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APPENDICES

Appendix A Characterization of PVA/Pt-Ru electrospinning solution

Table A1 Viscosity of PVA/Pt-Ru electrospinning solutions

Pt-Ru %	Speed (rpm)	Torque (%)	Viscosity (cP)	Shear Strength (D cm-1)	Shear rate (sec-1)	Average Viscosity (cP)	SD
0%	250	99.1	192	447	233	191.0	1.26
	250	99.1	192	447	233		
	250	99.3	192	447	233		
	248	99.1	190	445	235		
	249	99.2	189	443	235		
1%	240	99.6	208	465	223	207.2	3.31
	238	99.6	210	465	219		
	235	99.3	211	462	219		
	250	99.6	205	461	224		
	250	99.5	202	460	225		
3%	225	99.4	238	466	216	239.2	1.67
	220	99.6	240	468	213		
	220	99.6	241	468	215		
	219	99.4	239	466	213		
	219	99.4	238	465	212		
5%	206	99.5	298	465	209	299.8	5.38
	207	99.4	295	464	211		
	203	99.6	300	467	207		
	200	99.6	310	468	206		
	210	99.1	296	464	212		

* Viscosity of the solution was measured by a Brookfield Digital (Model DV-111) at the room temperature. Spindle number 21 was applied.

Appendix B Morphology of PVA/Pt-Ru nanoparticle nanocomposite nanofibers

Table B1 The diameter of composite nanofibers

	Diameter (micron)			
	PVA	Pt-Ru 0.36%	Pt-Ru 1.07%	Pt-Ru 1.79%
1	0.186	0.254	0.216	0.181
2	0.176	0.261	0.185	0.170
3	0.176	0.303	0.245	0.169
4	0.195	0.342	0.235	0.204
5	0.112	0.252	0.202	0.182
6	0.093	0.198	0.150	0.166
7	0.177	0.179	0.155	0.228
8	0.176	0.294	0.199	0.208
9	0.201	0.208	0.155	0.178
10	0.175	0.289	0.164	0.169
11	0.153	0.195	0.186	0.178
12	0.171	0.267	0.157	0.178
13	0.202	0.228	0.193	0.142
14	0.158	0.257	0.161	0.168
15	0.160	0.192	0.248	0.167
16	0.139	0.188	0.224	0.185
17	0.207	0.257	0.193	0.124
18	0.147	0.252	0.182	0.168
19	0.153	0.192	0.193	0.210
20	0.139	0.203	0.221	0.100
21	0.167	0.228	0.196	0.187
22	0.127	0.188	0.150	0.187
23	0.157	0.188	0.232	0.169
24	0.198	0.226	0.259	0.175
25	0.194	0.248	0.269	0.197
26	0.149	0.261	0.259	0.176
27	0.137	0.228	0.284	0.195
28	0.147	0.214	0.182	0.178
29	0.171	0.246	0.178	0.178
30	0.195	0.162	0.176	0.184
31	0.186	0.213	0.195	0.239
32	0.218	0.238	0.187	0.163
33	0.175	0.199	0.176	0.170
34	0.197	0.262	0.193	0.177
35	0.188	0.204	0.202	0.198
36	0.177	0.209	0.186	0.154
37	0.175	0.261	0.193	0.155
38	0.175	0.316	0.164	0.198
39	0.204	0.217	0.179	0.189
40	0.195	0.187	0.132	0.167
41	0.186	0.329	0.253	0.145
42	0.138	0.170	0.189	0.165
43	0.169	0.261	0.190	0.135

