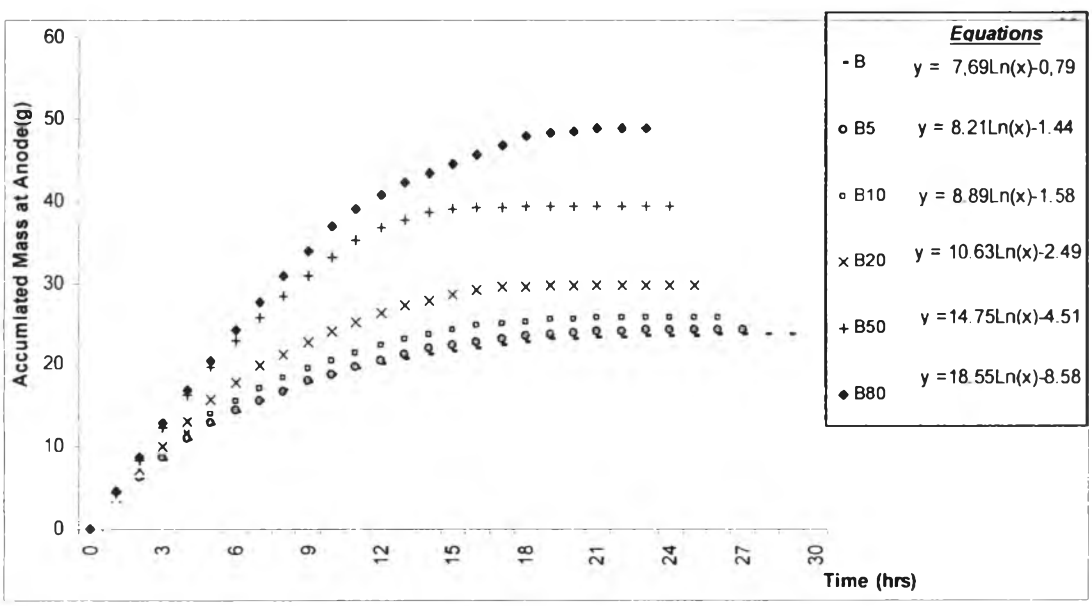


Figure D2 Accumulate weight equation of admicelled rubber (PTh: NR).

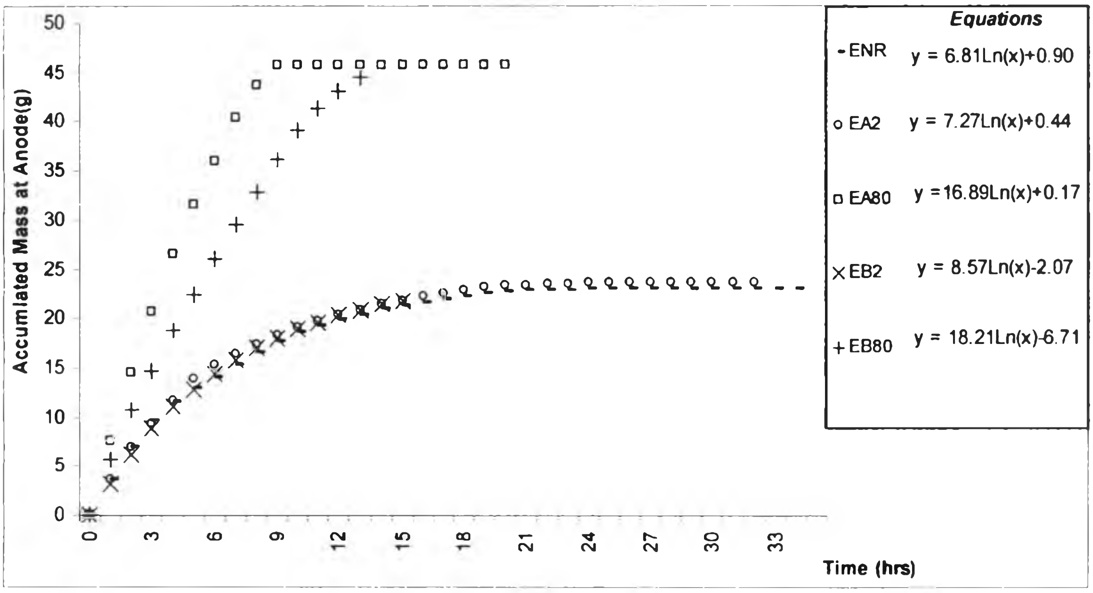


Figure D3 Accumulate weight equation of admicelled rubber (NR-Monomer-I_2)

Appendix E The pH values for preparation admicelled rubbers

TableE1 pH values for preparation admicelled rubbers : PPy solution

PPy conc/ Time (hrs)	20mM	50 mM	100mM	200mM	500mM	800mM
0	3	3	3	3	3	3
1	3.36	3.31	2.77	2.58	2.54	2.46
2	3.54	3.54	2.84	3.53	3.54	2.86
3	3.03	2.95	3.08	3.58	5.15	3.7
4	3.03	2.96	3.08	3.54	3.51	2.84
5	3	2.64	2.78	3.5	4.18	4.73
6	4.5	2.5	2.8	3.31	3.95	4.45
7	3.7	2.36	2.79	3.31	3.95	4.73
8	3.06	2.81	3	3.31	3.95	4.73
9	5.32	5.3	4	4.38	3.95	4.8
10	4.35	5.19	4.8	4.35	5.19	5.58
11	3.09	5.32	4.9	4.75	5.26	5.81
12	3	3	5.12	4.8	5.27	5.81
13	3	2.64	5.16	5.64	5.88	5.82
14	4.5	2.5	5.78	5.16	5.36	5.39
15	3.7	2.36	4.9	5.14	5.77	5.78
16	3.06	2.81	5.12			
17	3	3	5.16			
18	3	3	5.78			
19	3.09	3	5.45			
20	3	3	5.68			
21	3.55	4.81				
22	4.5	5.5				
23	4.7	5.36				
24	5.8	5.28				
25	4.5	5.24				
26	4.2	5.3				
27	4.7	5.19				
28	4.5	5.3				
29	5	5.19				
30	5.2	4.81				
31	4	4.81				
32	5.05	5.41				
33	4.84					
34	4.84					
35	4.95					

TableE2 pH values for preparation admicelled rubbers : PTh solution

PTh conc/ Time (hrs)	20mM	50mM	100mM	200mM	500mM	800mM
0	3	3	3	3	3	3
1	3.18	3.12	3.21	3.3	3.23	3.3
2	3.5	2.82	3,51	3,4	3,41	3,18
3	3.2	3.1	3,77	3,51	3,45	3,51
4	4.89	3,78	3,41	3,71	3,44	2,84
5	5.16	3,79	3,89	3,81	3,55	4,73
6	3.01	4,4	3,67	3,89	3,8	4,45
7	3.00	3,6	4,31	4,38	3,95	4,1
8	3.06	3,43	4,4	4,11	4,12	4,7
9	3.87	3,41	4,12	3,7	4,8	5,55
10	3.50	3,67	3,43	3,6	5,19	5,8
11	3.87	4,09	3,57	3,65	5,91	5,1
12	4.97	3,78	4,22	4,89	5,8	4,56
13	3.45	4,55	4,55	5,07	4,81	4,54
14	3.98	4,65	3,5	5,01	5,11	4,86
15	4.43	4,59	4,48	4,76	5,3	4,51
16	3.03	4,77	3,61	4,11	5,4	5,4
17	4.76	3,78	4,41	4,32	5,51	5,7
18	4.68	3,4	4,1	3,71	4,87	5,91
19	3.09	3,82	3,8	4,66	5,11	5,65
20	3.01	3,47	4	5,4	5	5,61
21	3.55	3,8	4,71	5,32	5,34	5,74
22	4.82	3,51	4,12	5,11	5,31	5,67
23	4.41	4,12	4,58	5,24	5,51	5,75
24	4.64	4,51	5,3	5,4	5,54	
25	4.71	5,2	5,43	5,14		
26	4.91	5,14	5,44			
27	4.64	5,23				
28	5.11					
29	5.20					
30	5.12					

Appendix F Data of Fourier-Transform Infrared Spectroscopy

Table F1 FT-IR peak assignments for the IR absorption band

Wavenumber (cm^{-1})	Assignment
Rubber	
3035	=C-H stretching
2960	C-H stretching of CH_3
2926	C-H stretching of CH_2
2853	C-H stretching of CH_2 and CH_3
1663	C=C stretching
1448	C-H bending of CH_2
1375	C-H bending of CH_3
1128	C-H bending
834	C=CH wagging
Polypyrrole	
1557	C=C stretching
1476	C-C stretching
1285,1193	=C-H in plane
1044	N-H in plane
924	C-H stretching
787	=C-H out of plane
684	C-C out of plane
618	N-H out of plane
Thiophene	
2958,2919	C-H stretching
1645,1522	C=C and C-C stretching
1468. 1400, 1377	CH_2 deformation
1209.1096,1069	C-H in plane deformation
828	C-H out of plane deformation
720	C-S bending

Table F2 FT-IR peak assignments for the IR absorption band of iodine

Wavenumber ,λ (cm^{-1})	Assignment	Ref
620-490	C-I stretching	140-143
495	C-I stretching	147
724,782,1530,1540	PPy doped with Iodine (C-C)-I	148-150
708,1450,1520,2300	PTh doped with Iodine (C-C)-I	148

Appendix G Data of Conductivity Measurement

Table G1 Volume and surface conductivity of the admicelled rubbers

Vary the electrode

Condition PPy 50 mM electrical 6 volts

Sample	Resistivity V Ω.cm	σ_v $S.cm^{-1}$	Resistivity S Ω	σ_s S	Thickness (cm)
Cu|Zn	$8.248182012 \times 10^{9}$	$1,21239 \times 10^{-10}$	$1.1209980402 \times 10^{-10}$	8.92062×10^{-11}	0.3540
Cu|Pb	$4.133199185 \times 10^{5}$	2.41943×10^{-6}	$4.417770733 \times 10^{5}$	2.26359×10^{-6}	0.3271
Cu|Cu	1.6692494×10^{7}	5.99072×10^{-8}	2.5363340×10^{8}	3.9427×10^{-9}	0.2940

Table G2 Volume and surface conductivity of the admicelled rubbers

Vary type of conductive polymers

Conditions : various PPy (mM) ; electrical 9 volts ; using cu | cu electrode

PPY (mM)	PPy : NR %	Resistivity V Ω.cm	σ_v S.cm^{-1}	Resistivity S Ω	σ_s S	Thickness (cm)
Rubber	-	1.39 E+14	7.18 E-15	4.06 E+14	2.46 E-15	0.3336
20	2.613	1.79 E+09	1.49 E-10	4.34 E+09	2.30 E-10	0.3140
50	6.287	1.67 E+07	5.99 E-08	2.54 E+08	3.94 E-09	0.2940
100	11.831	3.22 E+05	3.10 E-06	6.13 E+05	1.63 E-06	0.2925
200	21.158	2.64 E+-05	3.79 E-06	9.68 E+05	1.03 E-06	0.2821
500	40.152	3.22 E+-04	3.10 E-05	3.26 E+04	3.06 E-05	0.2823
800	51.771	3.13 E+03	3.19 E-04	2.61 E+03	3.83 E-04	0.3095

Conditions : various PTh (mM) ; electrical 9 volts ; using cu | cu electrode

PTh (mM)	PTh : NR %	Resistivity V Ω.cm	σ_v S.cm^{-1}	Resistivity S Ω	σ_s S	Thickness (cm)
Rubber	-	1.39E+14	7.18E-15	4.07E+14	2.46E-15	0.334
20	3.256	3.97E+11	2.52E-12	5.40E+11	1.85E-12	0.387
50	7.761	3.88E+09	2.57E-10	7.08E+10	1.41E-11	0.394
100	14.404	3.50E+07	2.86E-08	7.61E+07	1.31E-08	0.395
200	25.181	1.12E+07	8.94E-08	7.13E+07	1.40E-08	0.391
500	45.693	1.87E+06	5.35E-07	3.61E+06	2.77E-07	0.490
800	57.379	1.21E+05	8.26E-06	3.84E+05	2.61E-06	0.413

Table G3 Conductivity of natural rubber sheet at various monomer concentrations

Sample (mM)		Resistivity V Ω.cm	σ_v S.cm^{-1}	Resistivity S Ω	σ_s	Thickness (cm)
Iodine dope	Enr	1,38E+13	7,25E-14	2,14E+12	4,67E-13	0.3310
	EA2	1.39E+09	7,17E-10	4,27E+09	2,34E-10	0.3287
	EA80	1.75E+03	5.71E-04	9,74E+03	1,03E-04	0.3095
	EB2	6.79E+09	1,47E-10	2,74E+07	3,65E-08	0.3375
	EB80	2.95E+04	3.39E-05	2,28E+04	4,39E-05	0.3305
w/o dope	Rubber	1,39E+14	7,18E-15	4,07E+14	2,46E-15	0.3336
	A2	1.80E+09	1.49E-10	4.35E+09	2.30E-10	0.3140
	A80	3.13E+03	3.19E-04	2.61E+03	3.83E-04	0.3095
	B2	3.97E+11	2.52E-12	5.40E+11	1.85E-12	0.387
	B80	1.21E+05	8.26E-06	3.84E+05	2.61E-06	0.413

where A= PPY, B= PTh , E= dope with iodine

<u>**Example**</u> the calculation the volume conductivity and surface conductivity

At PPy =20mM

Resistance = V/I =m	**24640605.04**	**Resistance =V/I =m**	**81387943.72**
volume resistivity =	M*22.9/t **1797037756**	**Surface resistivity =**	m*53.4 **4346116195**
V. Conductivity =	1/resistivity **5.56471E-10**	**S. Conductivity =**	1/resistivity **2.3009E-10**

when the specimen thickness is 0.314 cm

the equations is follow by :

