

## REFERENCES

- Hagen, J. (2006) Industrial Catalysis: A practical Approach. 2<sup>nd</sup> Ed., Wiley-VCH, 225-227.
- Bai, J., Li, Y., Yang, S., Du, J., Wang, S., Zheng, J., Wang, Y., Yang, Q., Chen, X., and Jing, X. (2007) A simple and effective route for the preparation of poly(vinylalcohol) (PVA)nanofibers containing gold nanoparticles by electrospinning method Solid State Communications, 141, 292–295.
- Chen, L., Zhao, W., Jiao, Y., He, X., Wang, J., and Zhang, Y. (2007) Characterization of Ag/Pt core-shell nanoparticles by UV–vis absorption, resonance light-scattering techniques. Spectrochimica Acta Part A, 68, 484-490.
- Chen, W. X., Lee, J. Y., and Liu, Z. (2004) Preparation of Pt and PtRu nanoparticles supported on carbon nanotubes by microwave-assisted heating polyol process. Materials Letters, 58, 3166–3169.
- Gu, S. Y., Ren, J., and Vancso, G. J. (2005) Process optimization and empirical modeling for electrospun polyacrylonitrile (PAN) nanofiber precursor of carbon nanofibers. European Polymer Journal, 41, 2559–2568.
- Huang, Z. M., Zhang, Y. -Z., Kotaki, M., and Ramakrishna, S. (2003) A review on polymer nanofibers by electrospinning and their applications in nanocomposites. Composites Science and Technology, 63, 2223–2253.
- Jiang, L., Sun, G., Zhenhua Zhou, Z., Zhou, W., and Xin, Q. (2004) Preparation and characterization of PtSn/C anode electrocatalysts for direct ethanol fuel cell. Catalysis Today, 93–95, 665–670.
- Jiang, S. P., Liu, Z., Tang, H. L., and Pan, M. (2006) Synthesis and characterization of PDDA-stabilized Pt nanoparticles for direct methanol fuel cells. Electrochimica Acta, 51, 5721–5730.
- Jin, W. J., Jeon, H. J., Kim, J. H., and Youk, J. H. (2007) A study on the preparation of poly(vinyl alcohol) nanofibers containing silver nanoparticles. Synthetic Metals, 157, 454–459.

- Kenawy, E. R., Abdel-Hay , F. I., El-Newehy, M. H., and Wnek, G. E. (2007) Controlled release of ketoprofen from electrospun poly(vinyl alcohol) nanofibers. Materials Science and Engineering A, 459, 390–396.
- Kim, P., Joo , B., Kim, W., Kim, J., Song, I. K., and Yi, J. (2007) Preparation of highly dispersed Pt catalyst using sodium alkoxide as a reducing agent and its application to the methanol electro-oxidation. Journal of Molecular Catalysis A: Chemical, 263, 15–19.
- Koski, A., Yim, K., and Shivkumar S. (2004) Effect of molecular weight on fibrous PVA produced by electrospinning. Materials Letters, 58, 493–497.
- Krklješ, A. N., Marinović-Cincović, M. T., Kačarević-Popović, Z. M., and Nedeljković, J. M. (2007) Dynamic thermogravimetric degradation of gamma radiolytically synthesized Ag–PVA nanocomposites. Thermochimica Acta, 460, 28–34.
- Lee, D., Hwang, S., and Lee, I. (2006) One-step preparation and characterization of PtRu (1:1)/C electrocatalysts by polyol method for polymer electrolyte fuel cells. Journal of Power Sources, 160, 155–160.
- Li, N., Qin, X. H., Yang, E. L., and Wang, S. L. (2008) Effect on instability section of PVA electrospinning nanofibers by adding LiCl. Materials Letters, 62, 1345–1348.
- Lin, C. S., Khan, M. R., and Lin, S. D. (2005) Platinum states in citrate sols by EXAFS. Journal of Colloid and Interface Science, 287, 366–369.
- Liu, Z., Gan, L. M., Hong, L., Chen, W., and Lee, J. Y. (2005) Carbon-supported Pt nanoparticles as catalysts for proton exchange membrane fuel cells. Journal of Power Sources, 139, 73–78.
- Liu, Z., Guo, B., Hong, L., and Lim, T. H. (2006) Microwave heated polyol synthesis of carbon-supported PtSn nanoparticles for methanol electrooxidation. Electrochemistry Communications, 8, 83–90.
- Ma, H., Wang, L., Chen, L., Dong, C., Yu, W., Huang, T., and Qian, Y. (2007) Pt nanoparticles deposited over carbon nanotubes for selective hydrogenation of cinnamaldehyde. Catalysis Communications, 8, 452–456.