	Diameter (micron)			
	PVA	Pt-Ru 0.36%	Pt-Ru 1.07%	Pt-Ru 1.79%
44	0.154	0.170	0.260	0.142
45	0.169	0.258	0.167	0.199
46	0.154	0.176	0.212	0.157
47	0.188	0.245	0.236	0.147
48	0.163	0.178	0.230	0.135
49	0.181	0.212	0.206	0.217
50	0.147	0.256	0.180	0.192
51	0.113	0.185	0.216	0.189
52	0.179	0.231	0.259	0.155
53	0.165	0.198	0.150	0.152
54	0.175	0.235	0.175	0.136
55	0.216	0.224	0.220	0.135
56	0.191	0.219	0.185	0.164
57	0.157	0.208	0.190	0.217
58	0.165	0.158	0.208	0.177
59	0.155	0.228	0.232	0.198
60	0.136	0.216	0.212	0.194
61	0.161	0.246	0.140	0.120
62	0.182	0.188	0.242	0.189
63	0.170	0.324	0.189	0.177
64	0.175	0.257	0.177	0.187
65	0.177	0.238	0.189	0.184
66	0.200	0.257	0.189	0.173
67	0.223	0.195	0.259	0.172
68	0.200	0.218	0.196	0.192
69	0.191	0.204	0.186	0.163
70	0.117	0.277	0.167	0.152
71	0.135	0.281	0.164	0.154
72	0.144	0.213	0.164	0.142
73	0.146	0.188	0.236	0.212
74	0.157	0.238	0.245	0.165
75	0.173	0.238	0.187	0.179
76	0.155	0.229	0.250	0.191
77	0.136	0.221	0.230	0.147
78	0.165	0.388	0.251	0.154