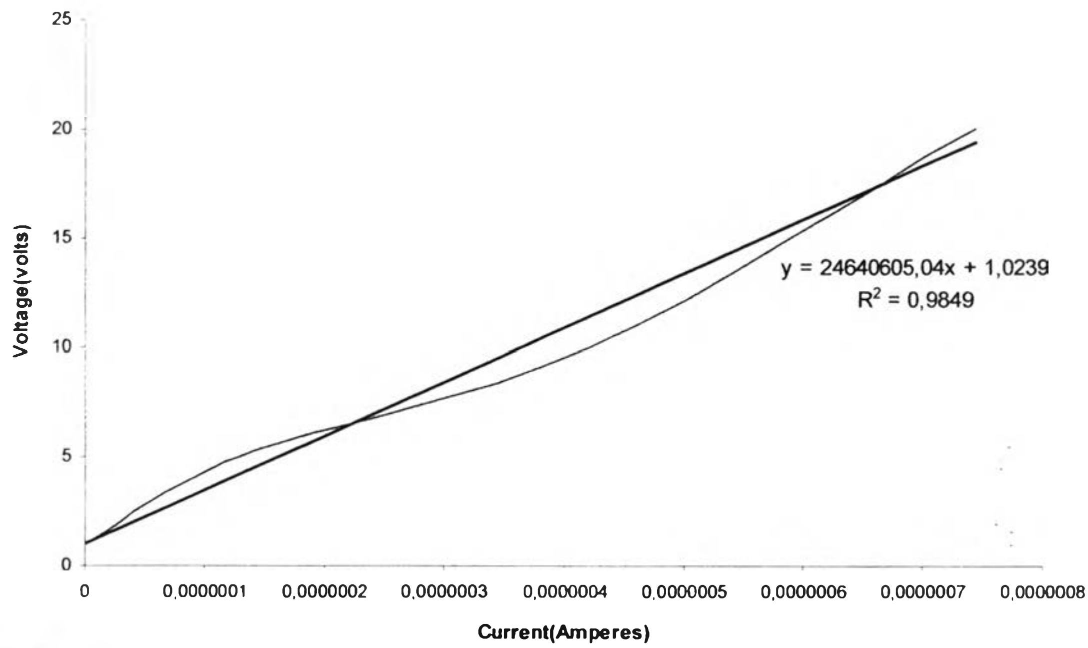


Figure G1 Volume resistance in linear range of PPy 20 mM

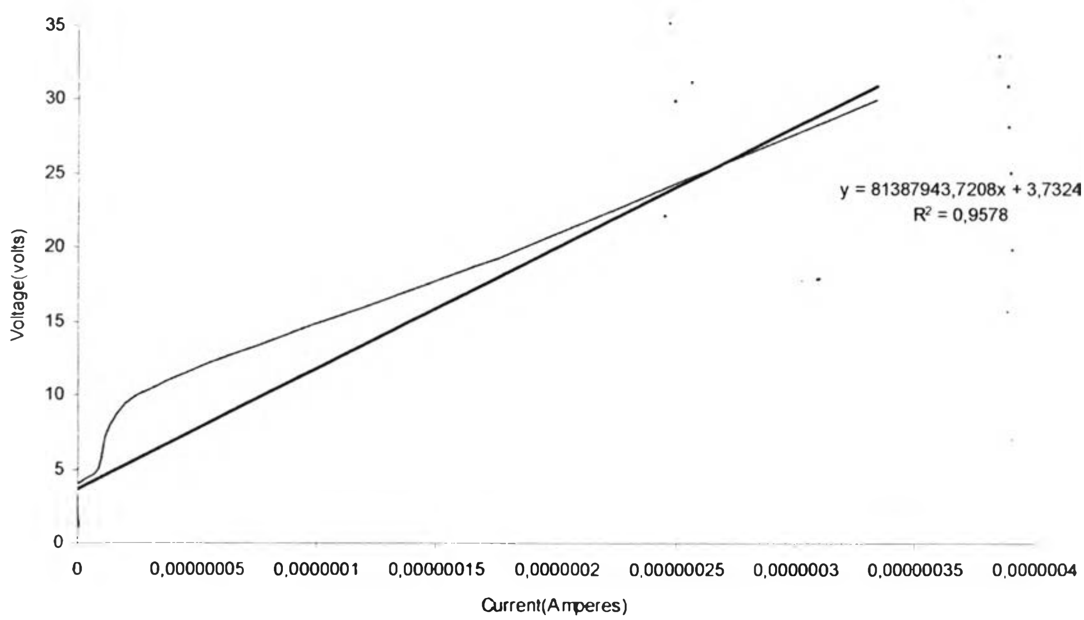


Figure G2 Surface resistance in linear range of PPy 20 mM

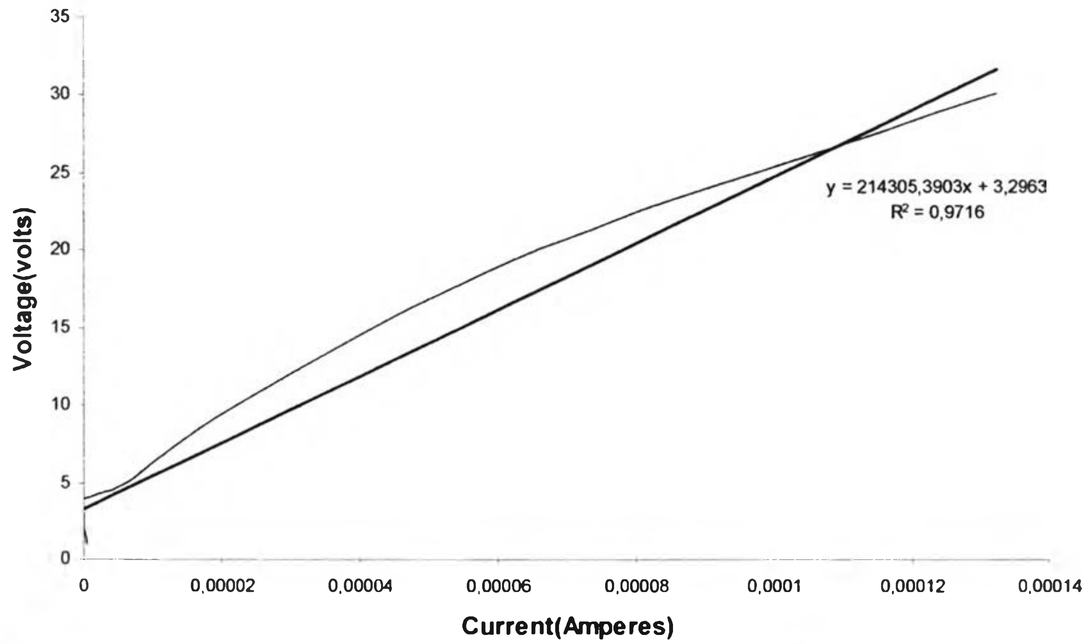


Figure G3 Volume resistance in linear range of PPy 50 mM

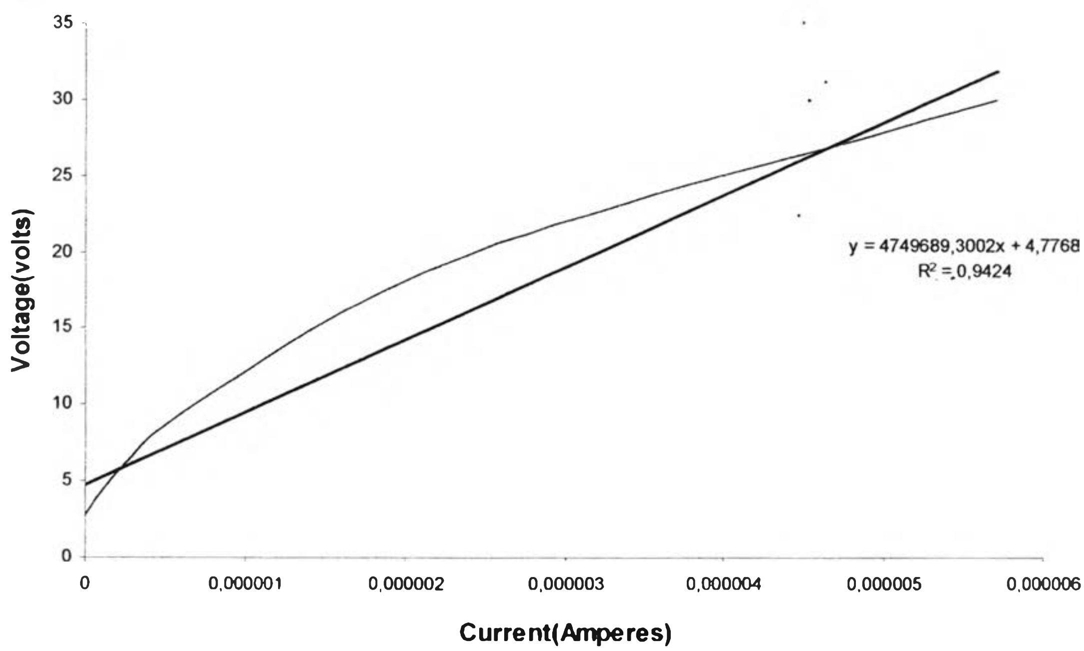


Figure G4 Surface resistance in linear range of PPy 50 mM

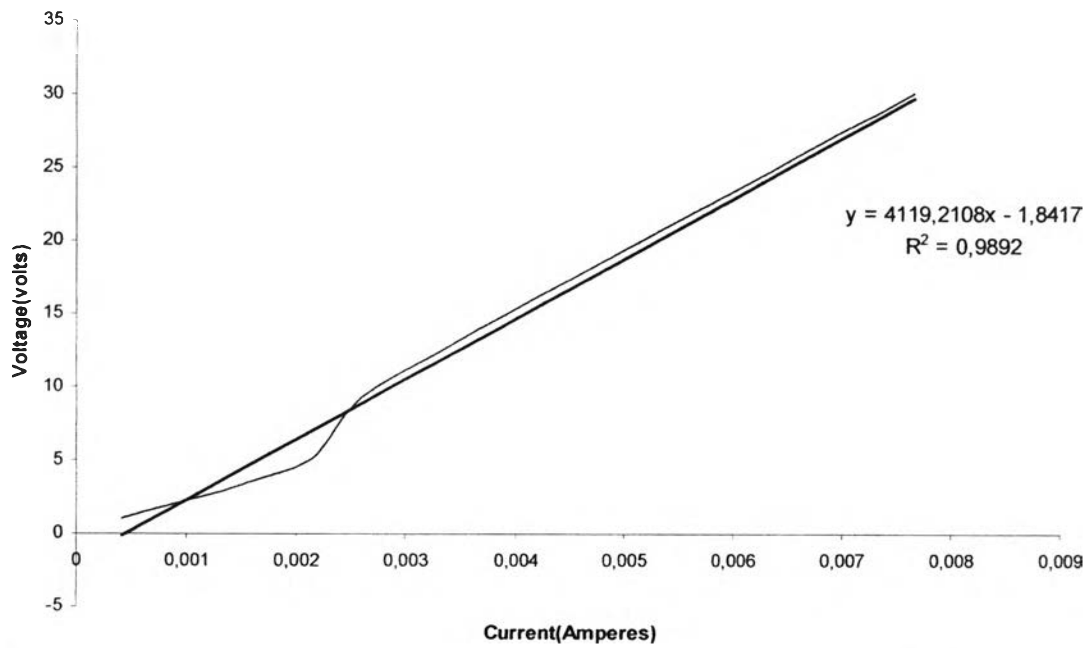


Figure G5 Volume resistance in linear range of PPy 100 mM

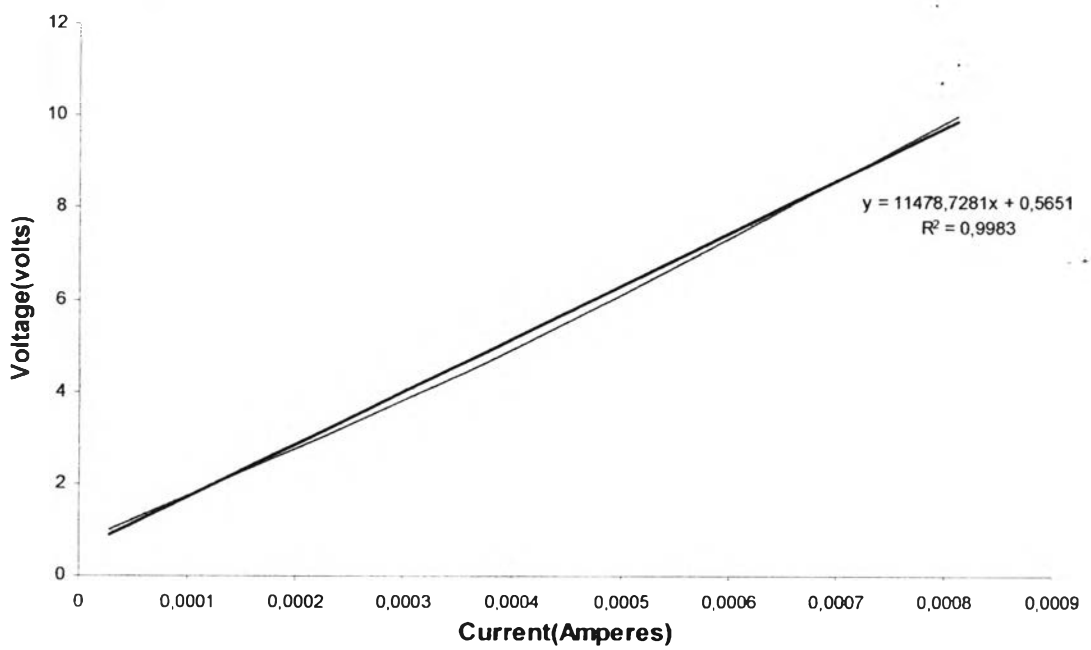


Figure G6 Surface resistance in linear range of PPy 100 mM

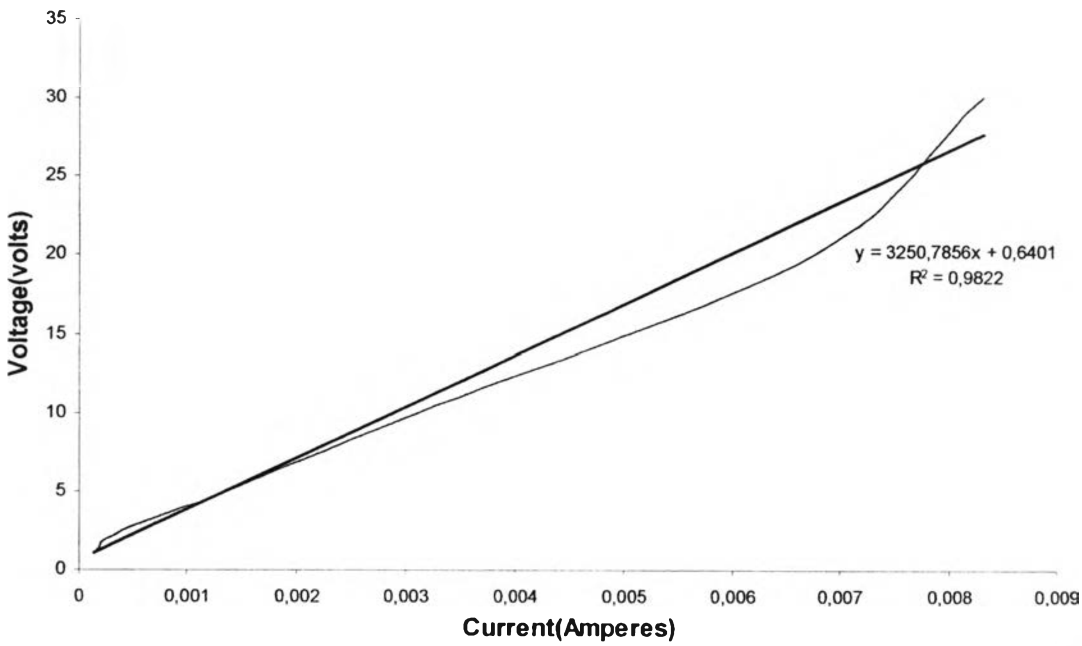


Figure G7 Volume resistance in linear range of PPy 200 mM

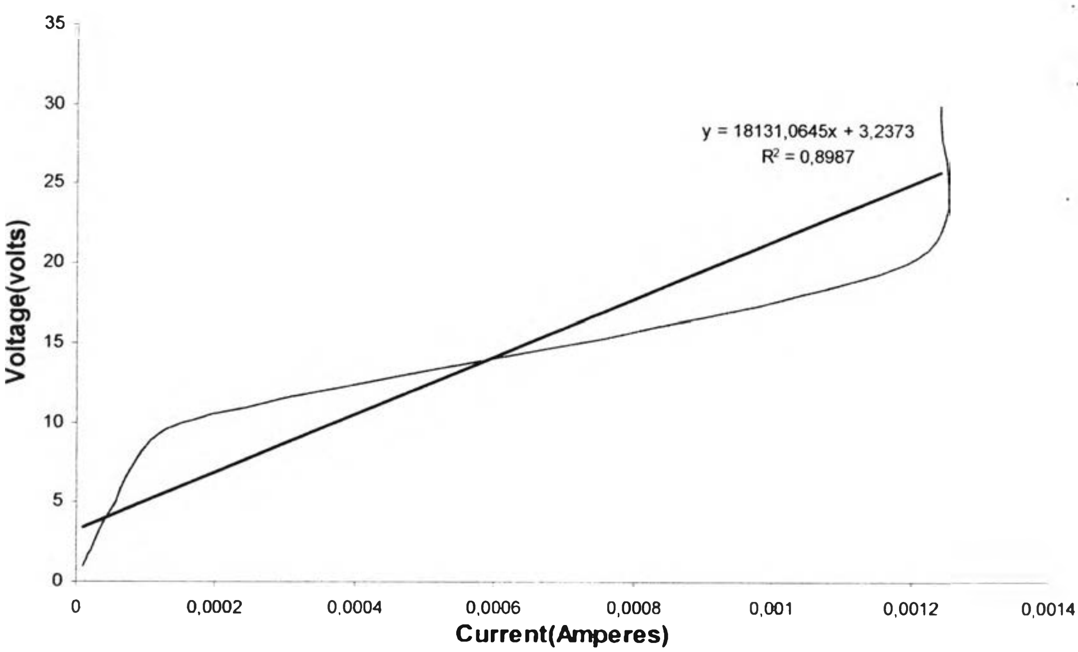


Figure G8 Surface resistance in linear range of PPy 200 mM

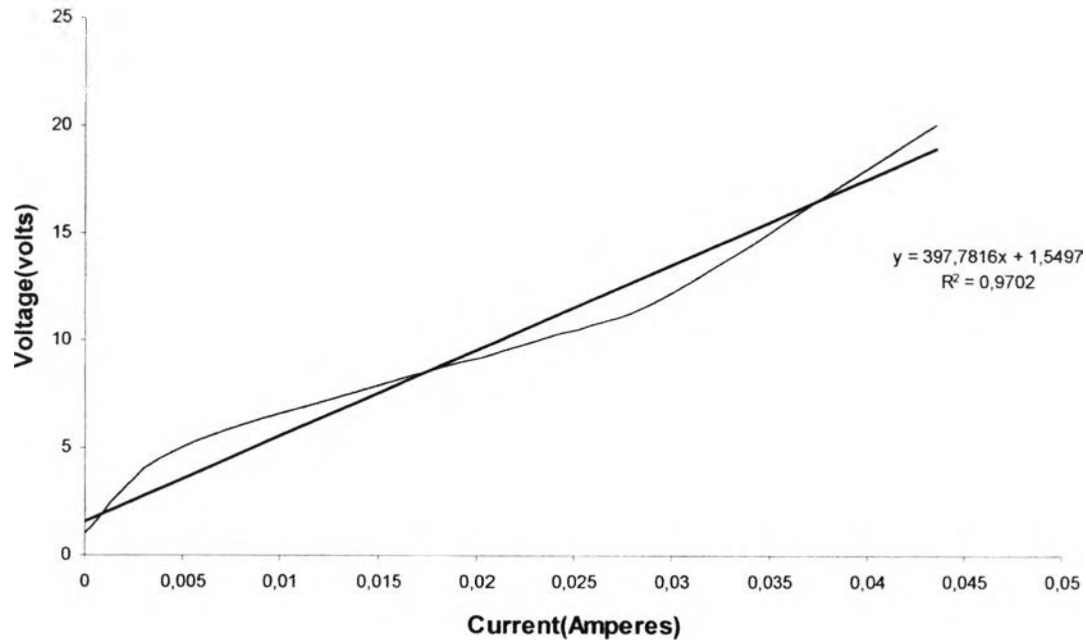