- Ma, J., Reng, S., Pan, D., Li, R., and Xie, K. (2005) PVP-Pt nanoclusters supported zeolite catalysts for converting methane to higher hydrocarbon at low temperature. Reactive & Functional Polymers, 62, 31–39.
- Peng, Z. and Kong, L. X. (2007) A thermal degradation mechanism of polyvinyl alcohol/silica nanocomposites. Polymer Degradation and Stability, 92, 1061–1071.
- Pieck, C. L., González, M. B., and Parera, J. M. (2001) Total metallic dispersion of sulfided Pt-Re/Al<sub>2</sub>O<sub>3</sub> naphtha reforming catalysts. Applied Catalysis A: General, 205, 305–312.
- Smit, E., Büttner, U., and Sanderson, R. D. (2005) Continuous yarns from electrospun fibers. Polymer, 46, 2419–2423.
- Tang, Y., Gong, J., Gu, X. H., Kim, H. Y., Dong, J. and Shen, X. Y. (2007) Fabrication and characterization of poly (vinyl alcohol)/chitosan blend nanofibers produced by electrospinning method. Carbohydrate Polymers, 67, 403–409
- Tang, Z., Geng, D., and Lu, G. (2005) Size-controlled synthesis of colloidal platinum nanoparticles and their activity for the electrocatalytic oxidation of carbonmonoxide. Journal of Colloid and Interface Science, 287, 159–166.
- Tao, J. and Shivkumar, S. (2007) Molecular weight dependent structural regimes during the electrospinning of PVA. Materials Letters, 61, 2325–2328.
- Toebes, M. L., Zhang, Y., Hájek, J., Nijhuis, T. A., Bitter, J. H. van Dillen, A. J., Murzin, D. Yu., Koningsberger, D. C., and de Jong, K. P. (2004) Support effects in the hydrogenation of cinnamaldehyde over carbon nanofiber-supported platinum catalysts: characterization and catalysis. Journal of Catalysis, 226, 215–225.
- Wan, Y. Q., He, J. H., Wu, Y., and Yu, J. Y. (2006) Vibrorheological effect on electrospun polyacrylonitrile (PAN) nanofibers. Materials Letters, 60, 3296–3300.
- Wei, Z. D., Chan, S. H., Li, L. L., Cai, H. F., Xia, Z. T., and Sun, C. X. (2005) Electrodepositing Pt on a Nafion-bonded carbon electrode as a catalyzed electrode for oxygen reduction reaction. Electrochimica Acta, 50, 2279–

2287.

- Zeng, J., Lee, J. Y., and Zhou, W. (2006) Activities of Pt/C catalysts prepared by low temperature chemical reduction methods. Applied Catalysis A: General, 308, 99–104.
- Zhuo, X., Liu, H., Guo, D., and Yang, X. (1999) Enantioselective Hydrogenation of Pyruvates over Polymer-stabilized and Supported Platinum Nanoclusters. Tetrahedron, 55, 7787-7804.
- Zhao, J., Wang, P., Chen, W., Liu, R., Li, X., and Nie, Q. (2006) Microwave synthesis and characterization of acetate-stabilized Pt nanoparticles supported on carbon for methanol electro-oxidation. Journal of Power Sources, 160, 563–569.
- Zhou, J. H., He, J. P., Ji, Y. J., Dang, W. J., Liu, X. L., Zhao, G. W., Zhang, C. X., Zhao, J. S., Fu, Q. B., and Hu, H. P. (2007) CTAB assisted microwave synthesis of ordered mesoporous carbon supported Pt nanoparticles for hydrogen electro-oxidation. Electrochimica Acta, 52, 4691–4695.
- Zhou, Z., Zhou, W., Wang, S., Wang, G., Jiang, J., Li, H., Sun, G., and Xin, Q. (2004) Preparation of highly active 40 wt.% Pt/C cathode electrocatalysts for DMFC via different routes. Catalysis Today, 93–95, 523–528.
- Chiu, H. T. “Chemical Vapor Deposition” Professor Hsin-Tien Chiu. 12 August 1998. 17 March 2008  
< <http://chiuserv.ac.nctu.edu.tw/~htchiu/cvd/home.html>>
- Remco Engineering “Ion Exchange” Remco Engineering: Water Systems and Controls. June 1981. 17 March 2008 <<http://www.remco.com/ix.htm>>

