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APPENDICES

Appendix A Preparation of Solution Cross-Linked NR/Clay Aerogel Composite

Table A1 Formulation of the NR/clay aerogel composites

Composition	Na^+-MMT (g)	Dry NR (g)	NR latex (g)	Existing water (g)	Total water (g)
2.5 wt% NR	2.75	1.44	2.40	0.96	57.5
5 wt% NR	2.75	2.88	4.79	1.92	57.5
10 wt% NR	2.75	5.75	9.58	3.83	57.5

Table A2 Density measurements of the pristine NR aerogels

Composition	Diameter (mm)	Height (mm)	Mass (g)	Volume (cm^3)	Density (gcm^{-3})	SD value
2.5 wt% NR	20.3	36.8	0.7707	11.95	0.065	
	20.2	36.1	0.7331	11.57	0.063	
	20.5	34.4	0.7228	11.32	0.064	
					0.064	0.001
5 wt% NR	19.45	36.85	1.0415	10.94	0.095	
	20.29	33.75	0.9764	10.91	0.089	
	20.61	33.57	1.007	11.19	0.089	
					0.093	0.004
10 wt% NR	19.7	35.28	1.3836	10.75	0.129	
	20.68	37.13	1.5287	12.47	0.123	
	20.59	35.12	1.4107	11.69	0.121	
					0.127	0.007

Table A3 Density measurements of the cross-linked NR aerogels (T_{prep} = -18°C and S_2Cl_2 = 1% (v/v))

Composition	Diameter (mm)	Height (mm)	Mass (g)	Volume (cm^3)	Density (gcm^{-3})	SD value
2.5 wt% NR	18.57	19.96	0.6000	5.40	0.111	
	18.55	20.11	0.5982	5.43	0.110	
	18.65	20.11	0.5831	5.49	0.106	
					0.109	0.002
5 wt% NR	18.76	19.90	0.8221	5.50	0.150	
	18.03	20.03	0.8030	5.11	0.157	
	18.87	20.00	0.8309	5.59	0.148	
					0.152	0.005
10 wt% NR	20.71	19.60	1.2202	6.60	0.185	
	19.73	19.35	1.0680	5.91	0.181	
	18.19	20.24	1.1862	5.26	0.223	
					0.197	0.025

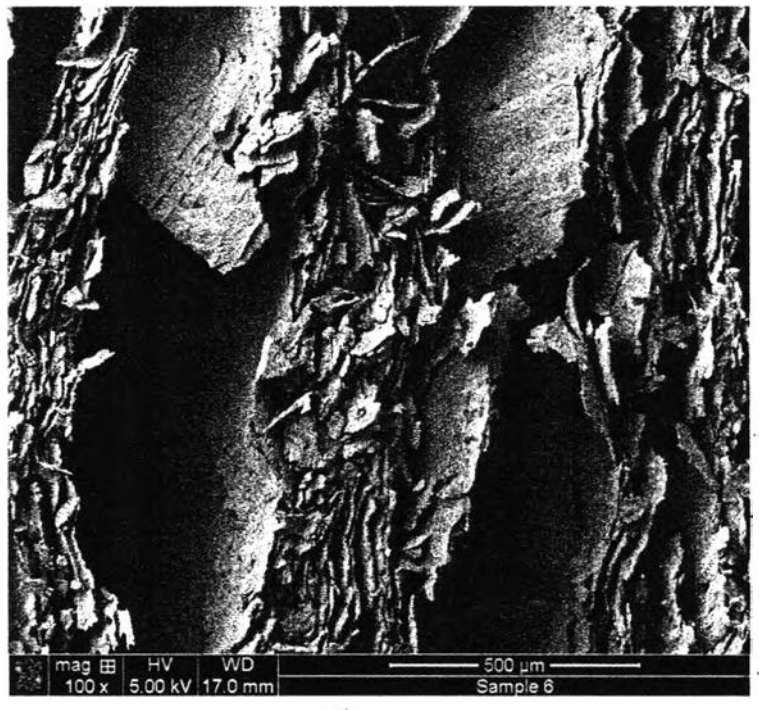


Figure A1 SEM micrographs of the 2.5 wt% NR aerogel cross-linked at 18°C. S_2Cl_2 = 1 % (v/v).