Figure G9 Volume resistance in linear range of PPy 500 mM

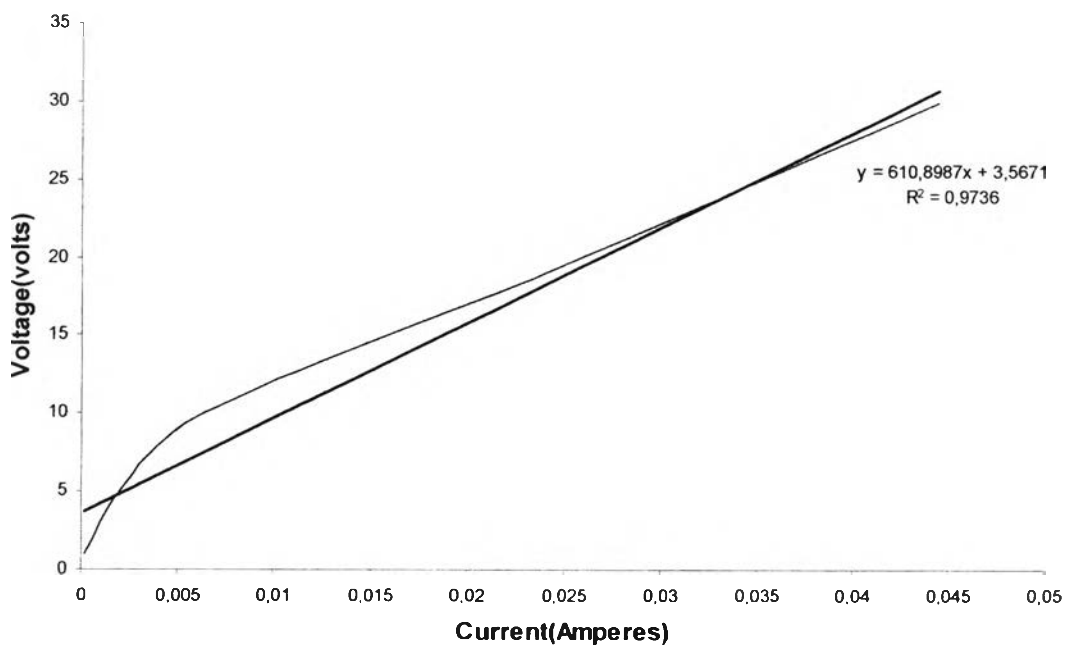


Figure G10 Surface resistance in linear range of PPy 500 mM

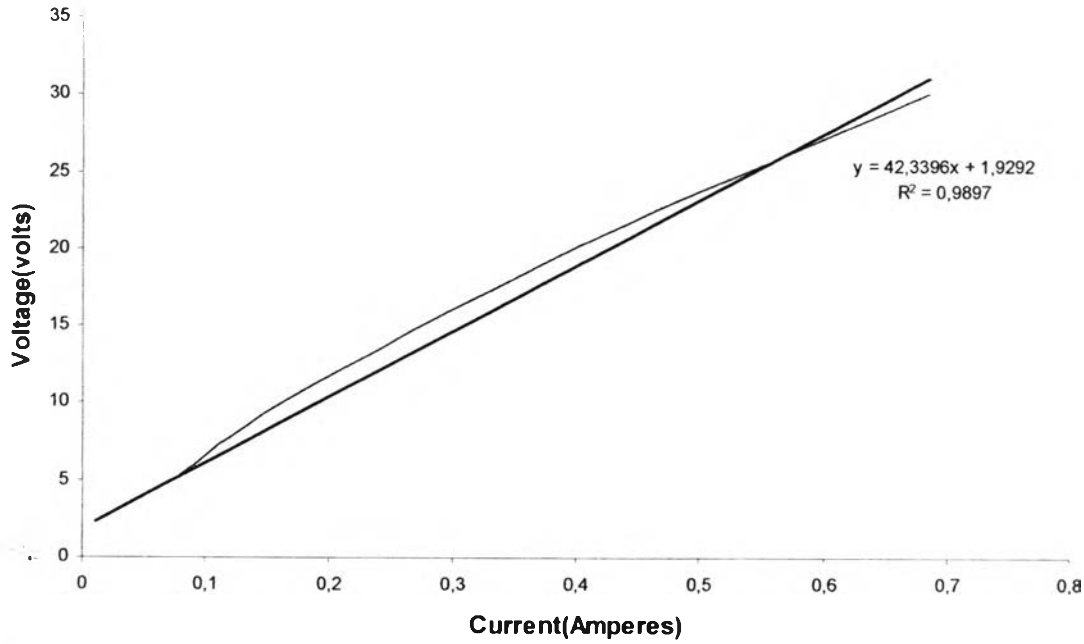


Figure G11 Volume resistance in linear range of PPy 800 mM

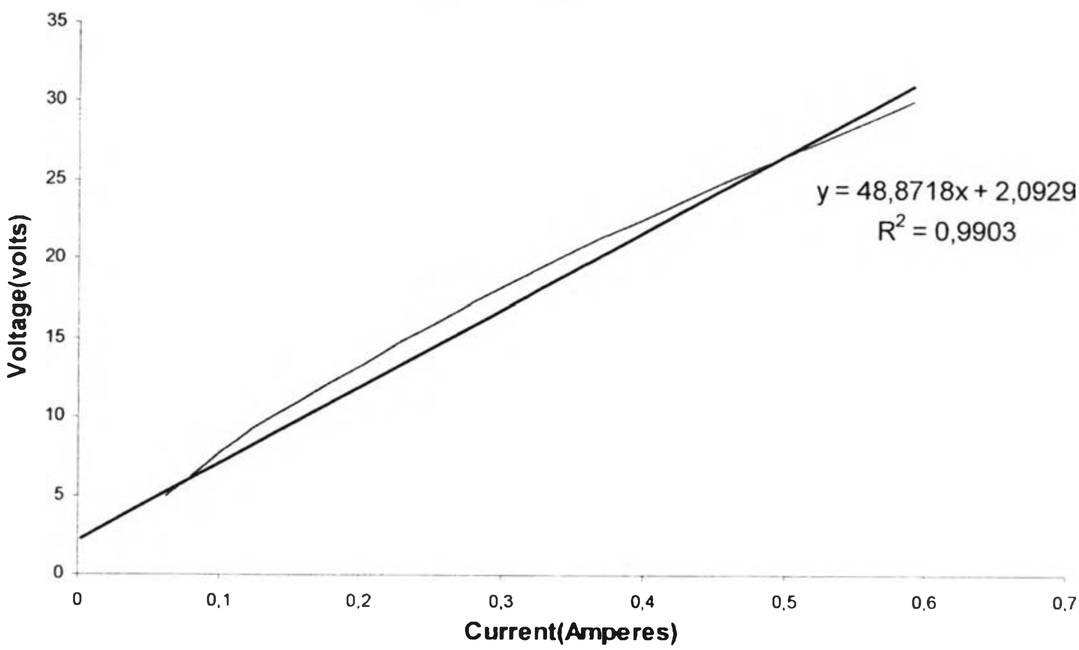


Figure G12 Surface resistance in linear range of PPy 800 mM

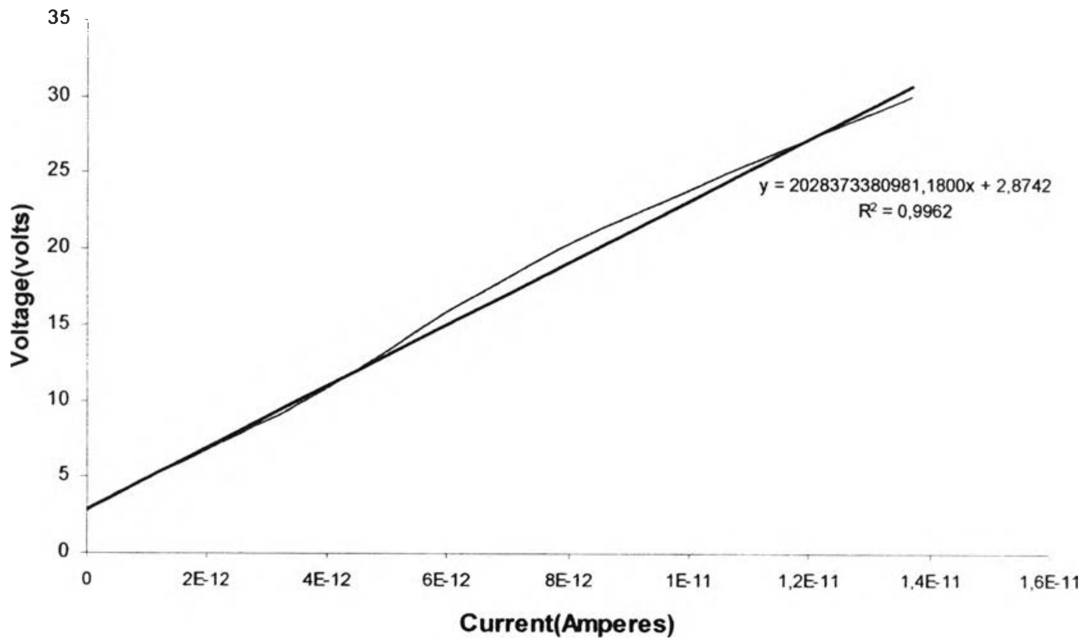


Figure G13 Volume resistance in linear range of NR

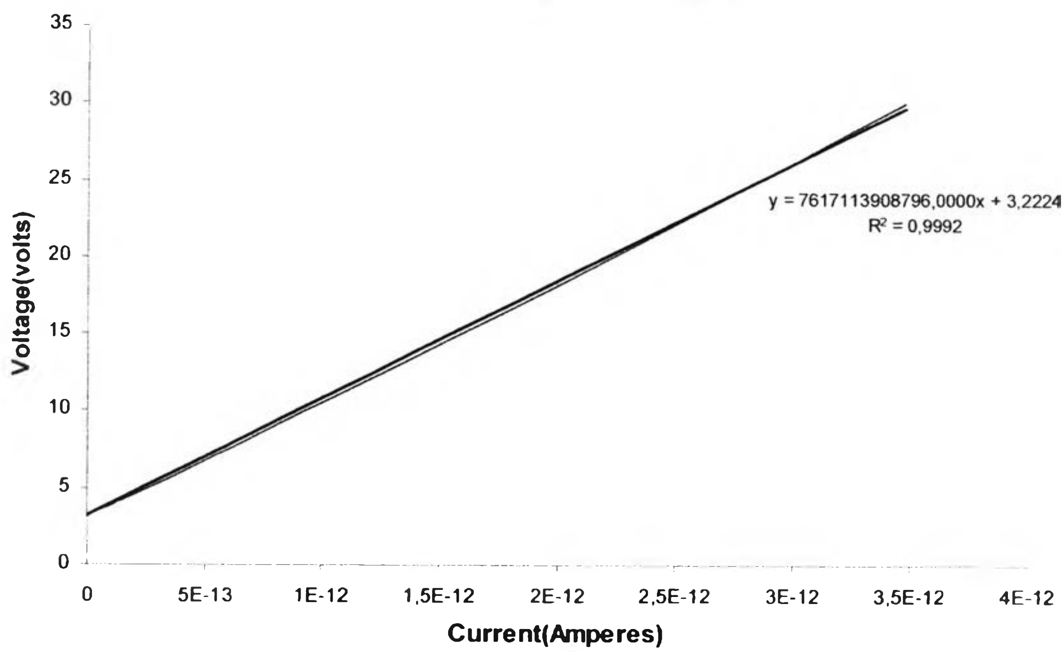


Figure G14 Surface resistance in linear range of NR

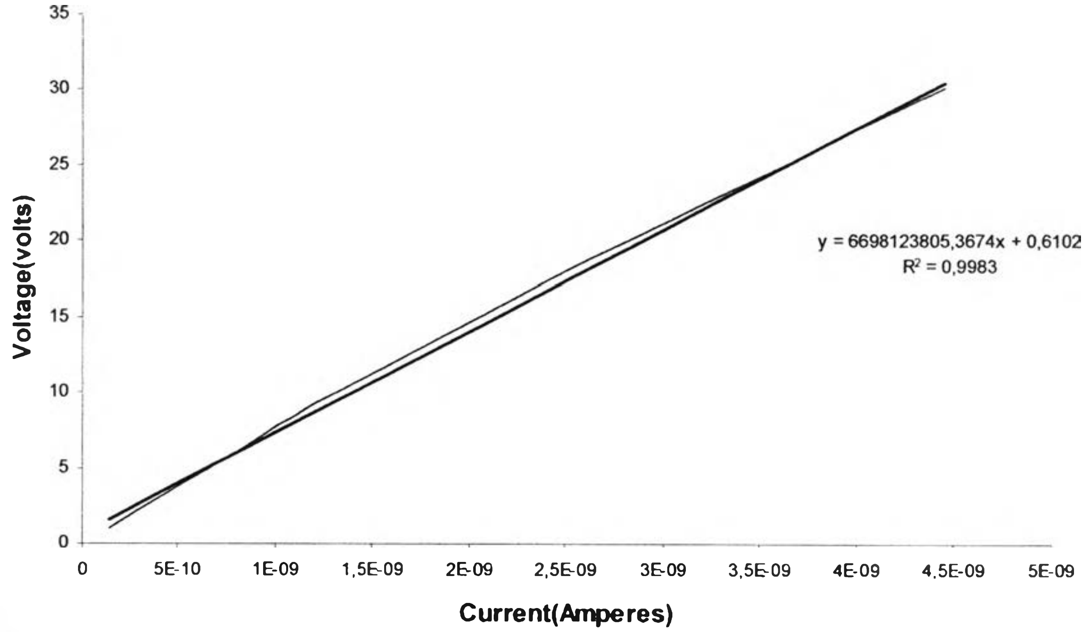


Figure G15 Volume resistance in linear range of PTh 20 mM

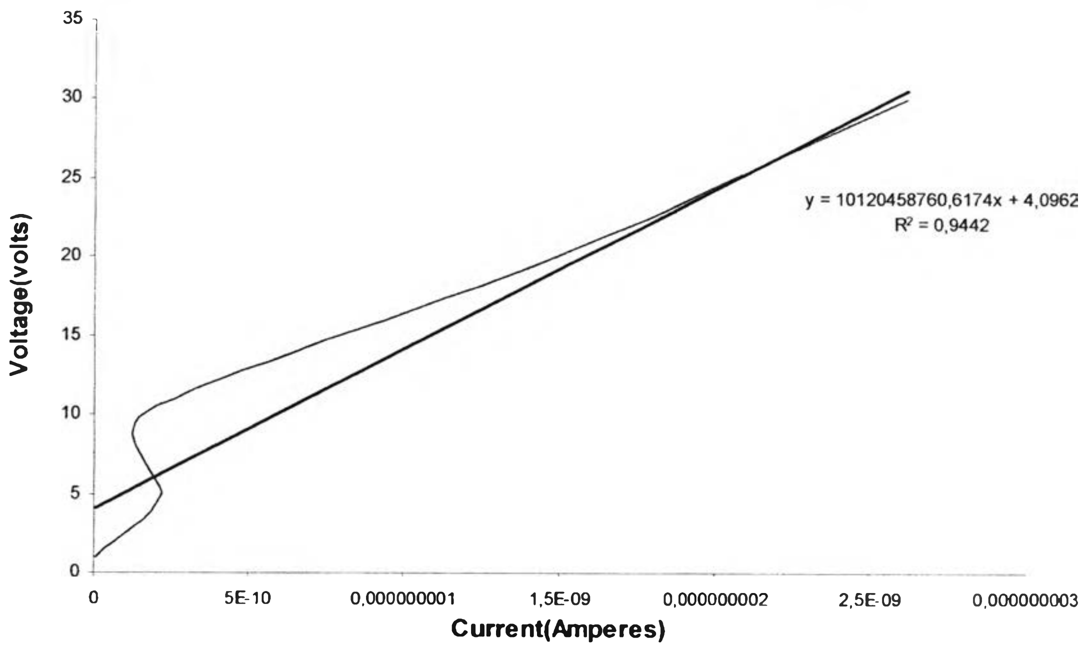


Figure G16 Surface resistance in linear range of PTh 20 mM

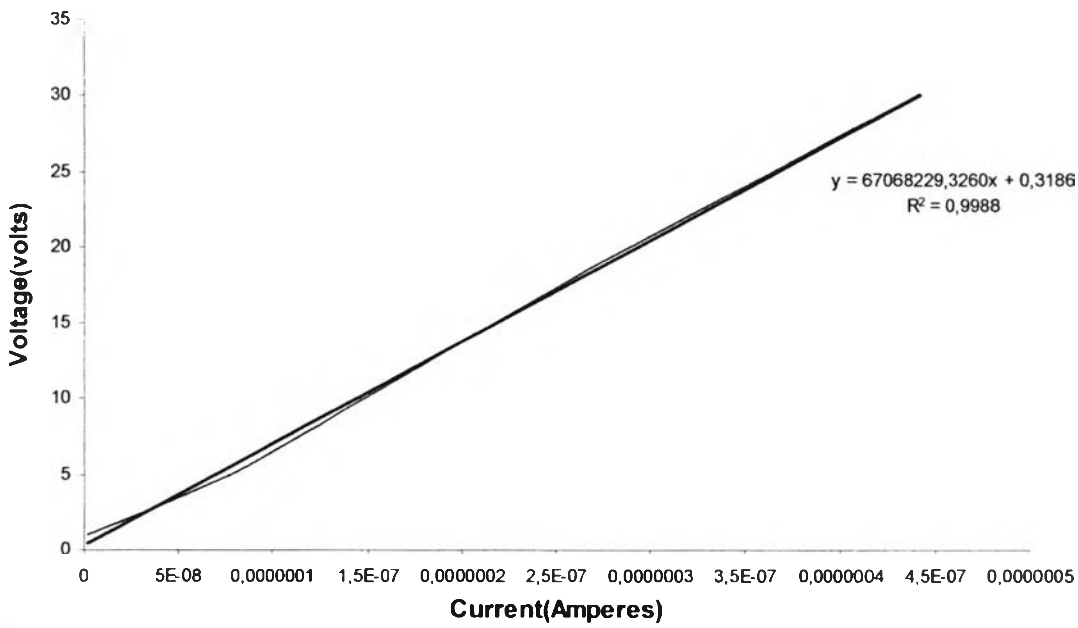


Figure G17 Volume resistance in linear range of PTh 50 mM

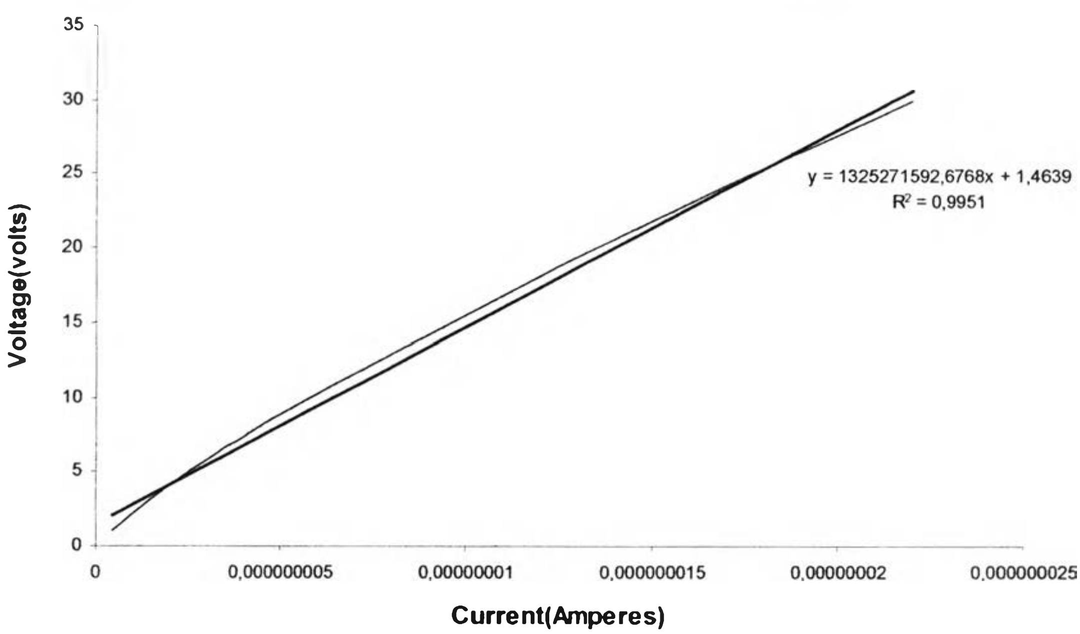