79	0.206	0.224	0.146	0.173
80	0.152	0.169	0.224	0.194
81	0.170	0.208	0.284	0.177
82	0.130	0.146	0.248	0.146
83	0.155	0.280	0.175	0.170
84	0.146	0.195	0.176	0.128
85	0.155	0.239	0.189	0.154
86	0.157	0.270	0.215	0.189
87	0.165	0.218	0.163	0.204
88	0.140	0.257	0.182	0.188
89	0.148	0.239	0.217	0.149
90	0.208	0.270	0.155	0.198
91	0.175	0.188	0.202	0.198

Diameter (micron)			
	PVA	Pt-Ru 0.36%	Pt-Ru 1.07%	Pt-Ru 1.79%
92	0.140	0.280	0.230	0.189
93	0.156	0.248	0.216	0.169
94	0.144	0.257	0.236	0.156
95	0.184	0.258	0.218	0.189
96	0.158	0.337	0.167	0.167
97	0.144	0.222	0.185	0.166
98	0.166	0.288	0.148	0.158
99	0.170	0.297	0.175	0.170
100	0.155	0.287	0.137	0.160
avg	0.167	0.234	0.200	0.180
SD	0.025	0.044	0.035	0.073
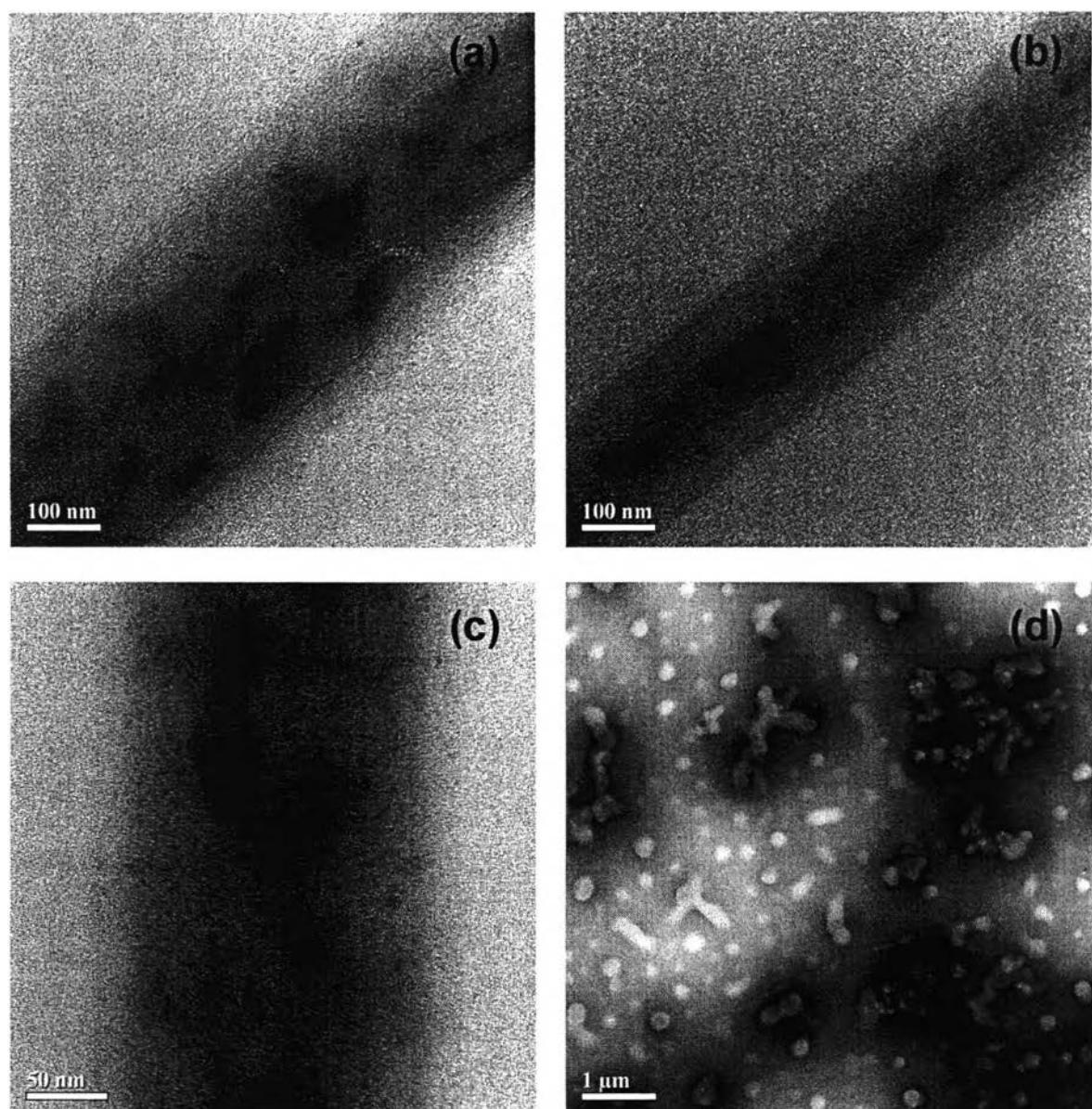
Figure B1 TEM images of PVA/Pt-Ru nanoparticle nanocomposite nanofibers with 8%(w/v) PVA and different % Pt-Ru loadings under 60k magnification: (a) 0.36%, (b) 1.07% (c) 1.79% and (d) the composite solution with 8%(w/v) PVA and 1.79%of Pt-Ru