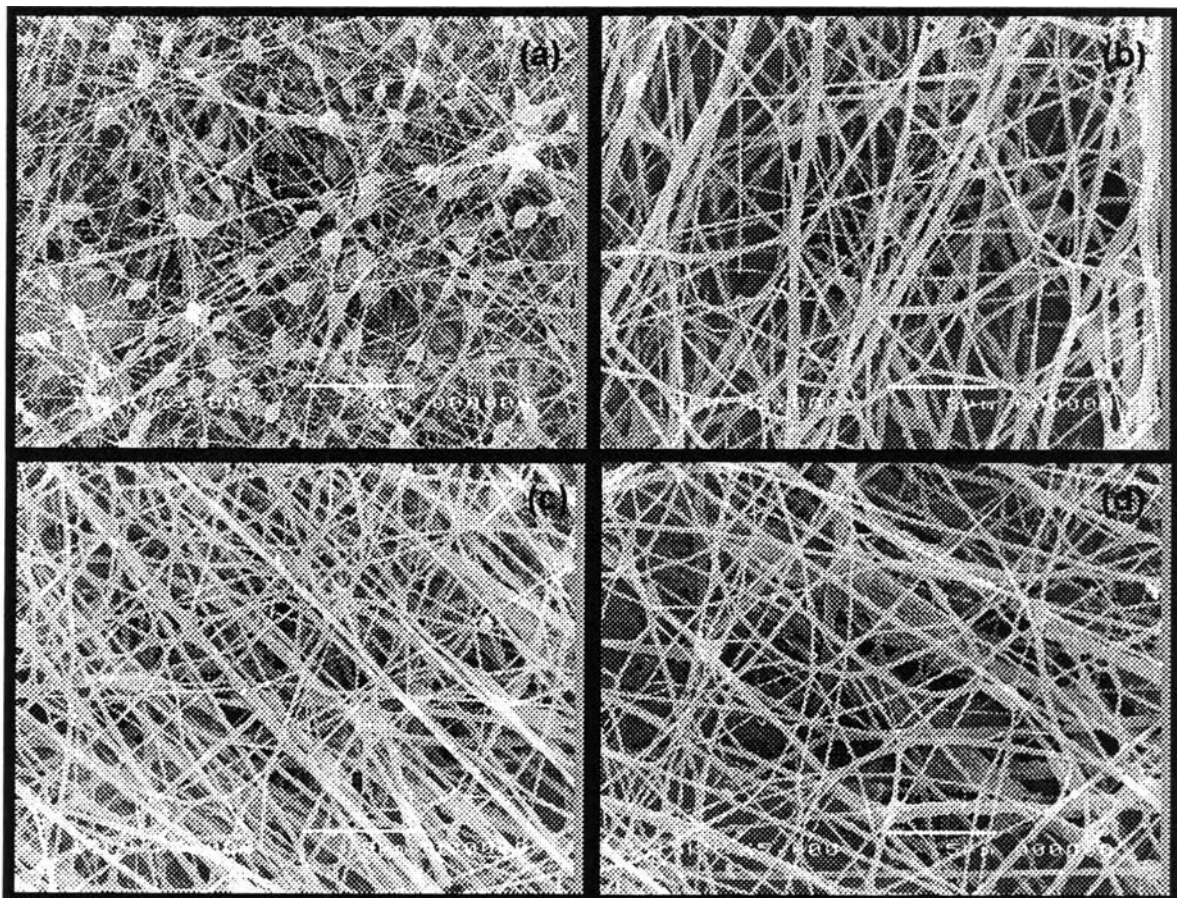
## APPENDIX

### Appendix A Characterization of PVA/Pt electrospinning solution

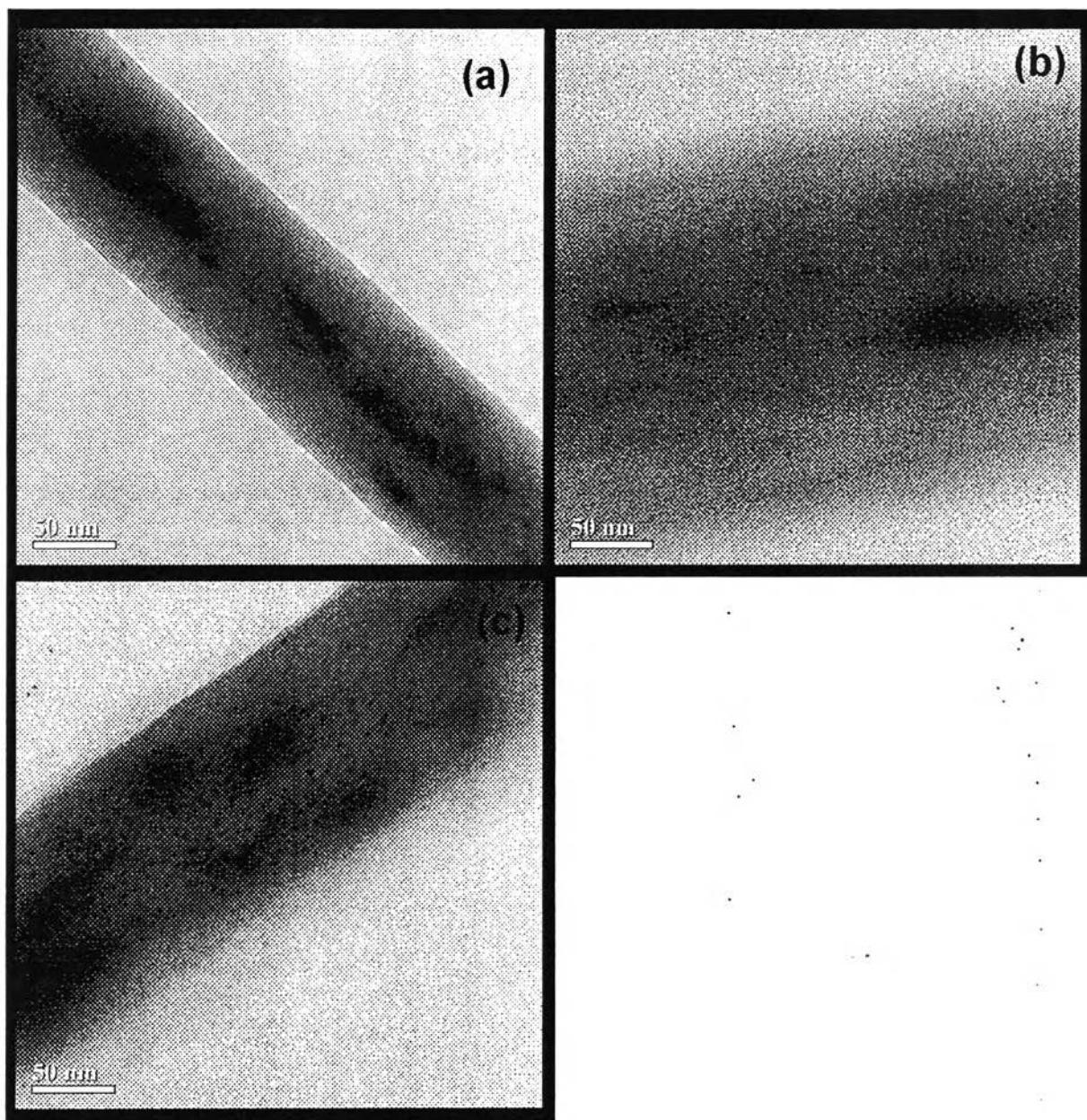
**Table A1** Viscosity of PVA/Pt electrospinning solutions

% Pt	Speed (rpm)	Torque (%)	Viscosity (cP)	Shear strength (D cm <sup>-1</sup> )	Shear rate (sec <sup>-1</sup> )	Average Viscosity (cP)	SD
0	249	99.6	191	463	232	192.67	1.53
	253	99.5	193	463	230		
	250	99.9	194	465	235		
1	232	99.8	215	464	216	219.00	5.29
	230	99.6	217	464	214		
	222	99.8	225	464	206		
3	197	99.9	254	465	183	259.00	5.13
	191	99.8	261	465	178		
	189	99.8	264	465	178		
5	151	99.8	330	464	140	333.00	3.00
	150	99.8	333	465	140		
	149	99.6	336	465	139		