Figure G18 Surface resistance in linear range of PTh 50 mM

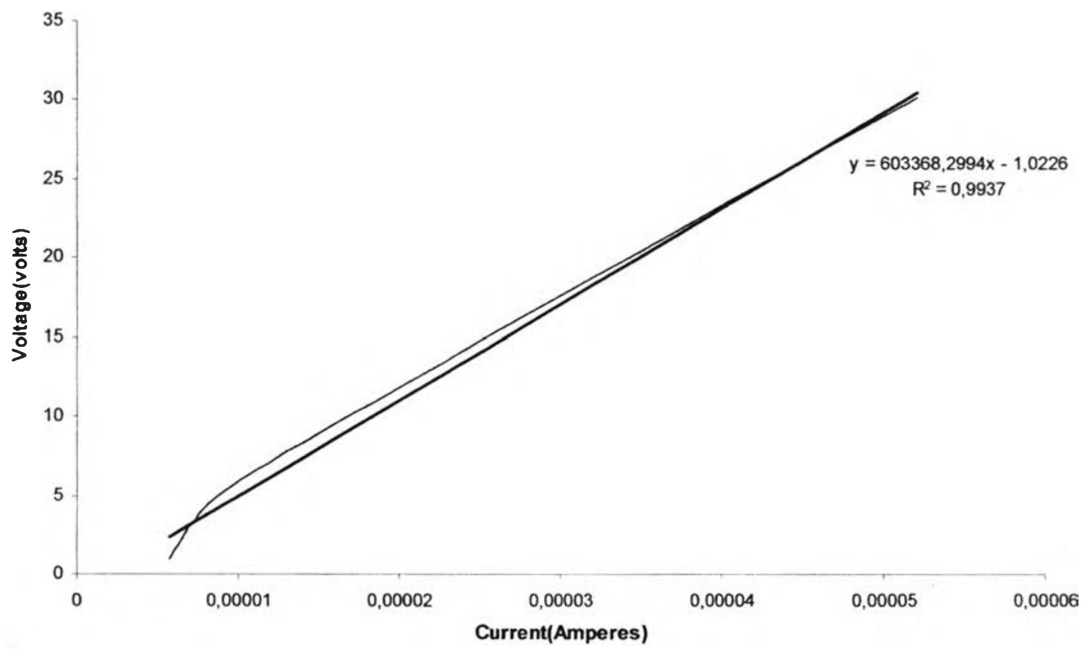


Figure G19 Volume resistance in linear range of PTh 100 mM

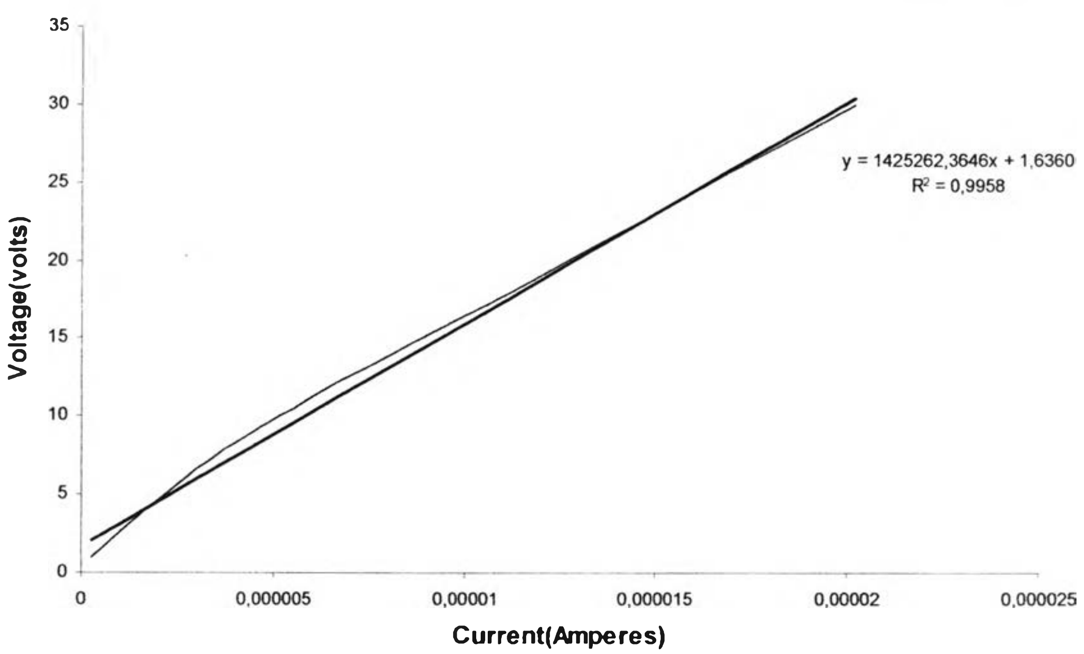


Figure G20 Surface resistance in linear range of PTh 100 mM

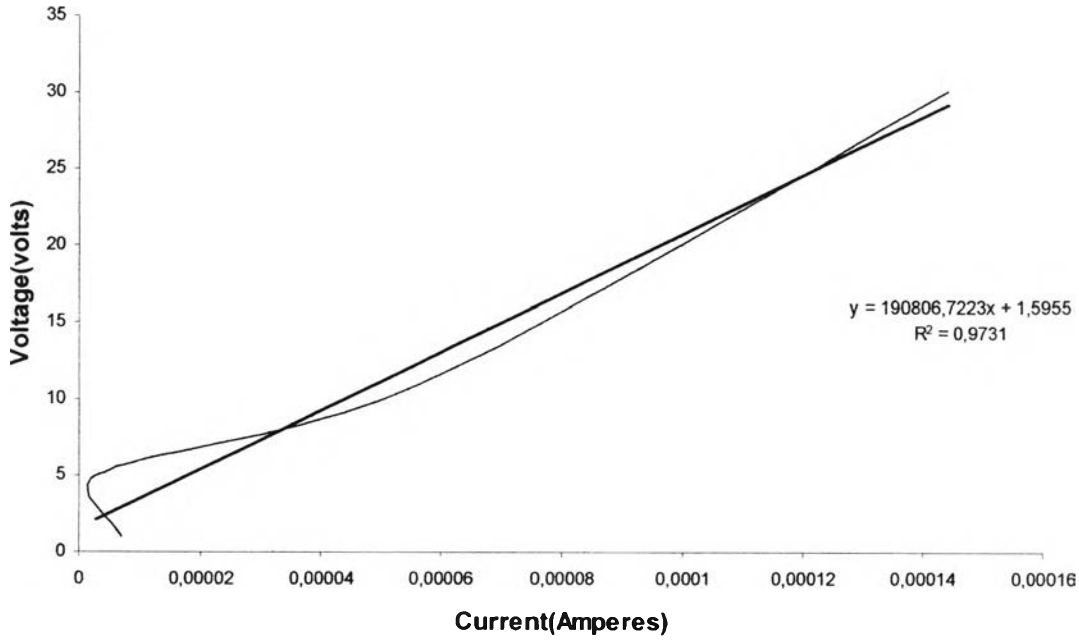


Figure G21 Volume resistance in linear range of PTh 200 mM

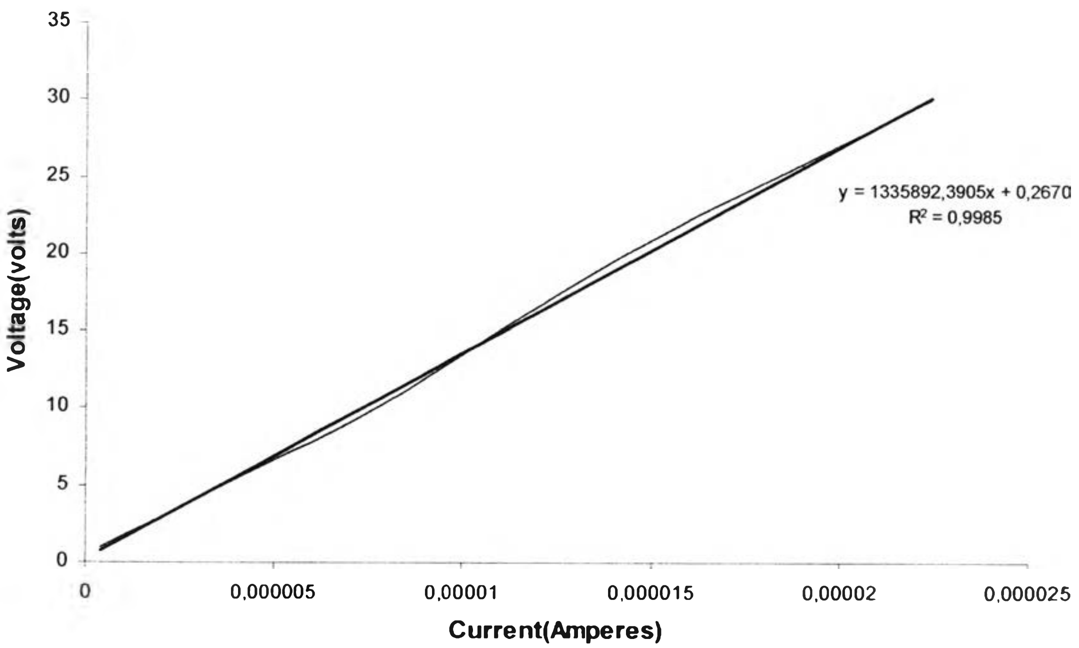


Figure G22 Surface resistance in linear range of PTh 200 mM

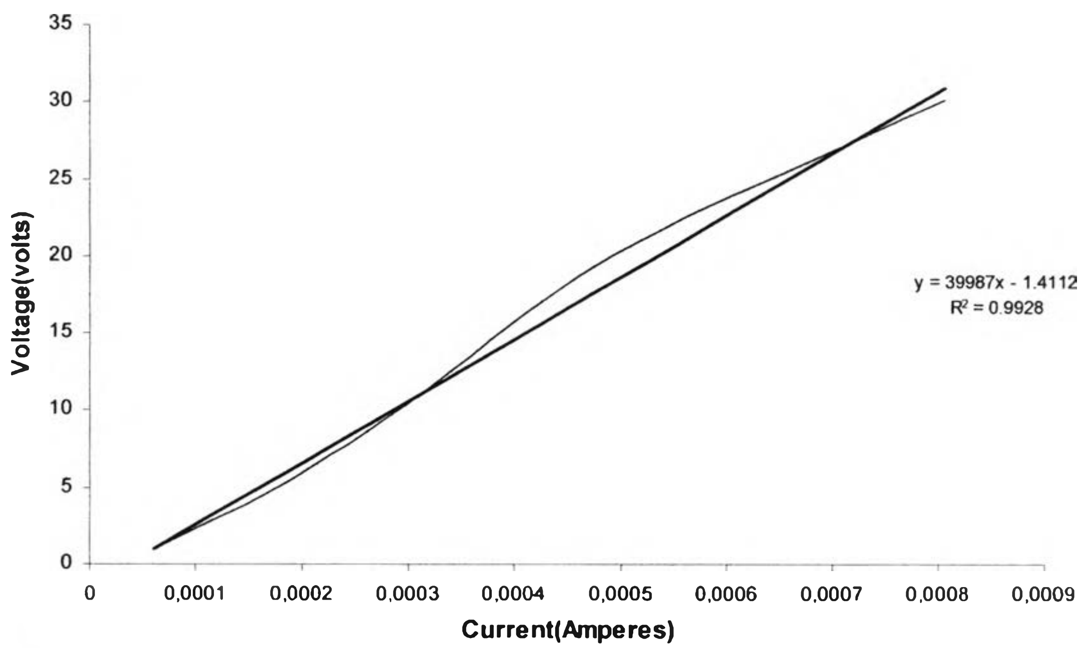


Figure G23 Volume resistance in linear range of PTh 500 mM

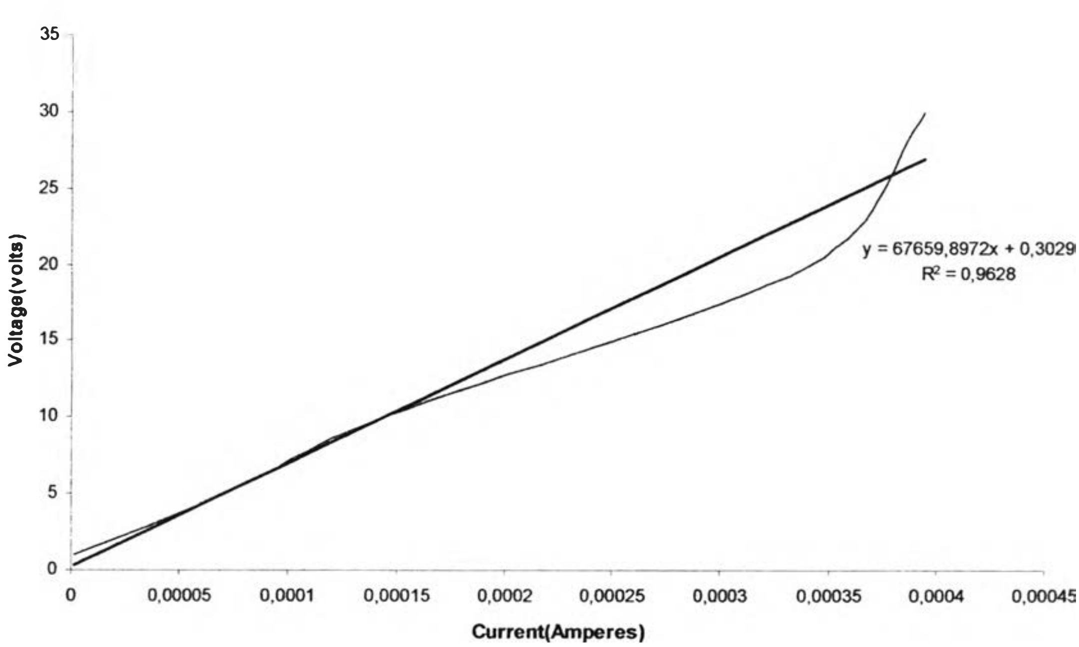


Figure G24 Surface resistance in linear range of PTh 500 mM

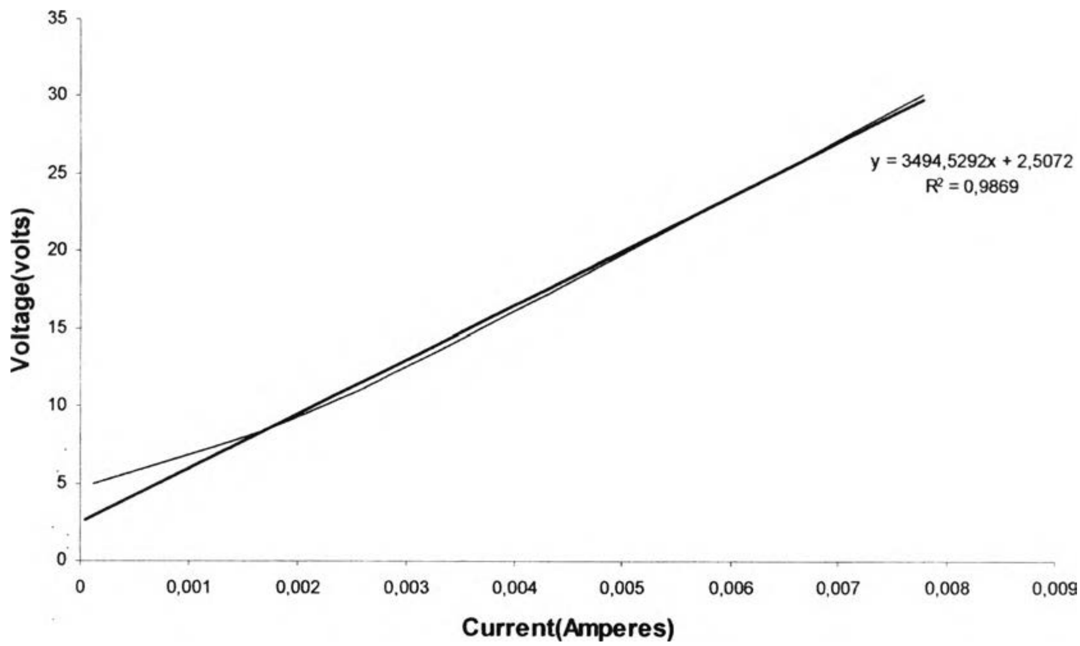


Figure G25 Volume resistance in linear range of PTh 800 mM

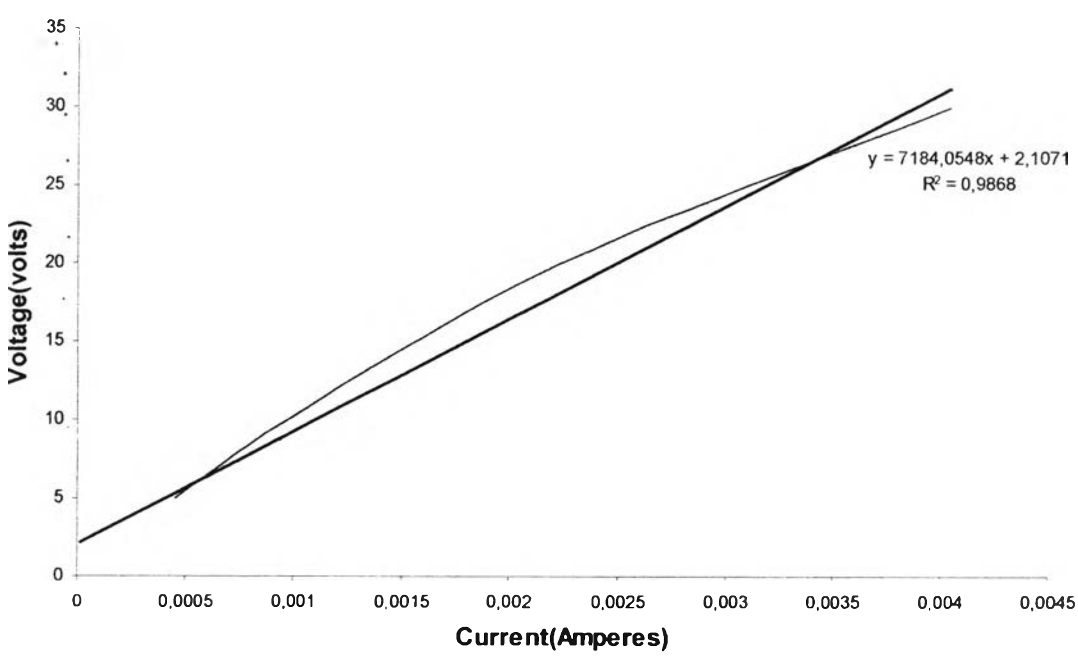


Figure G26 Surface resistance in linear range of PTh 800 mM