Appendix B Fabrication of New Semiconducting Nanomaterials

Table B1 Compositions of the $NP_{100}M_y$ series

Samples	Latex cream (g)	SDS (mM)	SDS (g)	Pyrrole (mM)	Pyrrole (g)	Na^+-MMT (phr)	Na^+-MMT (g)
NP_{100}	25	16	2.307	100	3.35	-	-
$NP_{100}M_1$	25	16	2.307	100	3.35	1	0.25
$NP_{100}M_3$	25	16	2.307	100	3.35	3	0.75
$NP_{100}M_5$	25	16	2.307	100	3.35	5	1.25
$NP_{100}M_7$	25	16	2.307	100	3.35	7	1.75

* The total volume of reaction mixture is 500 mL.

Table B2 Compositions of the $NP_{100}M_y$, $NP_{200}M_y$, and $NP_{800}M_y$ series

Samples	Latex cream (g)	SDS (mM)	SDS (g)	Pyrrole (mM)	Pyrrole (g)	Na^+-MMT (phr)	Na^+-MMT (g)
NP_{100}	25	16	2.307	100	3.35	-	-
$NP_{100}M_7$	25	16	2.307	100	3.35	7	1.75
NP_{200}	25	16	2.307	200	6.71	-	-
$NP_{200}M_7$	25	16	2.307	200	6.71	7	1.75
NP_{800}	25	16	2.307	800	26.84	-	-
$NP_{800}M_7$	25	16	2.307	800	26.84	7	1.75

* The total volume of reaction mixture is 500 mL.

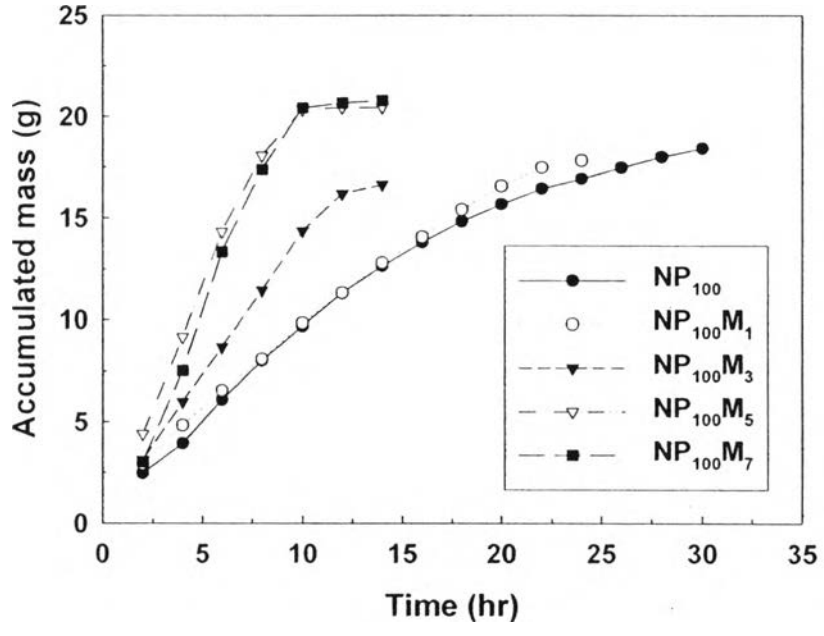


Figure B1 A plot between the accumulated mass at the anode electrode versus time for the $NP_{100}My$ series.