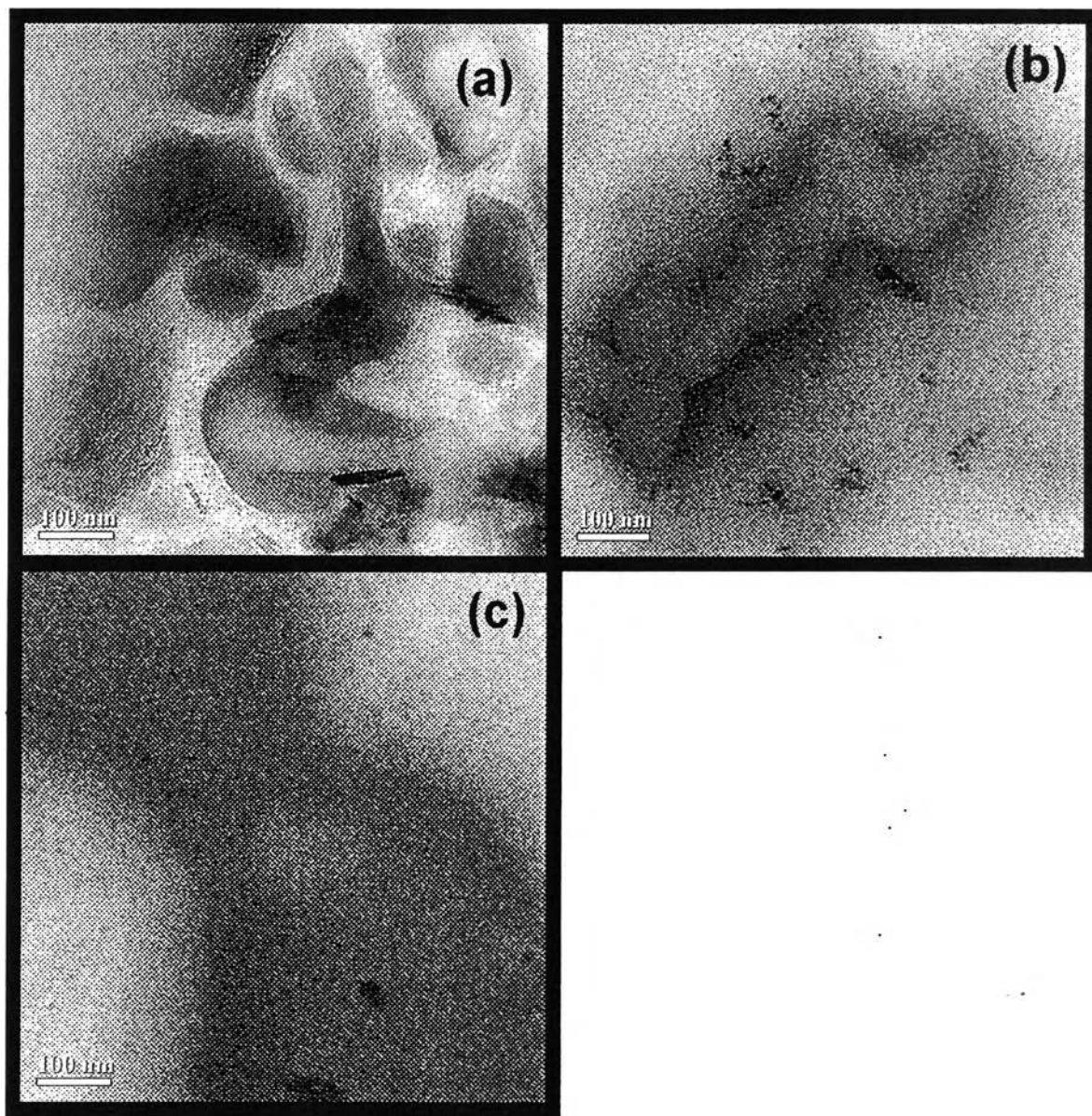
\* Viscosity of the solution was measured by a Brookfield Digital (Model DV-111) at the room temperature. Spindle number 21 was applied.