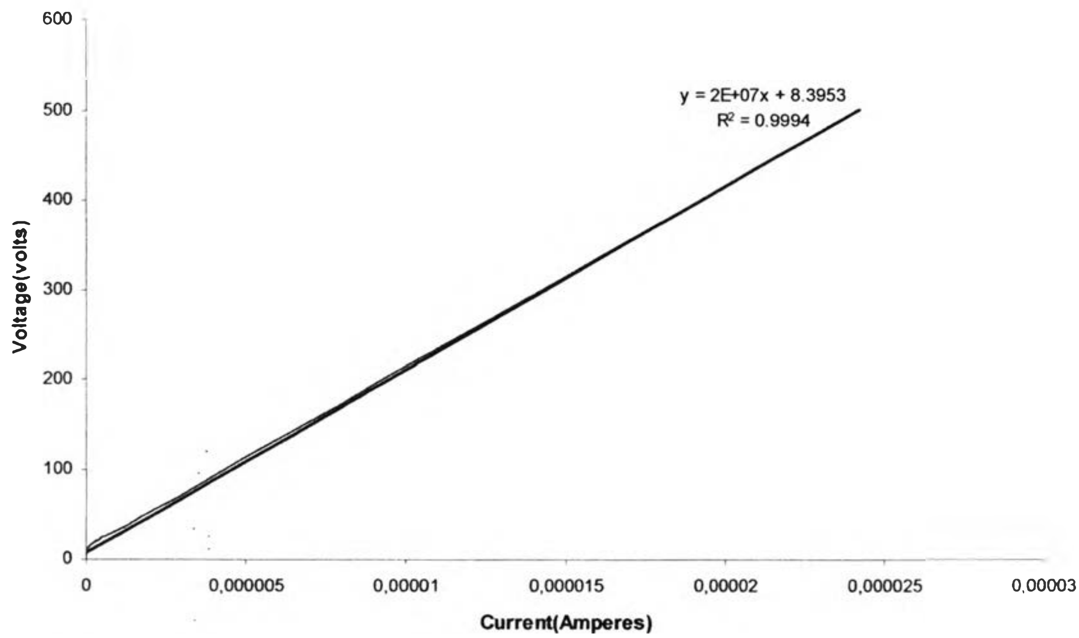


Figure G27 Volume resistance in linear range of PPy 20 mM doping with I_2 (E1)

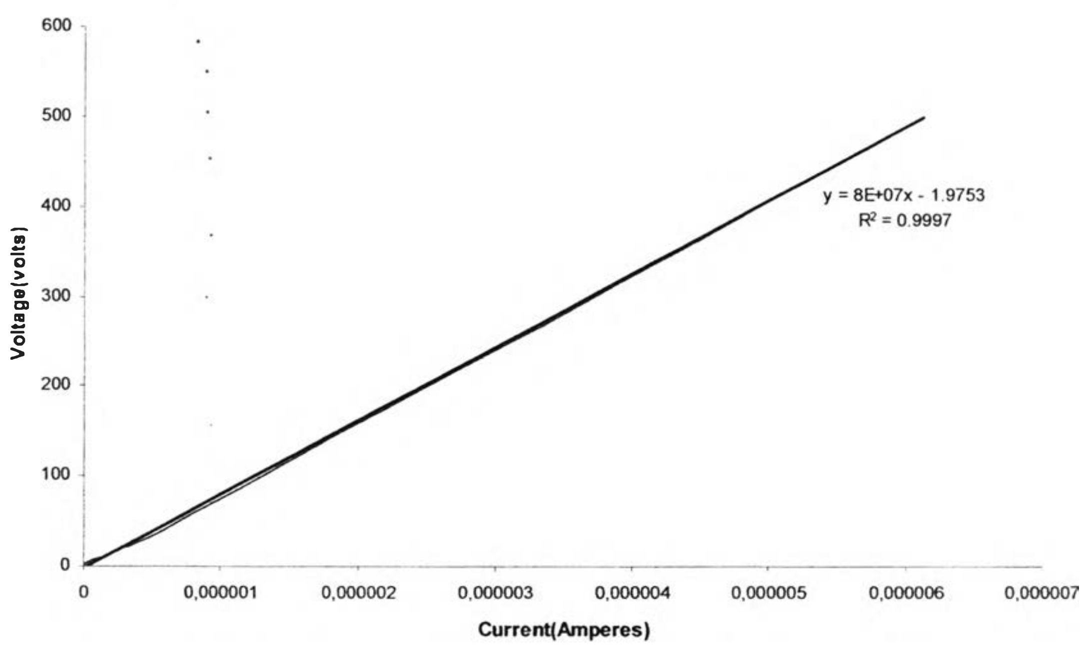


Figure G28 Surface resistance in linear range of PPy 20 mM doping with I_2 (E1)

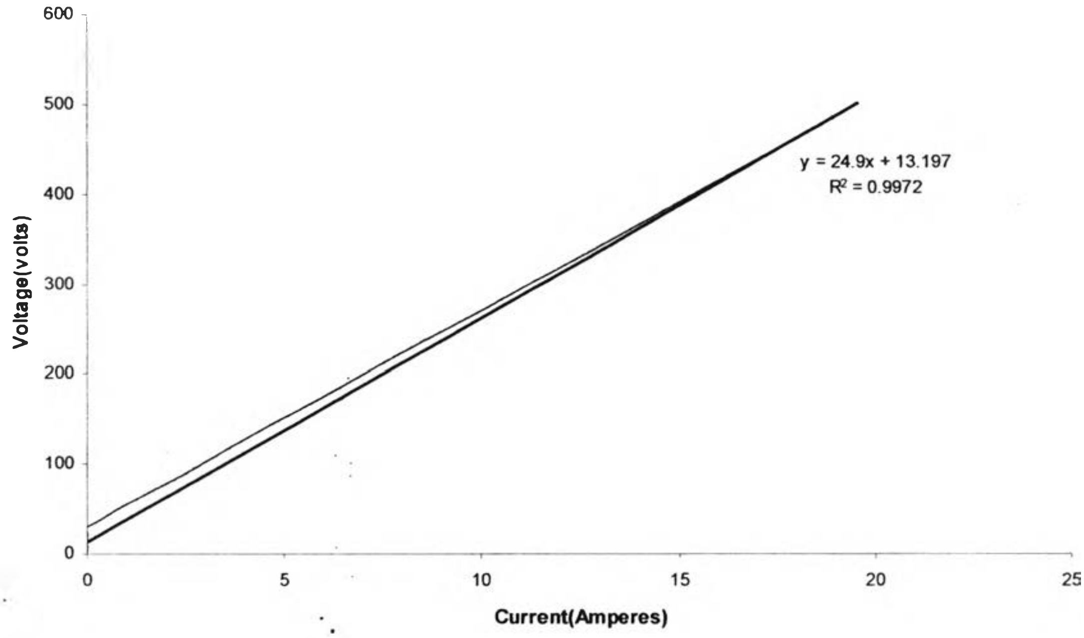


Figure G29 Volume resistance in linear range of PPy 800 mM doping with I_2 (E2)

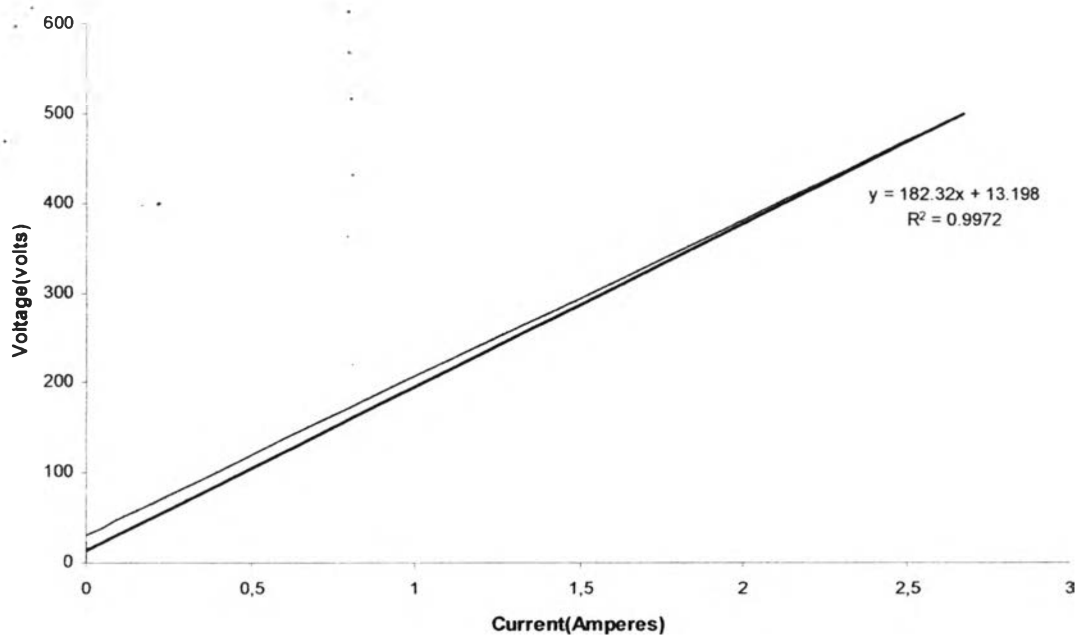


Figure G30 Surface resistance in linear range of PPy 800 mM doping with I_2 (E2)

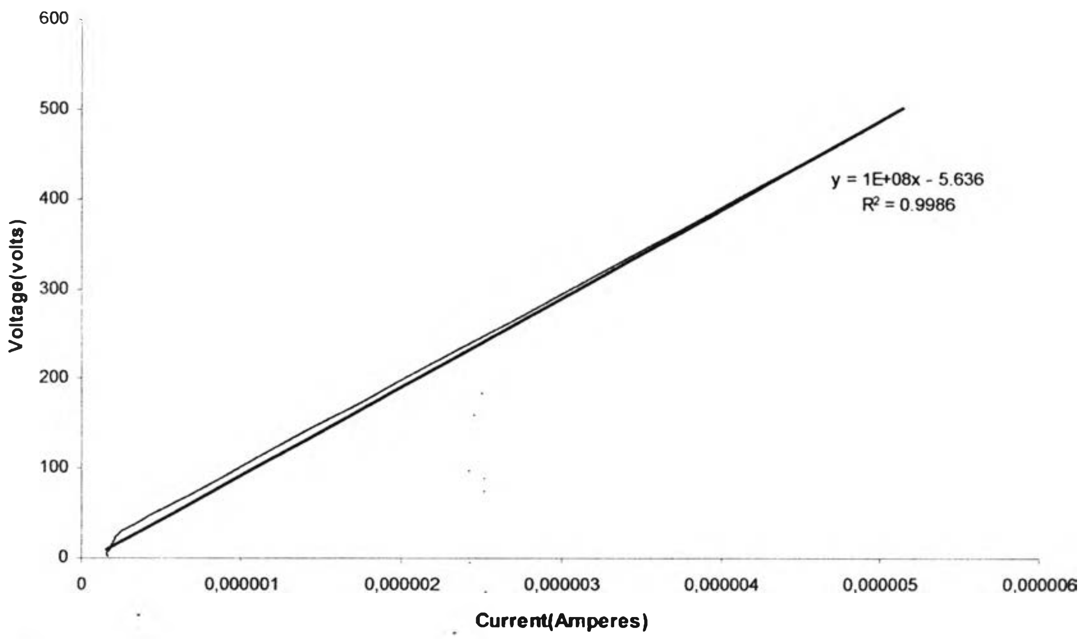


Figure G31 Volume resistance in linear range of PTh 20 mM doping with I_2 (E3)

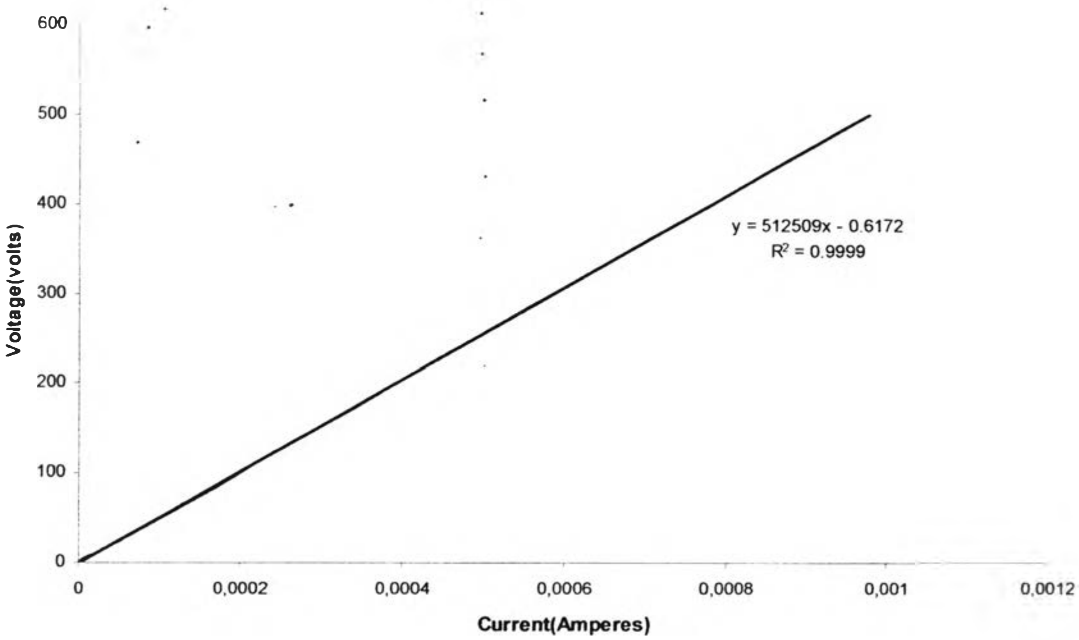


Figure G32 Surface resistance in linear range of PTh 20 mM doping with I_2 (E3)

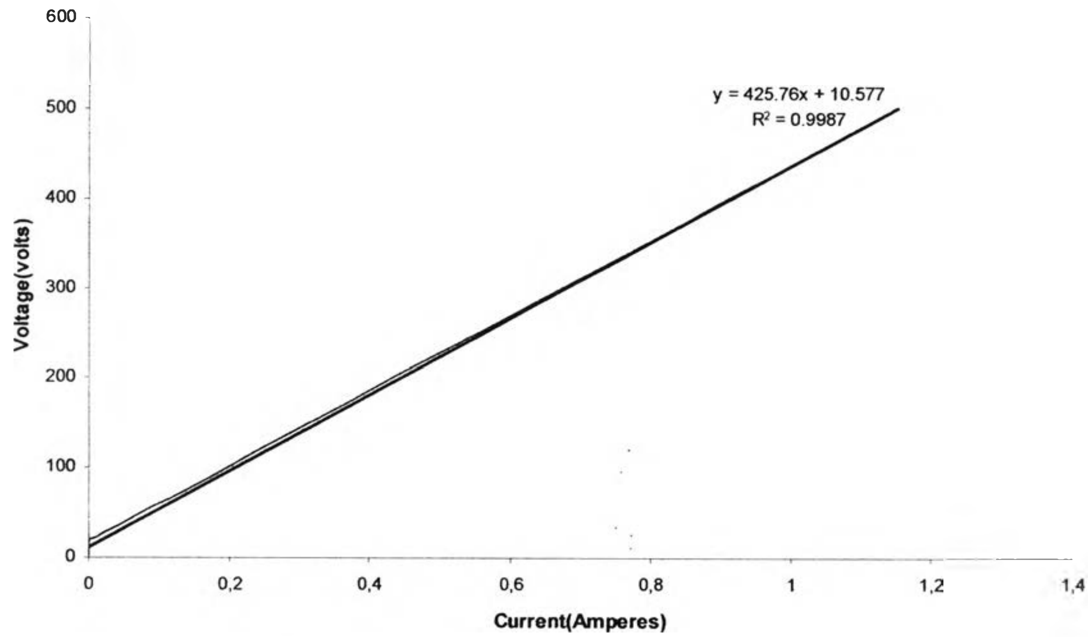


Figure G32 Volume resistance in linear range of PTh 800 mM doping with I_2 (E4)