Appendix C Characterization of PVA/Pt-Ru nanoparticle nanocomposite nanofibers
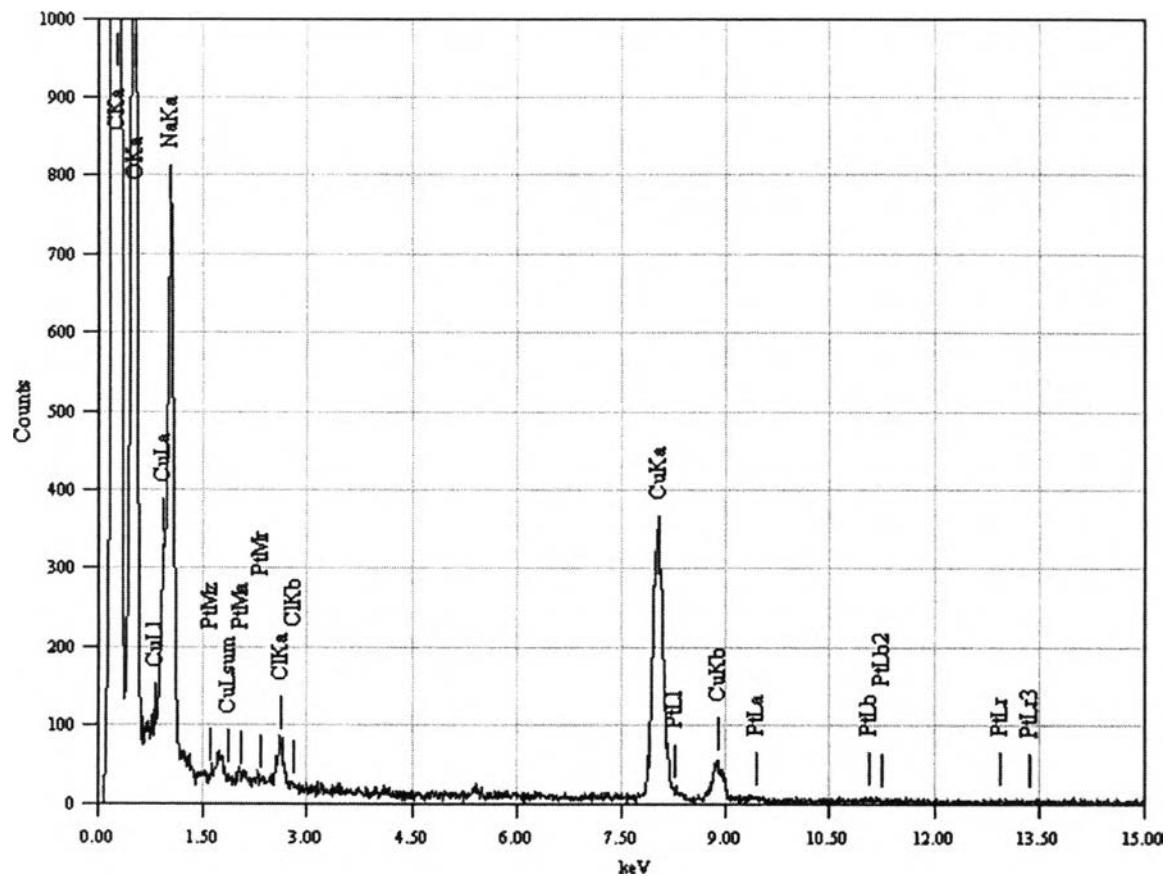