**Appendix B Morphology of PVA/Pt nanoparticle nanocomposite nanofibers**

**Figure B1** SEM images of PVA/Pt nanoparticle nanocomposite nanofibers with different % Pt loadings under 5,000 times magnification: (a) pure PVA, (b) 1 %, (c) 3% and (d) 5%.



**Figure B2** TEM images of PVA/Pt nanoparticle nanocomposite nanofibers with 8%(w/v) PVA and different % Pt loadings under 60k magnification: (a) 1%, (b) 3% and (c) 5%.



**Figure B2** TEM images of PVA/Pt nanoparticle nanocomposite solutions with 8%(w/v) PVA and different % Pt loadings under 30k magnification: (a) 1%, (b) 3% and (c) 5%.



## Appendix C Characterization of PVA/Pt nanoparticle nanocomposite nanofibers

Figure C1 EDX spectrum of pure PVA.

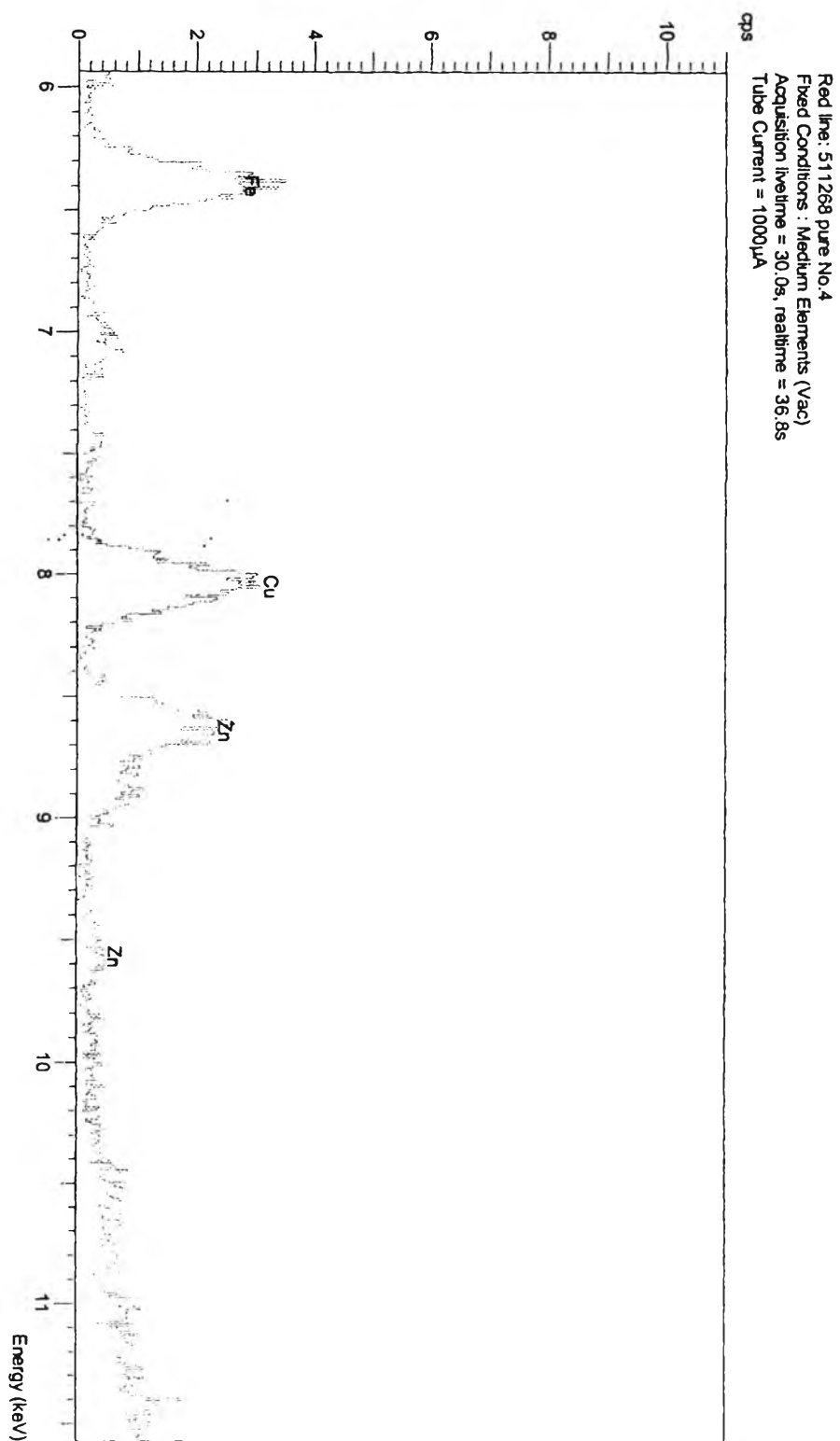


Figure C2 EDX spectrum of PVA with 1% Pt loading.