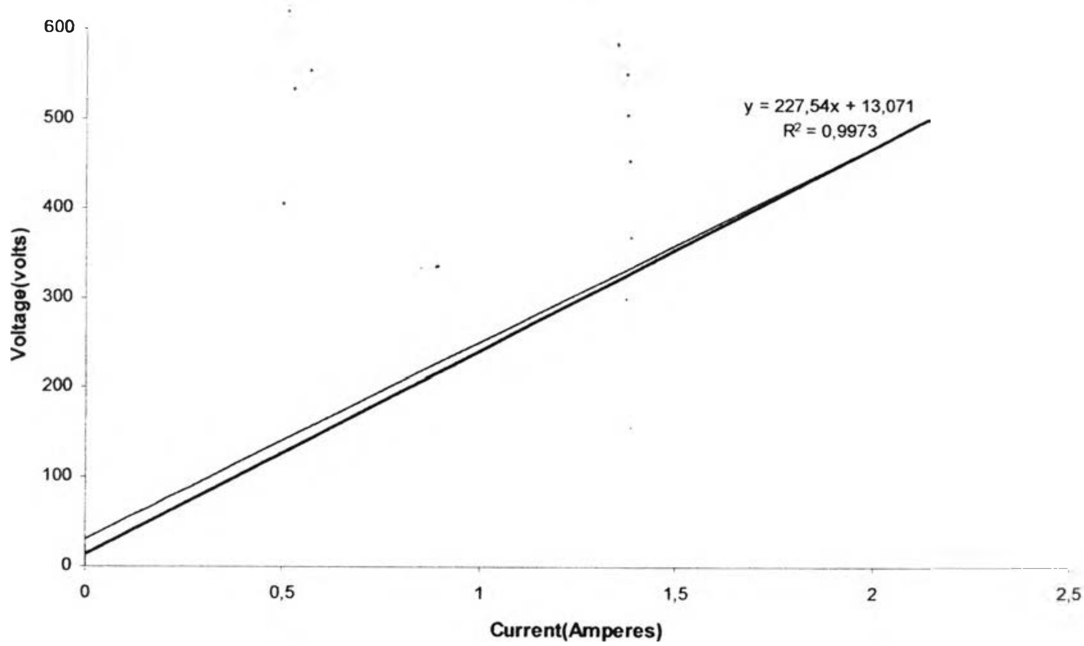


Figure G33 Surface resistance in linear range of PTh 800 mM doping with I_2 (E4)

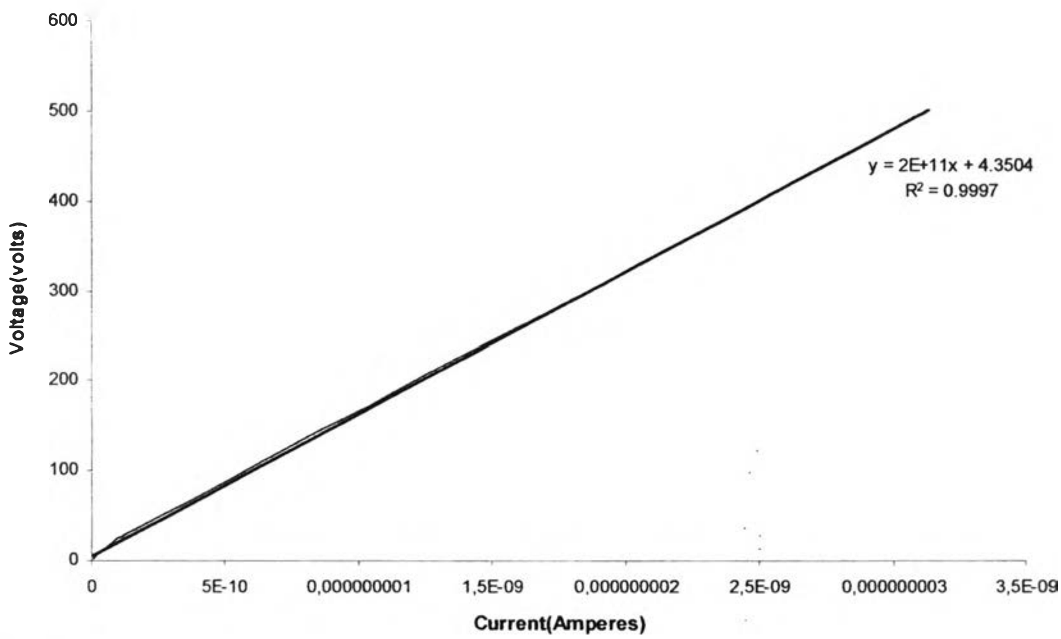


Figure G34 Volume resistance in linear range of NR doping with I_2 (E5)

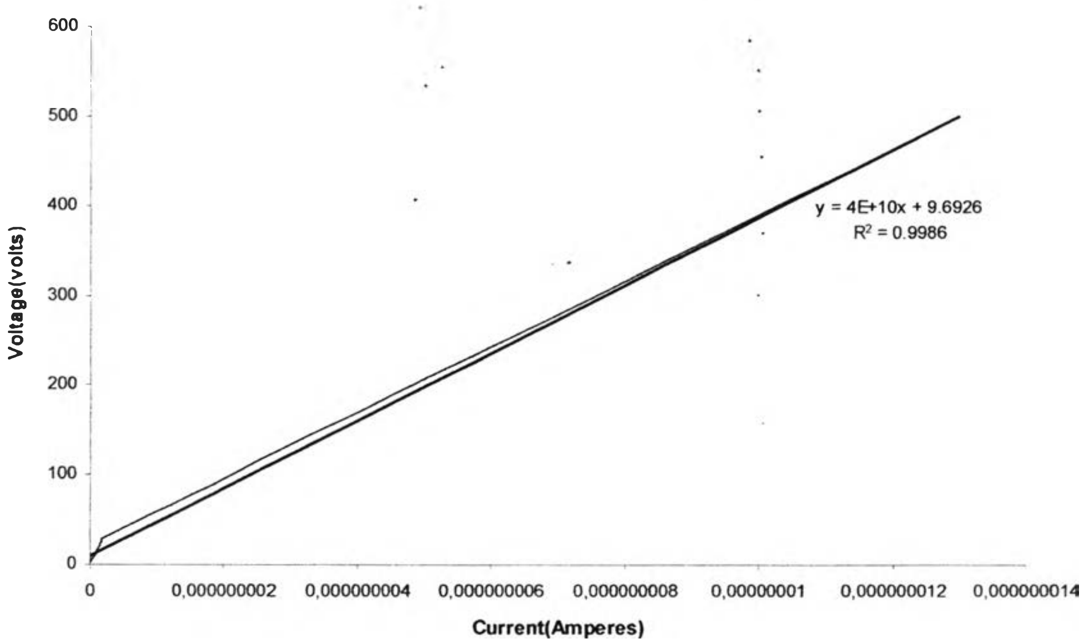


Figure G35 Surface resistance in linear range of NR doping with I_2 (E5)

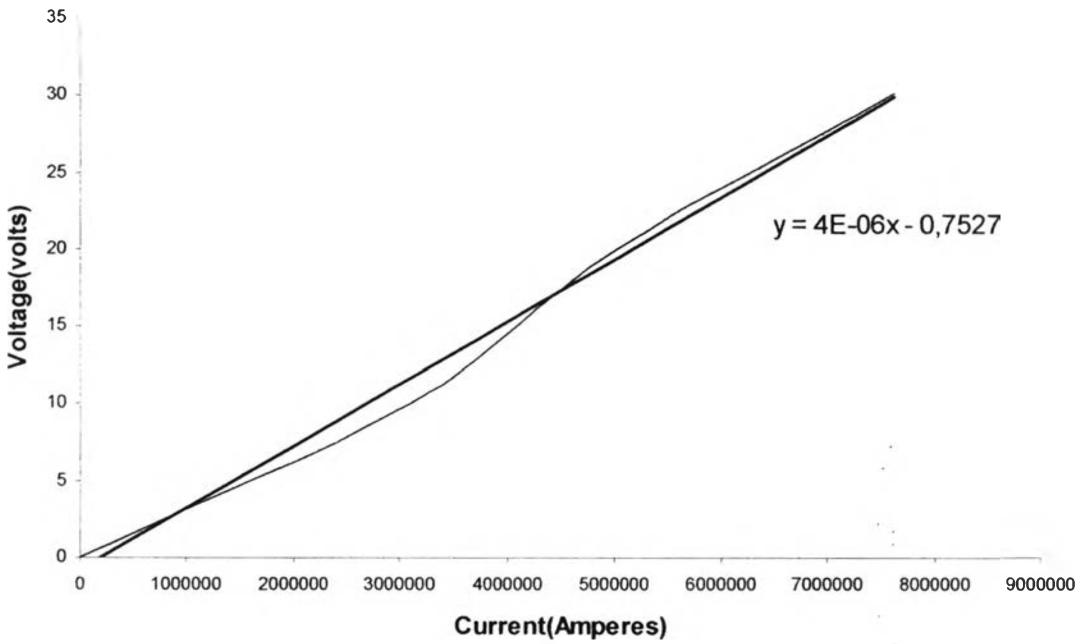


Figure G36 Volume resistance in linear range of PPy

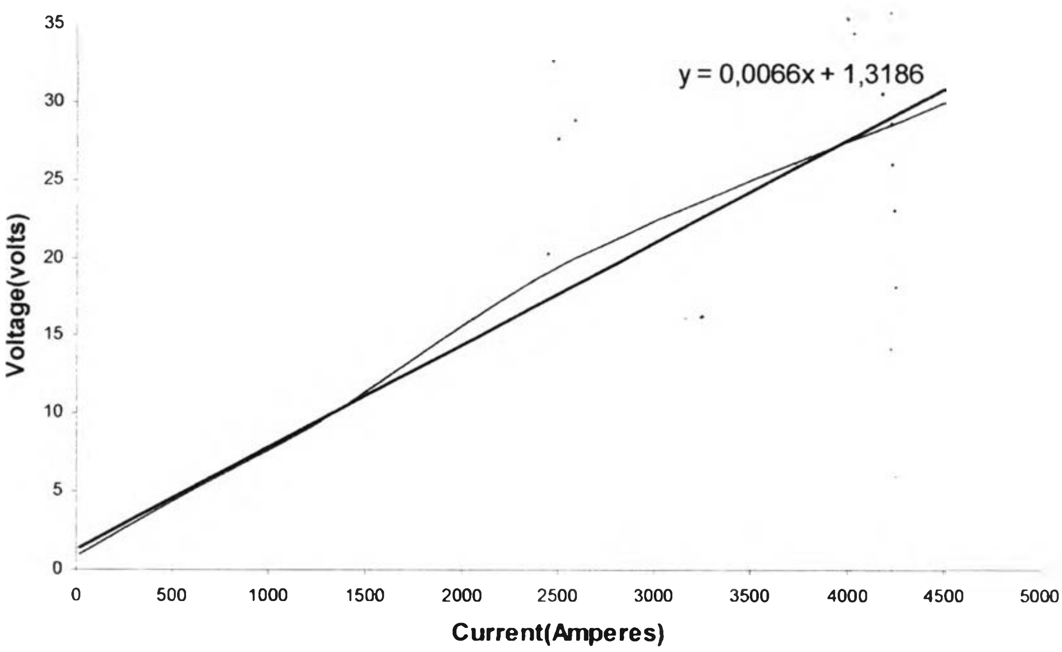


Figure G37 Surface resistance in linear range of PPy

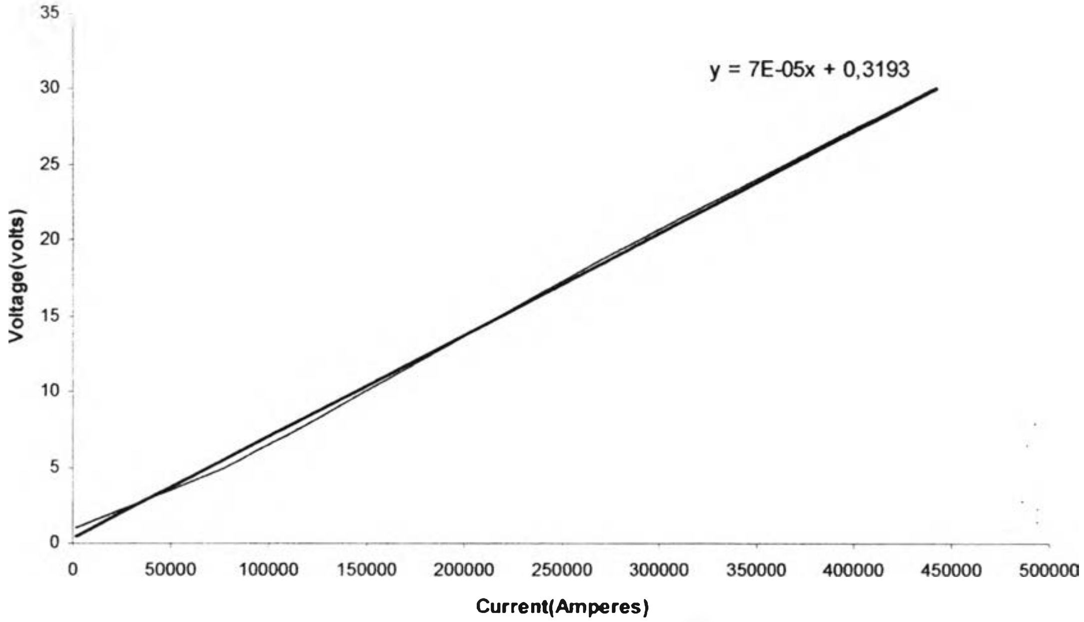


Figure G38 Volume resistance in linear range of PTh

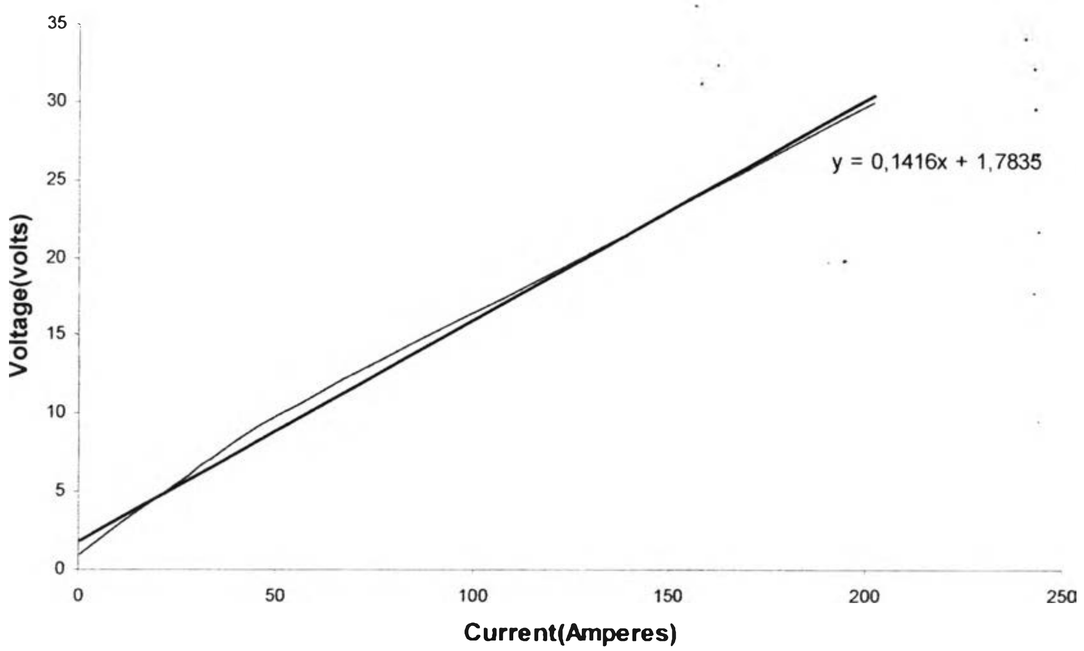


Figure G39 Surface resistance in linear range of PTh

Appendix H Scanning Electron Microscopy

H-1) Coating at the surface of samples

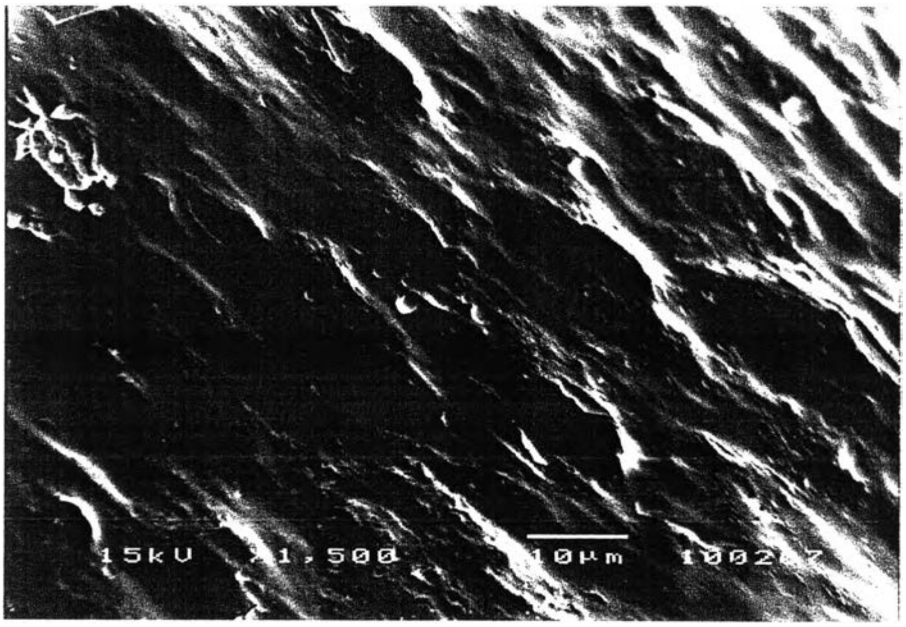


Figure H-1 Scanning electron micrograph of the coating admicelled rubber (with 20 mM PPy) by using electrochemical method magnification 1,500/15 kV.