Figure C 1 EDX spectrum of PVA with Pt-Ru 0.36%
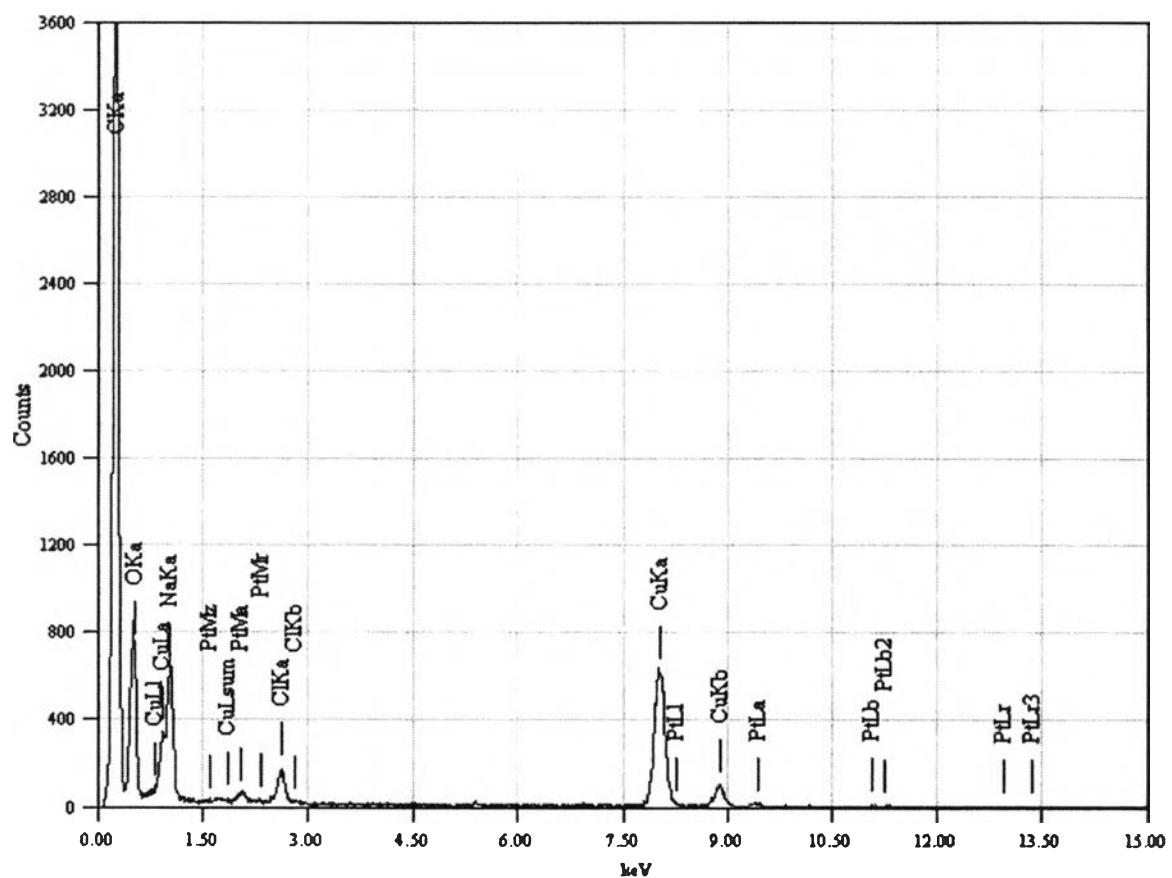
**Figure C2** EDX spectrum of PVA with Pt-Ru 1.07%
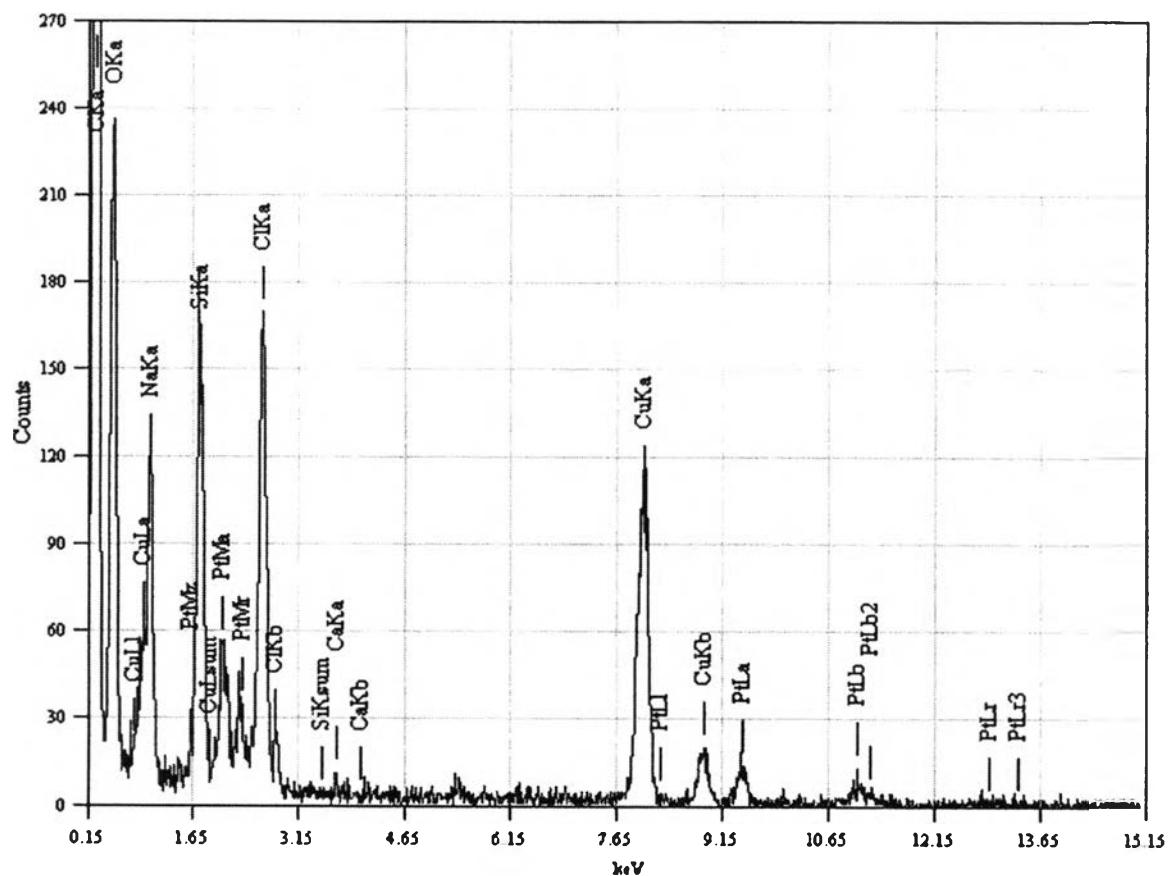
Figure C3 EDX spectrum of PVA with Pt-Ru 1.79%