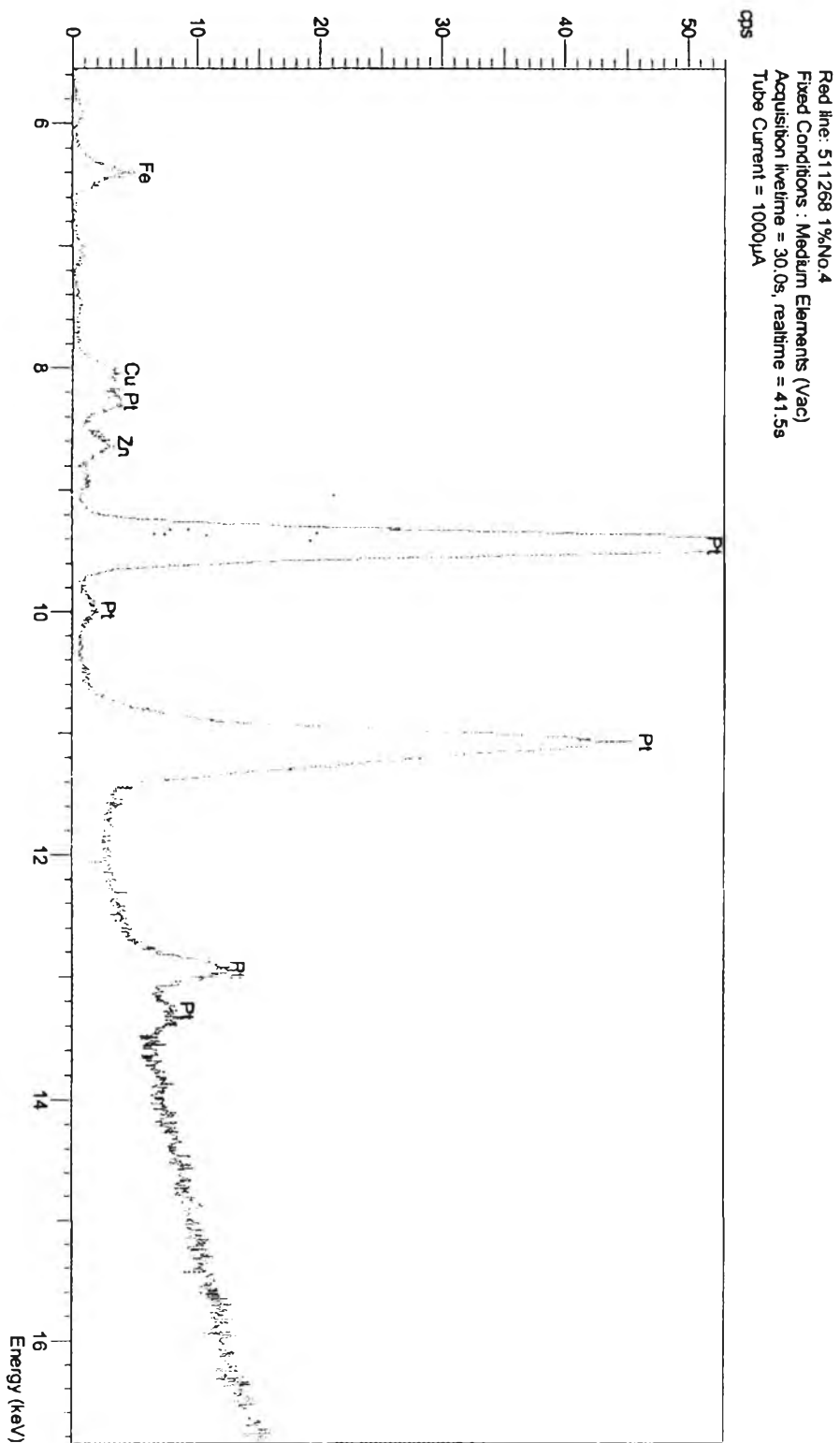


Figure C3 EDX spectrum of PVA with 3% Pt loading.