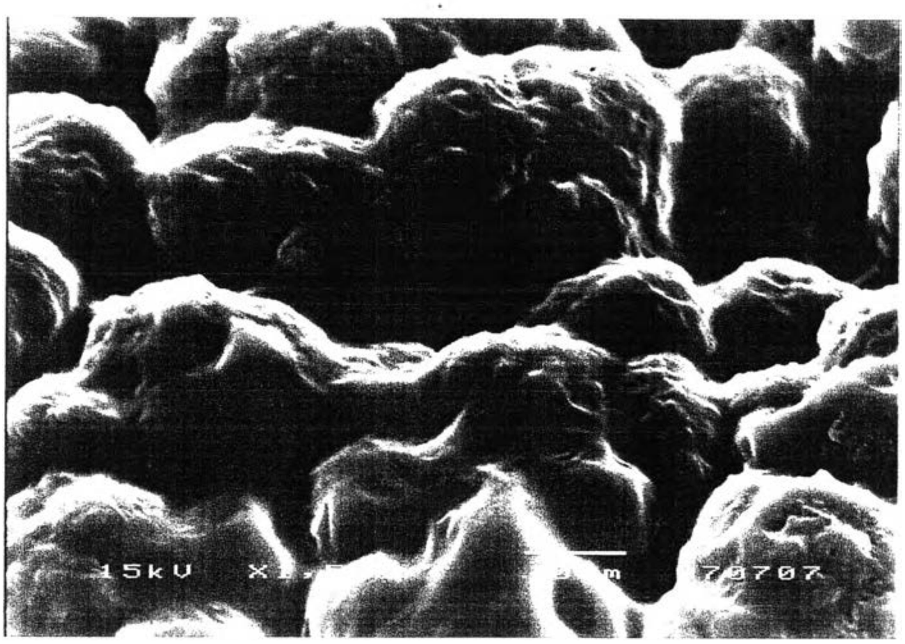


Figure H-2 Scanning electron micrograph of the coating admicelled rubber (with 50 mM PPy) by using electrochemical method magnification 1.500/15 kV.

Figure H-3 Scanning electron micrograph of the coating admicelled rubber (with 100 mM PPy) by using electrochemical method magnification 1,500/15 kV.

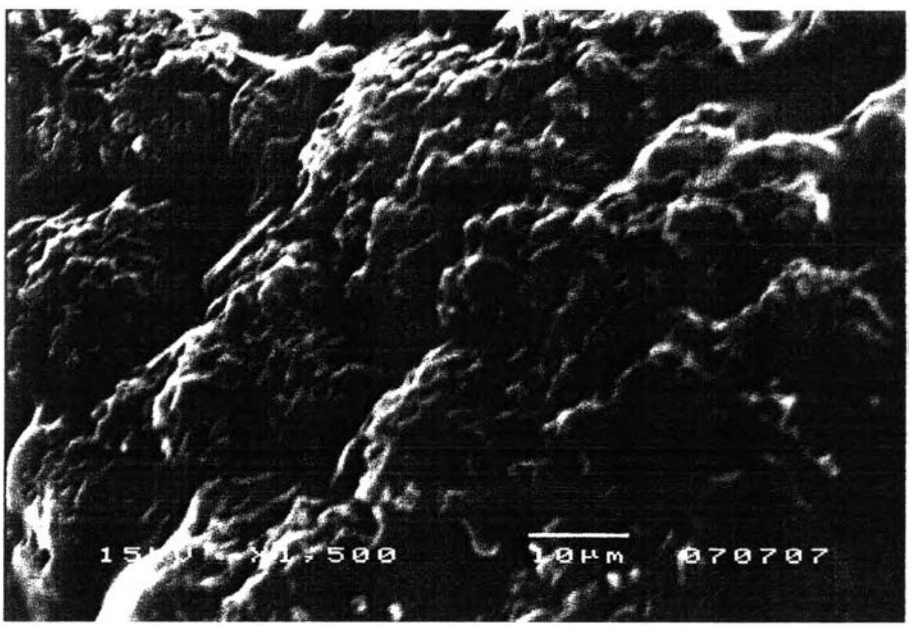


Figure H-4 Scanning electron micrograph of the coating admicelled rubber (with 200 mM PPy) by using electrochemical method magnification 1,500/15 kV.

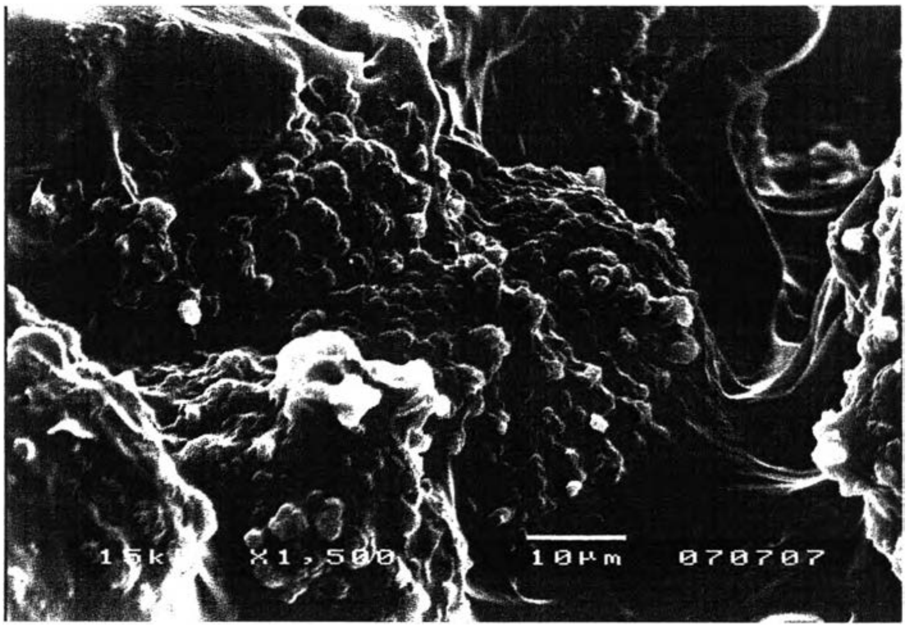


Figure H-5 Scanning electron micrograph of the coating admicelled rubber (with 500 mM PPy) by using electrochemical method magnification 1,500/15 kV.

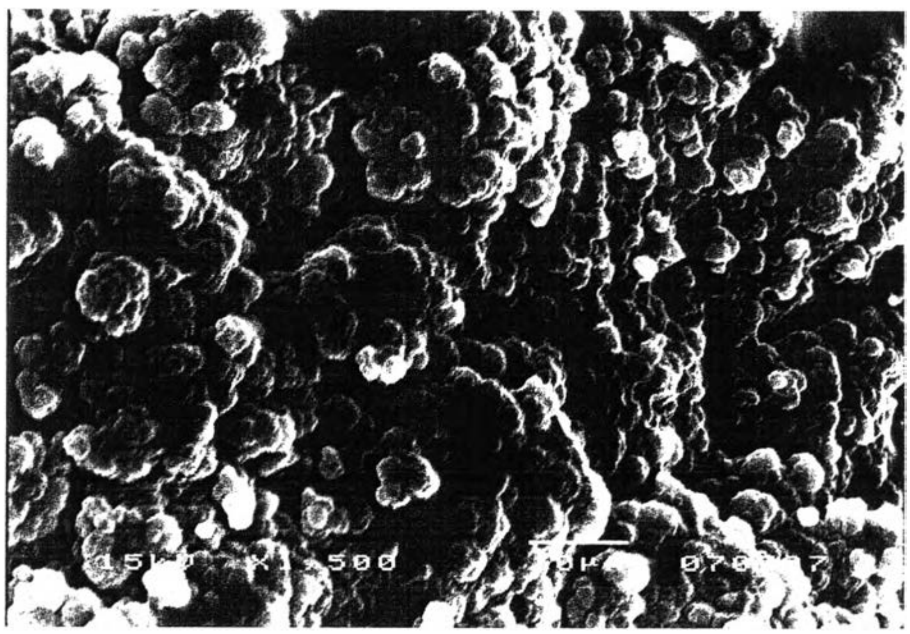


Figure H-6 Scanning electron micrograph of the coating admicelled rubber (with 800 mM PPy) by using electrochemical method magnification 1,500/15 kV.

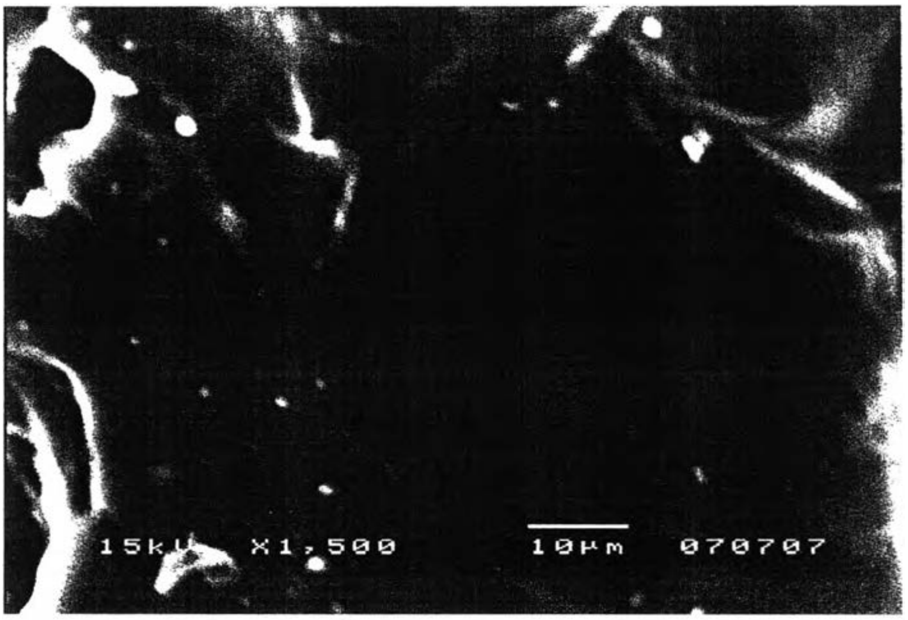


Figure H-7 Scanning electron micrograph rubber magnification 1,500/15 kV.

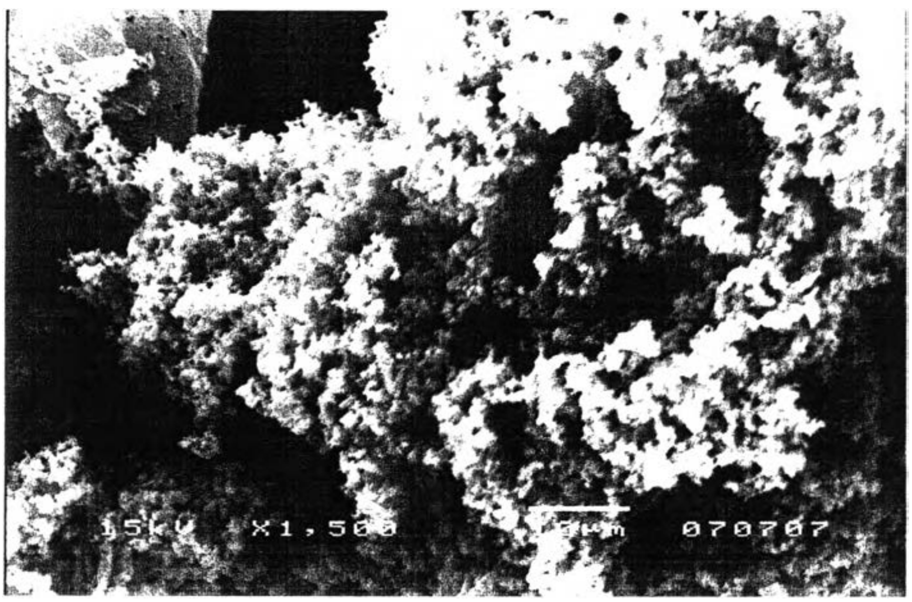


Figure H-8 Scanning electron micrograph of the coating polypyrrole by using electrochemical method magnification 1,500/15 kV

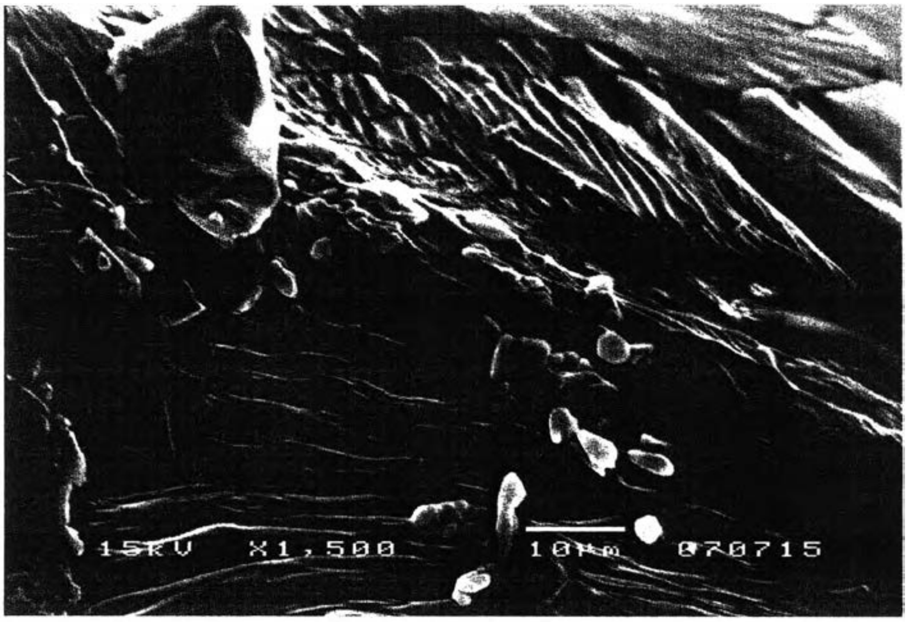


Figure H-9 Scanning electron micrograph of the coating admicelled rubber (with 20 mM PTh) by using electrochemical method magnification 1,500/15 kV.

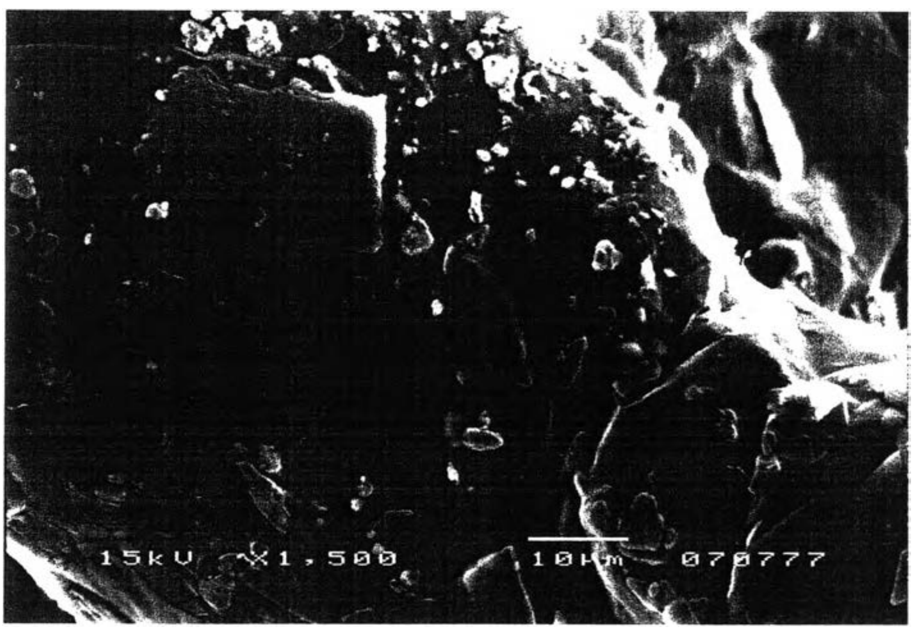


Figure H-10 Scanning electron micrograph of the coating admicelled rubber (with 50 mM PTh) by using electrochemical method magnification 1.500/15 kV.