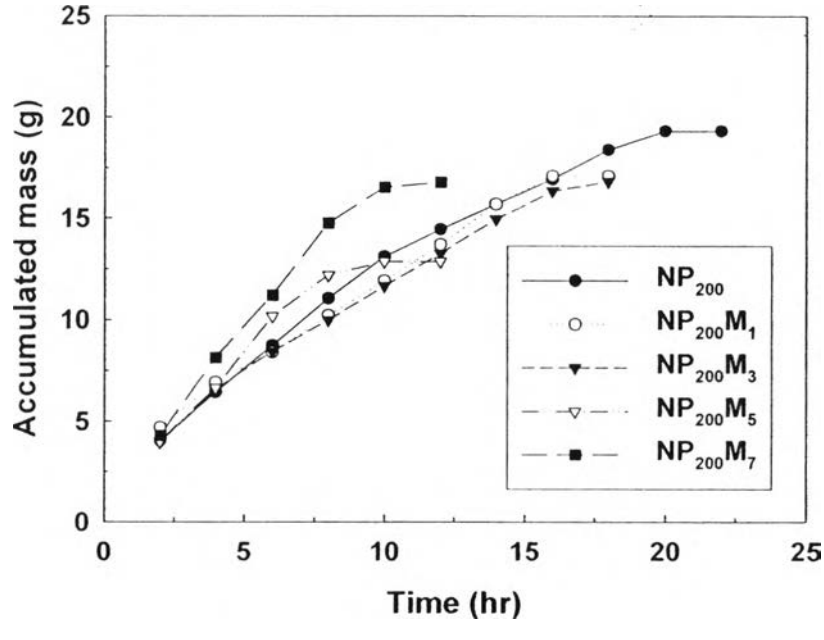


Figure B2 A plot between the accumulated mass at anode electrode versus time for the $NP_{200}My$ series.

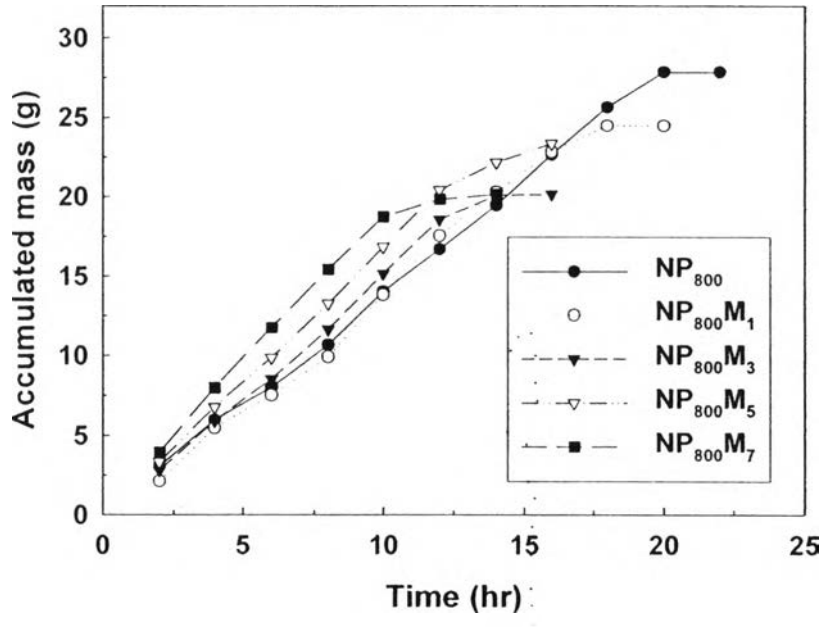


Figure B3 A plot between the accumulated mass at anode electrode versus time for the $NP_{800}My$ series.