Table C1 The Scherrer Equation

% Pt-Ru loading	2 theta		B (deg) (2 theta)	B (rad)	peak (2 theta)	theta	cos(theta)	Bcos(theta)	thickness (nm)
	start	end							
0.36	40.45	41.6	1.15	0.02006	41.015	20.5075	0.9366	0.0187892	7.376564
1.07	40.65	41.5	0.85	0.01484	41.039	20.5195	0.9366	0.0138965	9.973704
1.79	40.85	41.6	0.75	0.01309	41.023	20.5115	0.9366	0.0122617	11.30353
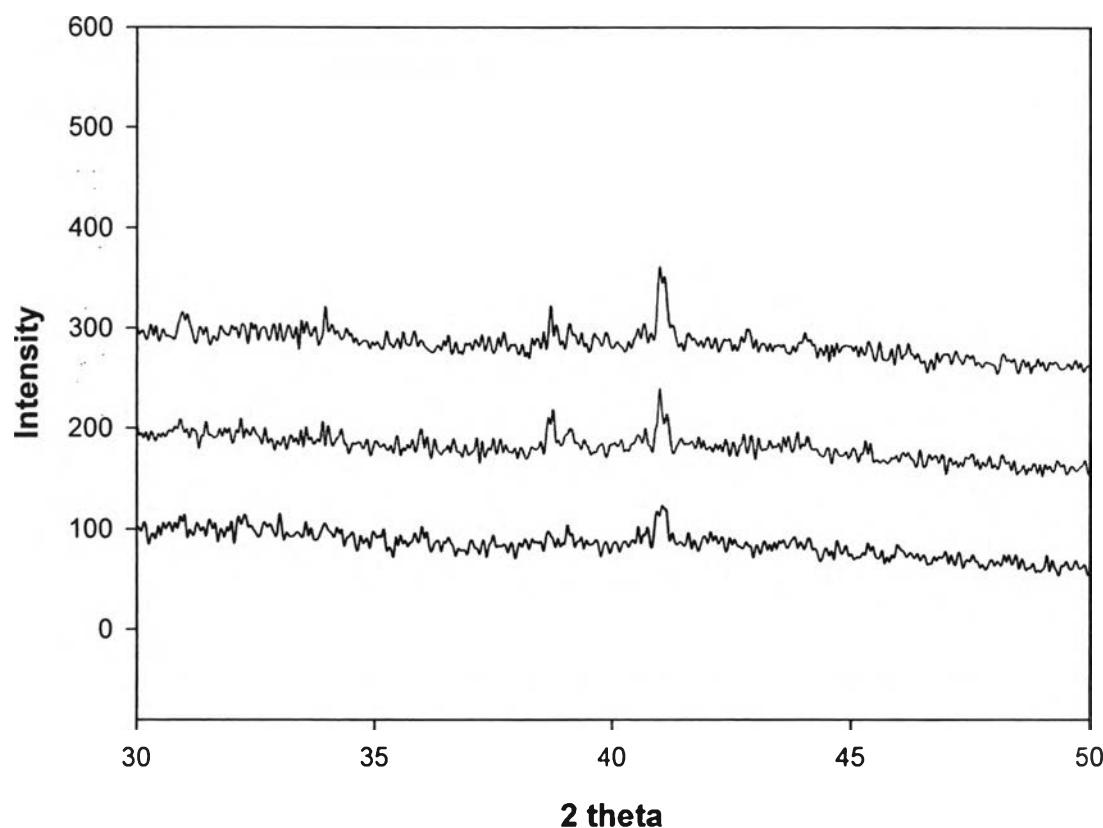
Figure C4 XRD pattern of PVA/Ru nanofibers with different Ru loadings: (a) 0.36%, (b) 1.07%, and (c) 1.79%.
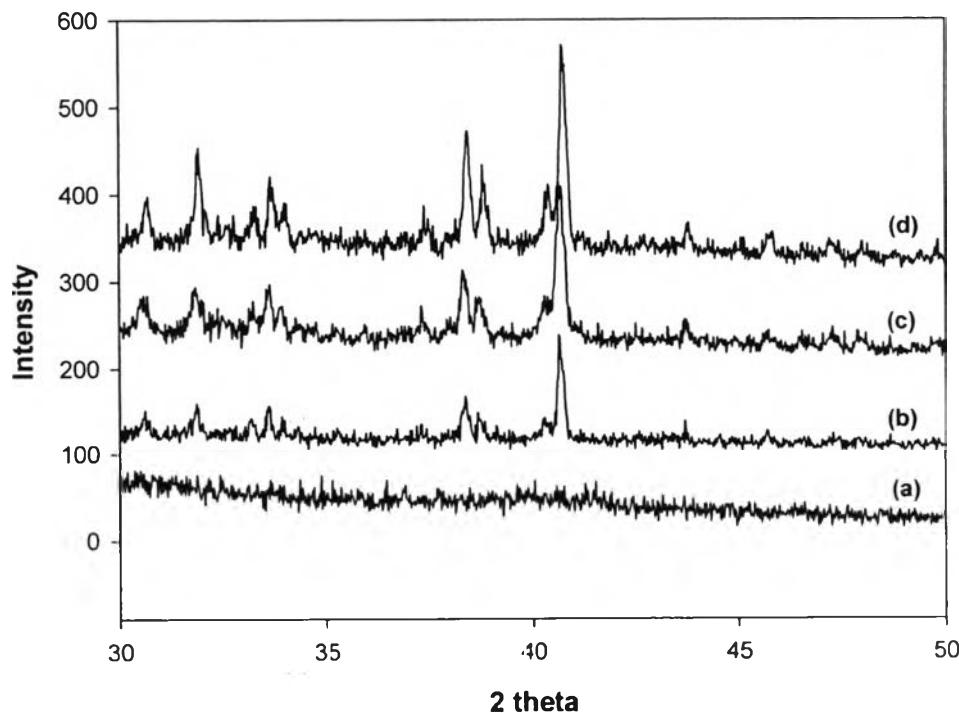
Figure C5 XRD of PVA/Pt nanocomposite nanofibers at different Pt loadings: (a) pure PVA, (b) 1%, (c) 3%, and (d) 5%.