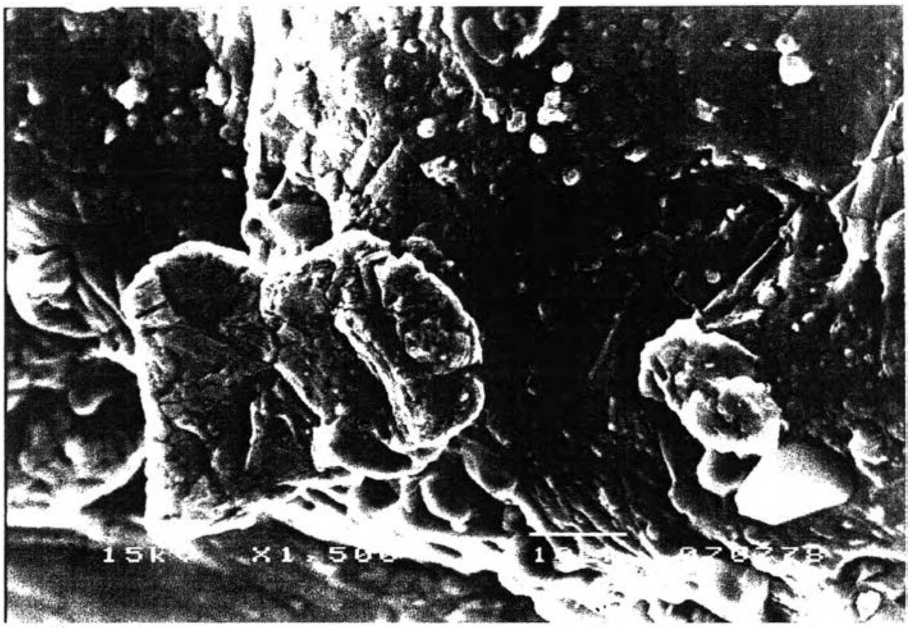


Figure H-11 Scanning electron micrograph of the coating admicelled rubber (with 100 mM PTh) by using electrochemical method magnification 1,500/15 kV.

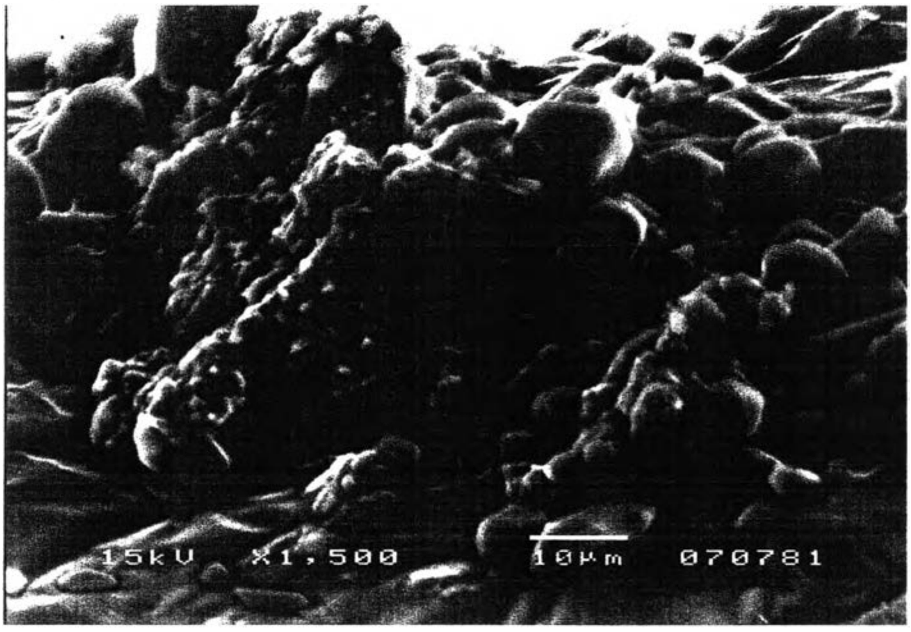


Figure H-12 Scanning electron micrograph of the coating admicelled rubber (with 200 mM PTh) by using electrochemical method magnification 1.500/15 kV.

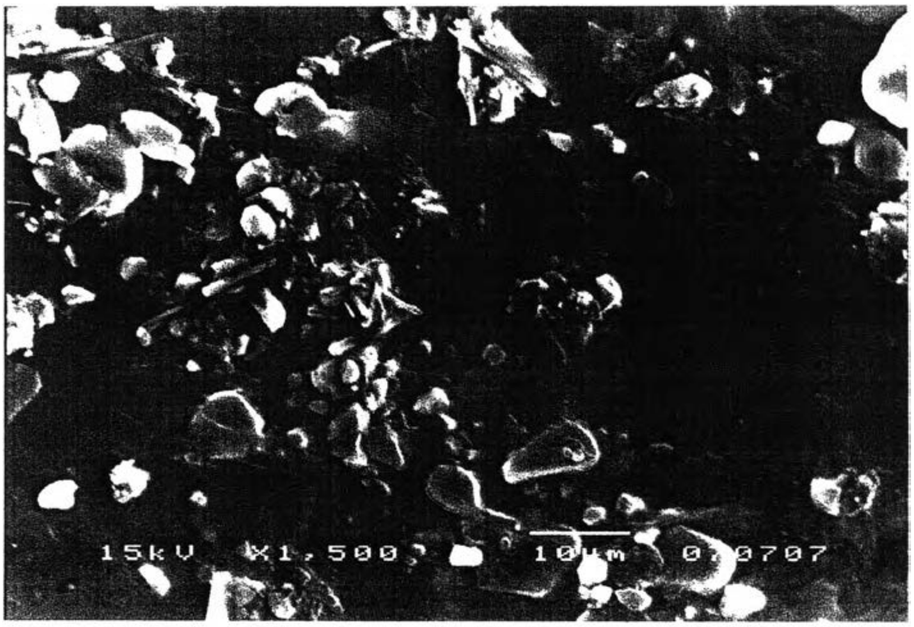


Figure H-13 Scanning electron micrograph of the coating admicelled rubber (with 500 mM PTh) by using electrochemical method magnification 1,500/15 kV.

Figure H-14 Scanning electron micrograph of the coating admicelled rubber (with 800 mM PTh) by using electrochemical method magnification 1,500/15 kV.

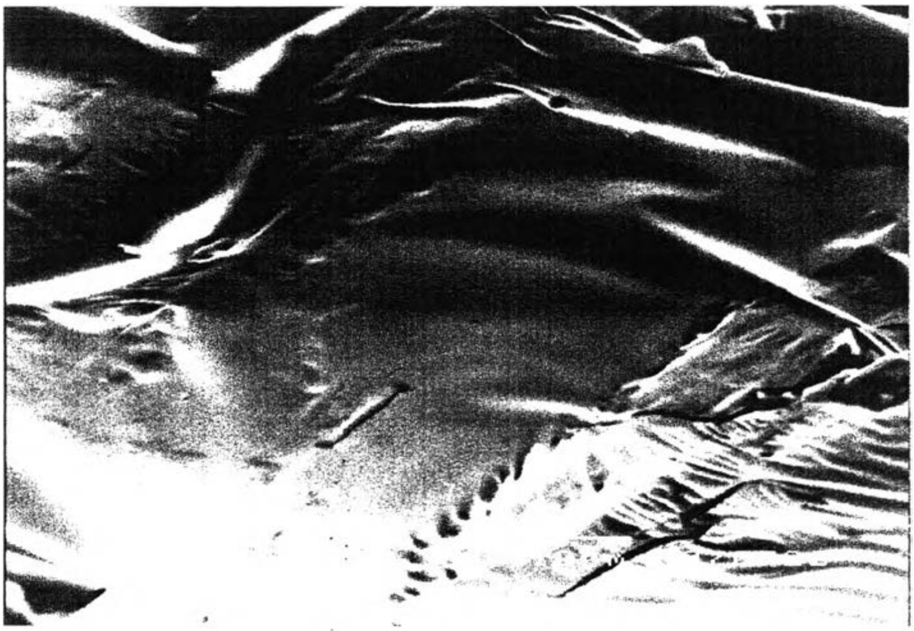


Figure H-15 Scanning electron micrograph rubber magnification 1,500/15 kV.

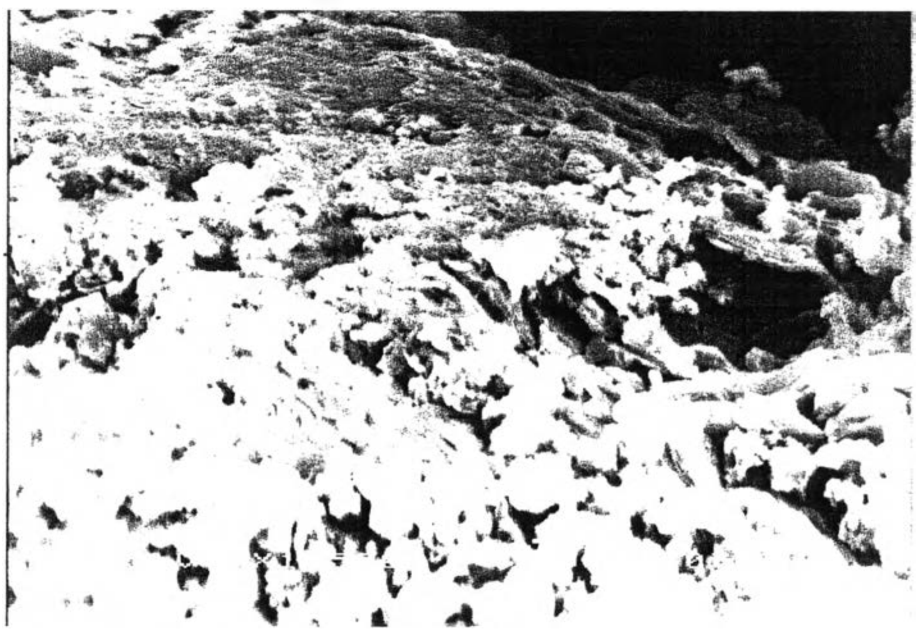


Figure H-16 Scanning electron micrograph of the coating polythiophene by using electrochemical method magnification 1.500/15 kV

Appendix I Determination of density by using Pycnometer

This method is applicable to determinate the PPy and PTh density. This procedure is simple by using a know volume bottle, typically 25 ml. The measurement has to carried out at a certain temperature by filling the liquid sample in the pyconometer bottle unit it is full and cap is put on. At this point the volume of liquid sample is equal to the bottle volume, i.e. 25 ml. Then the bottle is cleaned and weighed to a constant weight. Density is then calculated; divided measured weight by bottle volume.

Liquid sample :

$$d = \frac{b-e}{w-e} = \frac{m_{liquid}}{m_{water}}$$

Where : e= mass of pycnometer
w= mass of pycnometer filled with water at 23°C
b= mass of pycnometer filled with liquid at 23°C
d= sp.gr. 23/23 °C of liquid

Solid sample : sp.gr. 23/23°C /density 23°C

$$\text{Sp.gr. } 23/23°\text{C} = \frac{a \times d}{a + w - b}$$

a = mass of solid
b =mass of pyconometer filled with water + solid at 23°C

Table I-1 measurement density of sample of solid particle

Sample	Parameters	Value measurement	Density
PPy	a	0.0028 g	0.9620
	b	39.4458 g	
	d	0.9964 g/cm^3	
	w	39.4459 g	
PTh	a	0.0419 g	1.0794
	b	39.4488 g	
	d	0.9964 g/cm^3	
	w	39.4459 g	

Appendix J Calculation of density

Table J1 Calculation of density of pyrrole, thiophene content in the admicelled rubbers.

By volume fraction

Pyrrole (mM)	Pyrrole (g)	Latex cream (g)	Latex After dry (g)	Pyrrole (wt%)	Latex (wt%)	d	$d_{calculated\ of\ PPy}$
Rubber*		25	15.1527	0	100	0.9011± 0.028	-
Rubber** (centrifuge)		25	18.3075	0	100	0.9022± 0.018	-
Pyrrole				100	0	0.970	-
PPy***				100	0	0.9620	-
20	0.67	25	18.3075	3.5317	96.4682	0.9033 ±0.032	0.9032
50	1.68	25	18.3075	8.4080	91.5919	0.9040 ± 0,022	0.9181
100	3.35	25	18.3075	15.4729	84.5270	0.9101 ± 0.023	0.9526
200	6.71	25	18.3075	26.8284	73.1715	0.9164 ± 0.0326	0.9561
500	16.77	25	18.3075	47.8176	52.1823	0.9325 ± 0.0142	0.9673
800	26.84	25	18.3075	59.4647	40.5352	0.9409 ± 0.033	0.9689
Thiophene (mM)	**Thiophene (g)**	**Latex cream (g)**	**Latex After dry (g)**	**Thiophene (wt%)**	**Latex (wt%)**	**D**	$d_{calculated\ of\ PTh}$
Rubber*		25	15.1527	0	100	0.9011± 0.028	-
Rubber** (centrifuge)		25	18.3075	0	100	0.9022± 0.018	-
Thiophene				100	0	1,063	-
PTh***				100	0	1,0794	-
20	0.841	25	18.3075	4.3935	95.6065	0.9068 ±0.0224	1.0059
50	2.104	25	18.3075	10.3113	89.6886	0.9138 ± 0,023	1.0235
100	4.207	25	18.3075	18.6913	81.3086	0.9249± 0.0332	1.0360
200	8.414	25	18.3075	31.4957	68.5043	0.9428 ± 0.0144	1.0438
500	21.035	25	18.3075	53.4755	46.5245	0.9774 ± 0.0339	1.0531
800	33.656	25	18.3075	64.7769	35.2230	0.9973 ± 0.0213	1.0576

* DRC of Rubber =60.611% and ** DRC of cream put after centrifuge =73.20%.

*** Calculation the density of PPy and PTh in specimens (in appendix J)

Example the calculation of d_{cal}

at PPy = 20 mM

From $d_{composite} = \phi_1 d_1 + \phi_2 d_2$; $\phi_{total} = \phi_1 + \phi_2$

$$0.904 = \left[\frac{\frac{18.3075}{d_1}}{\frac{18.3075}{d_1} + \frac{0.67}{d_2}} \right] d_1 + (1 - \phi_1) d_2$$

where: $d_1 = d_{nr} = 0.9022$ g/cm^3 **, Where** $d_2 = d_{ppy} = ?$ g/cm^3

The volume fractions are determined as shown in Table J2.

Table J2 Calculation of volume fraction content in the admicelled rubbers.

Pyrrole (mM)	$V_1 = \frac{g_{nr}}{d_{nr}}$	$V_2 = \frac{g_{ppy}}{d_{ppy}}$	$\phi_1 = \frac{V_1}{V_1 + V_2}$	$\phi_2 = \frac{V_2}{V_1 + V_2}$
Rubber*	-	-	1	0
Rubber (centrifuge)**	-	-	1	0
Pyrrole	-	-	0	1
PPy***	-	-	0	1
20	20.2920	0.696466	0.9669	0.0331
50	20.2920	1.746362	0.9208	0.0792
100	20.2920	3.482328	0.8536	0.1464
200	20.2920	6.975052	0.7442	0.2558
500	20.2920	17.43243	0.5379	0.4621
800	20.2920	27.90021	0.4211	0.5789
Thiophene (mM)	$V_1 = \frac{g_{nr}}{d_{nr}}$	$V_2 = \frac{g_{PTh}}{d_{PTh}}$	$\phi_1 = \frac{V_1}{V_1 + V_2}$	$\phi_2 = \frac{V_2}{V_1 + V_2}$
Rubber*	-	-	1	0
Rubber (centrifuge)**	-	-	1	0
Thiophene	-	-	0	1
PTh***	-	-	0	1
20	20.2920	0.779137	0.9630	0.0370
50	20.2920	1.949231	0.9123	0.0876
100	20.2920	3.897536	0.8388	0.1611
200	20.2920	7.795071	0.7225	0.2775
500	20.2920	19.48768	0.5101	0.4899
800	20.2920	31.18029	0.3942	0.6057

when

d_{nr} = 0.9022± 0.018

d_{PPy} =0.9620

d_{PTh} =1.0794

Table J3 Calculation of density of pyrrole, thiophene content in the admicelled rubbers.

By weight fraction

$$d_{cal} = d_{nr}X_{nr} + d_{PPy}X_{PPy}$$

$$d_{cal} = d_{nr}X_{nr} + d_{PThy}X_{PTh}$$

Pyrrole (mM)	**Pyrrole** (g)	**Latex cream** (g)	**Latex After dry** (g)	**Pyrrole** (wt%)	**Latex** (wt%)	d_{cal}
Rubber		25	15.1527	0	100	0.9011
Rubber (centrifuge)		25	18.3075	0	100	0,9022
Pyrrole				100	0	0,9700
PPy				100	0	0.9620
20	0.67	25	18.3075	3.5317	96.4682	0.9045
50	1.68	25	18.3075	8.4080	91.5919	0.9078
100	3.35	25	18.3075	15.4729	84.5270	0.9126
200	6.71	25	18.3075	26.8284	73.1715	0.9203
500	16.77	25	18.3075	47.8176	52.1823	0.9346
800	26.84	25	18.3075	59.4647	40.5352	0.9425
Thiophene (mM)	**Thiophene** (g)	**Latex cream** (g)	**Latex After dry** (g)	**Thiophene** (wt%)	**Latex** (wt%)	d_{cal}
Rubber*		25	15.1527	0	100	0.9011
Rubber (centrifuge)**		25	18.3075	0	100	0,9022
Thiophene				100	0	1.0630
PTh***				100	0	1.0794
20	0.841	25	18.3075	4.3935	95.6065	0.9092
50	2.104	25	18.3075	10.3113	89.6886	0.9187
100	4.207	25	18.3075	18.6913	81.3086	0.9322
200	8.414	25	18.3075	31.4957	68.5043	0.9528
500	21.035	25	18.3075	53.4755	46.5245	0.9882
800	33.656	25	18.3075	64.7769	35.2230	1.0064

* DRC of Rubber =60.611% and ** DRC of cream put after centrifuge =73.20%.

CURRICULUM VITAE

Name: Ms. Adisorn Chirasakulkarun

Date of Birth: May 1, 1983

Nationality: Thai

University Education:

2001-2004 Bachelor Degree of Engineer, Faculty of Chemical Engineer, Mahidol University, Nakornprathom, Thailand

Publications: -

Presentation:

1. Chiraskulkarun, A., and Magaraphan, R. (2007, December 4-7) Admicellar polymerization of dope polypyrrole on natural rubber. Oral presented at 10th Pacific Polymer Conference, Kobe, Japan