Appendix C Calculation of the Volume Conductivity

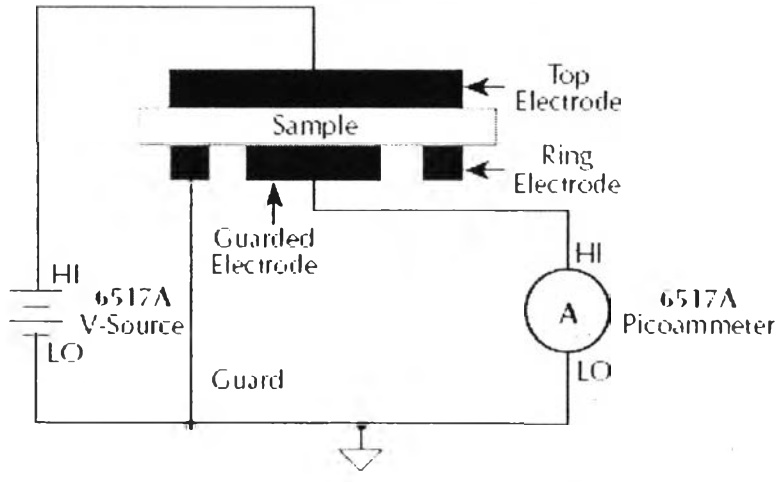
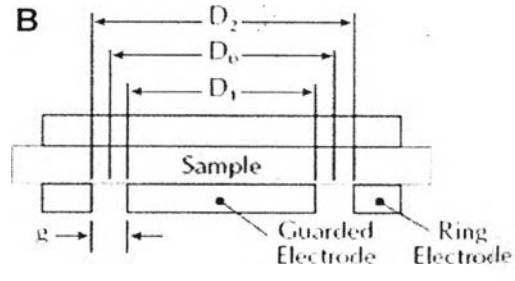


Figure C1 Schematic of the two point-probe configuration.

A

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



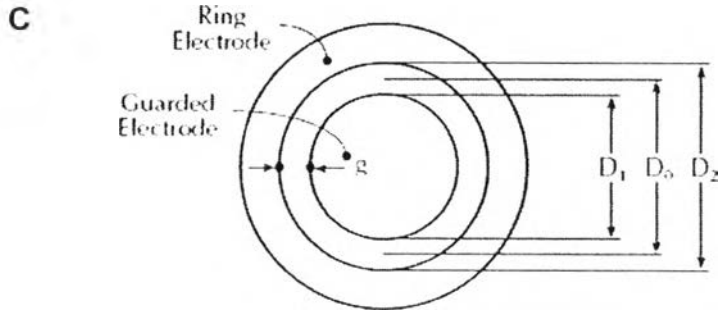


Figure C2 The dimensions of circular electrode.

The volume resistivity of the semiconducting materials was computed from the following equation:

$$\rho_v = \frac{K_v}{\tau} R \qquad \text{(C1)}$$

$$K_v = \pi(\frac{D_1}{2} + B\frac{g}{2})^2 \qquad \text{(C2)}$$

where ρ_v is the volume resistivity (Ω·cm), K_v is the effective area of the guarded electrode for the particular electrode arrangement employed, τ is an average thickness of the sample (cm), R is the calculated resistance (Ω), D_1 is the outside diameter of guarded electrode (~ 2 inch), g is a distance between the guarded and ring electrodes (~0.125 inch), and B is typically zero for the volume conductivity measurement.

The specific conductivity (σ) is then equal to a reciprocal of the volume resistivity and has a unit of siemens per centimeter (Scm^{-1}):