Appendix D Calculation Pt-Ru loadings in PVA electrospinning solutions

Pt-Ru 0.36%wt

0.05 M H_2PtCl_6 0.75 ml

mol H_2PtCl_6	= (0.05)(0.75) / 1000	= $3.75*10^{-5}$ mol
g Pt	= $3.75*10^{-5}$ * 195.217	= $7.32*10^{-3}$ g

0.05M $RuCl_3$ 0.25 ml

mol $RuCl_3$	= (0.05)(0.25) / 1000	= $1.25*10^{-5}$ mol
g Ru	= $1.25*10^{-5}$ * 101.7	= $1.27*10^{-3}$ g

g Pt + Ru	= ($7.32*10^{-3}$) + ($1.27*10^{-3}$)	= $8.59*10^{-3}$ g
%wt Pt+Ru/ PVA	= ($8.59*10^{-3}$)/2.4 * 100	= **0.36 %wt**

Pt-Ru 1.07%wt

0.05 M H_2PtCl_6 2.25 ml

mol H_2PtCl_6	= (0.05)(2.25) / 1000	= $1.125*10^{-4}$ mol
g Pt	= $1.125*10^{-4}$ * 195.217	= $2.17*10^{-2}$ g

0.05M $RuCl_3$ 0.75 ml

mol $RuCl_3$	= (0.05)(0.75) / 1000	= $3.75*10^{-5}$ mol
g Ru	= $3.75*10^{-5}$ * 101.7	= $3.81*10^{-3}$ g

g Pt + Ru	= ($2.17*10^{-2}$) + ($3.81*10^{-3}$)	= $2.55*10^{-2}$ g
%wt Pt+Ru/ PVA	= ($2.55*10^{-2}$)/2.4 * 100	= **1.07 %wt**

Pt-Ru 1.79 %wt

0.05 M H_2PtCl_6 3.75 ml

mol H_2PtCl_6	$= (0.05)(3.75) / 1000$	$= 1.875*10^{-4}$ mol
g Pt	$= 1.875*10^{-4} * 195.217$	$= 3.66*10^{-2}$ g

0.05M $RuCl_3$ 1.25 ml

mol $RuCl_3$	$= (0.05)(1.25) / 1000$	$= 6.25*10^{-5}$ mol
g Ru	$= 6.25*10^{-5} * 101.7$	$= 6.36*10^{-3}$ g

g Pt + Ru	$= (3.66*10^{-2}) + (6.36*10^{-3})$	$= 4.30*10^{-2}$ g
%wt Pt+Ru/ PVA	$= (4.30*10^{-2})/2.4 * 100$	$= \mathbf{1.79\ \%wt}$

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Presentation:

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