$$\sigma_v = \frac{1}{\rho_v} \qquad \text{(C3)}$$

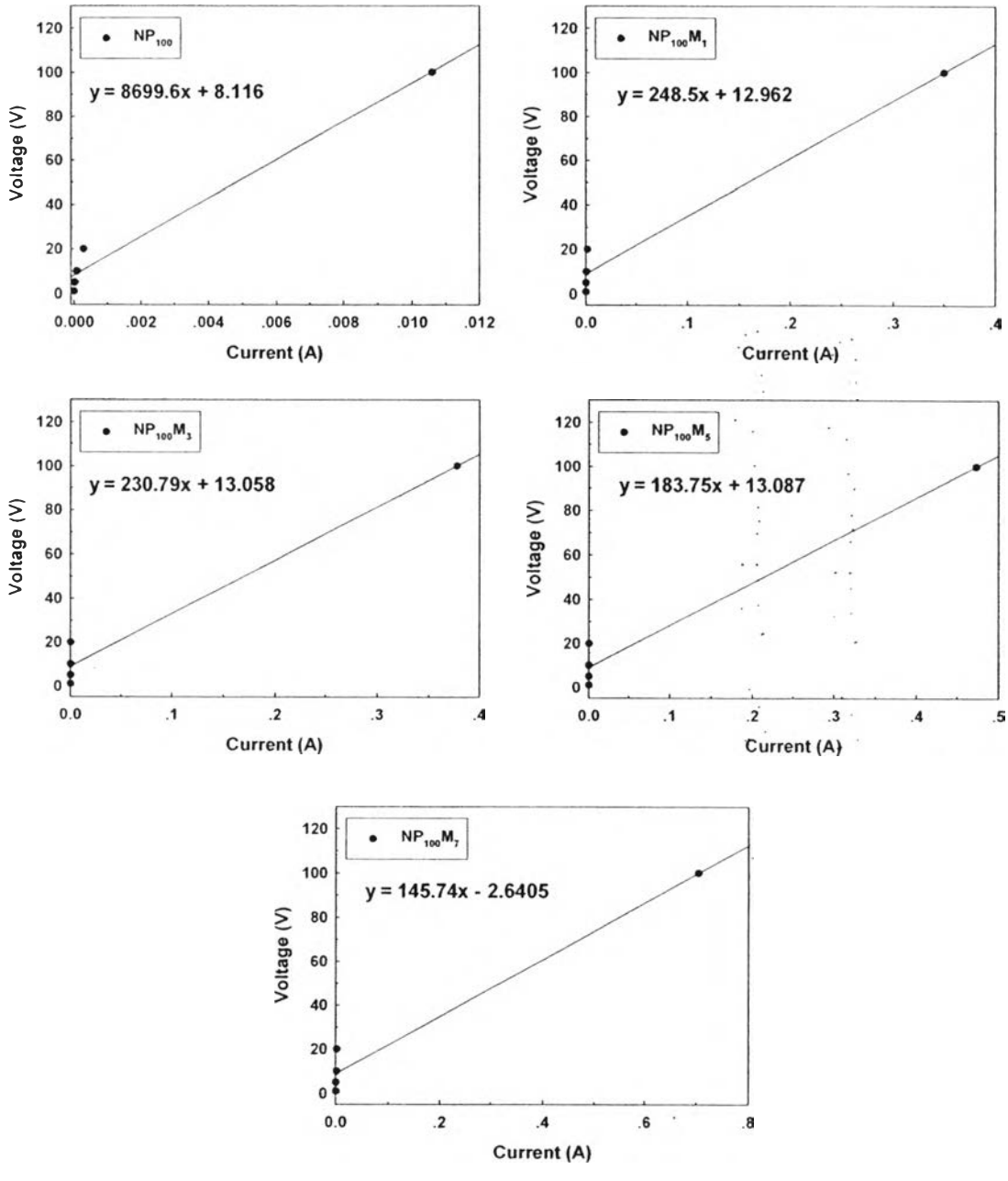


Figure C3 A plot between voltage and current of the $NP_{100}M_y$ series (the slope of each plot represents the volume resistance).

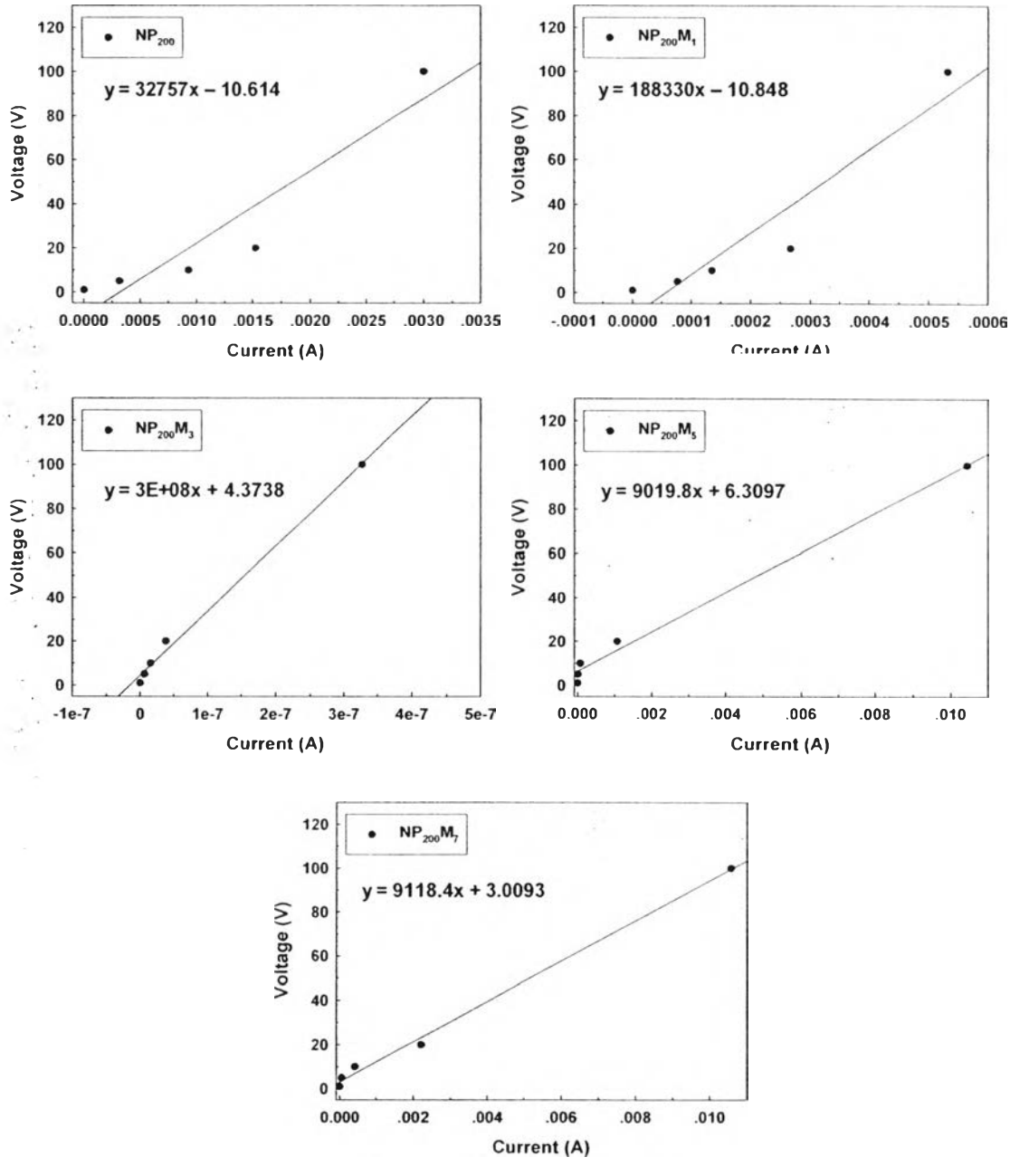


Figure C4 A plot between voltage and current of the $NP_{200}M_y$ series (the slope of each plot represents the volume resistance).

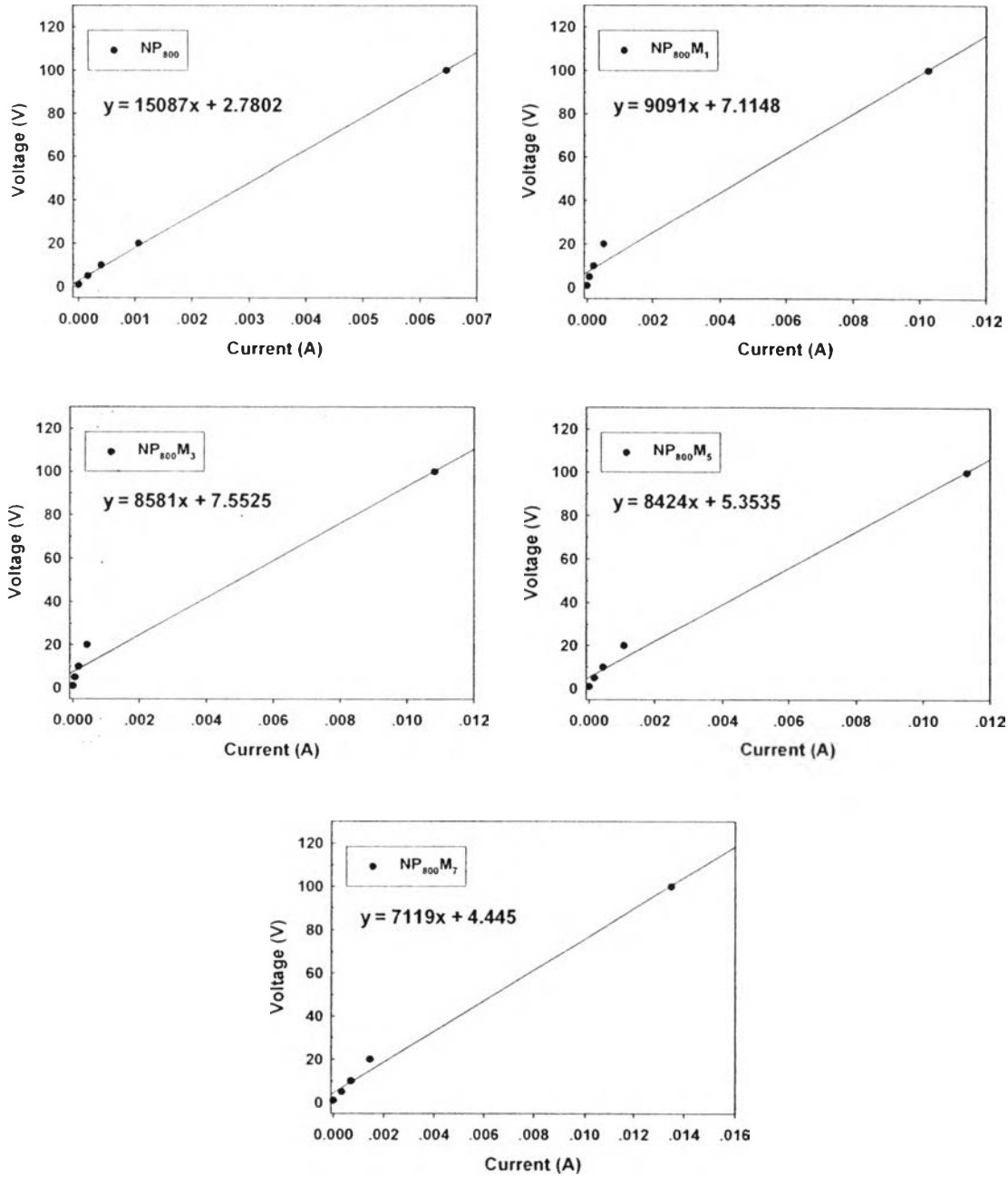


Figure C5 A plot between voltage and current of the $NP_{800}M_y$ series (the slope of each plot represents the volume resistance).

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2. Pojanavaraphan, T., Chirasakulkarun, A., Muksing, N., and Magaraphan, R. (2009) Electrolytic admicellar polymerization of pyrrole on natural rubber/clay nanocomposites. Journal of Applied Polymer Science, 112, 1552-1564.
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Emphasis on the cross-linking conditions and polymer concentration, in preparation.

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3. Pojanavaraphan, T., Chirasakulkarun, A., Muksing, N., and Magaraphan, R. (2009, April 3-5) Electrolytic admicellar polymerization of pyrrole on natural rubber/clay nanocomposites. RGJ-Ph.D. Congress X, Chonburi, Thailand.
4. Pojanavaraphan, T., Schiraldi, D.A., and Magaraphan, R. (2009, August 7) Mechanical, rheological, and swelling behaviors of natural rubber/clay aerogel composites. RGJ Seminar Series LXII, Bangkok, Thailand.