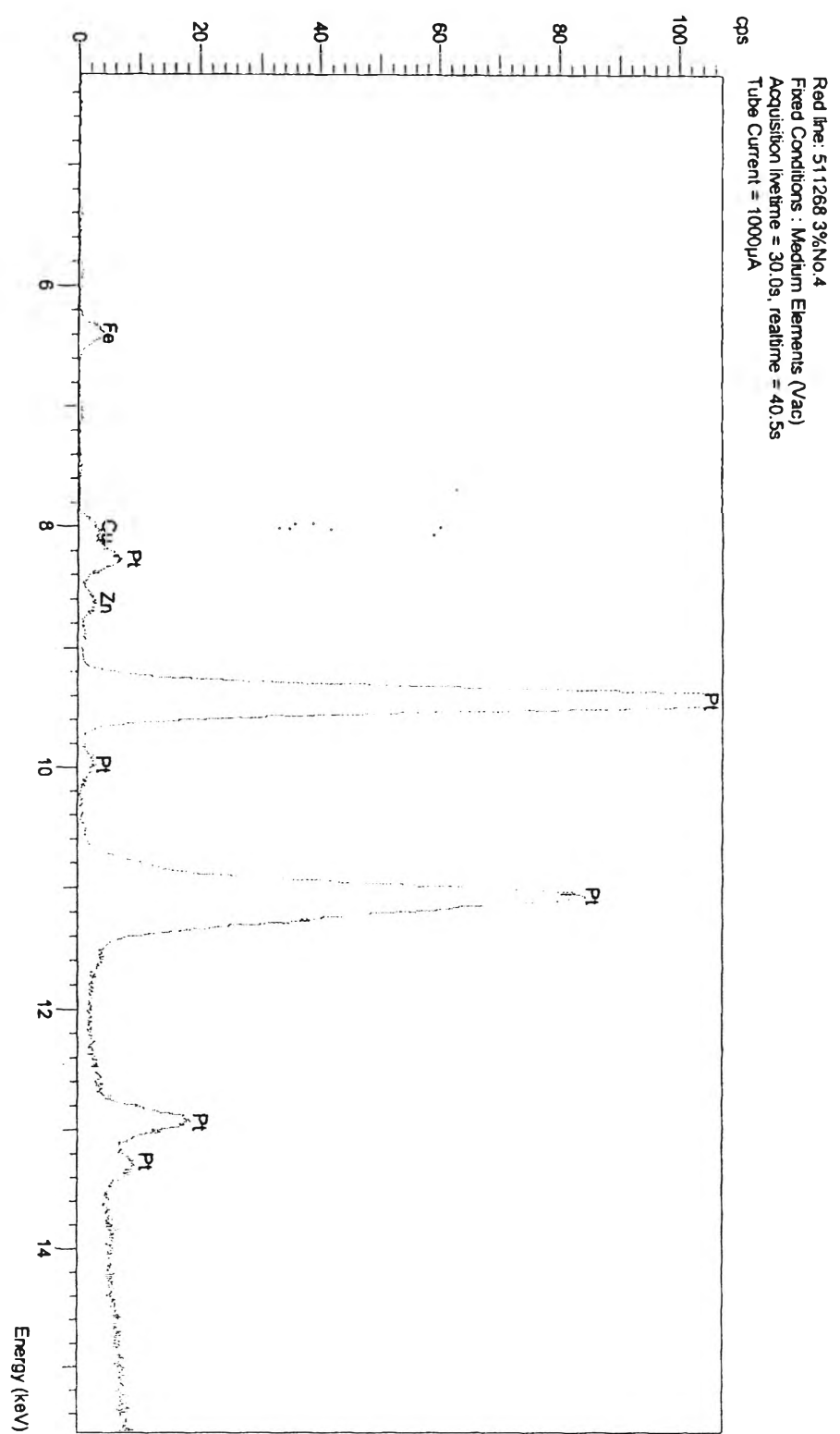
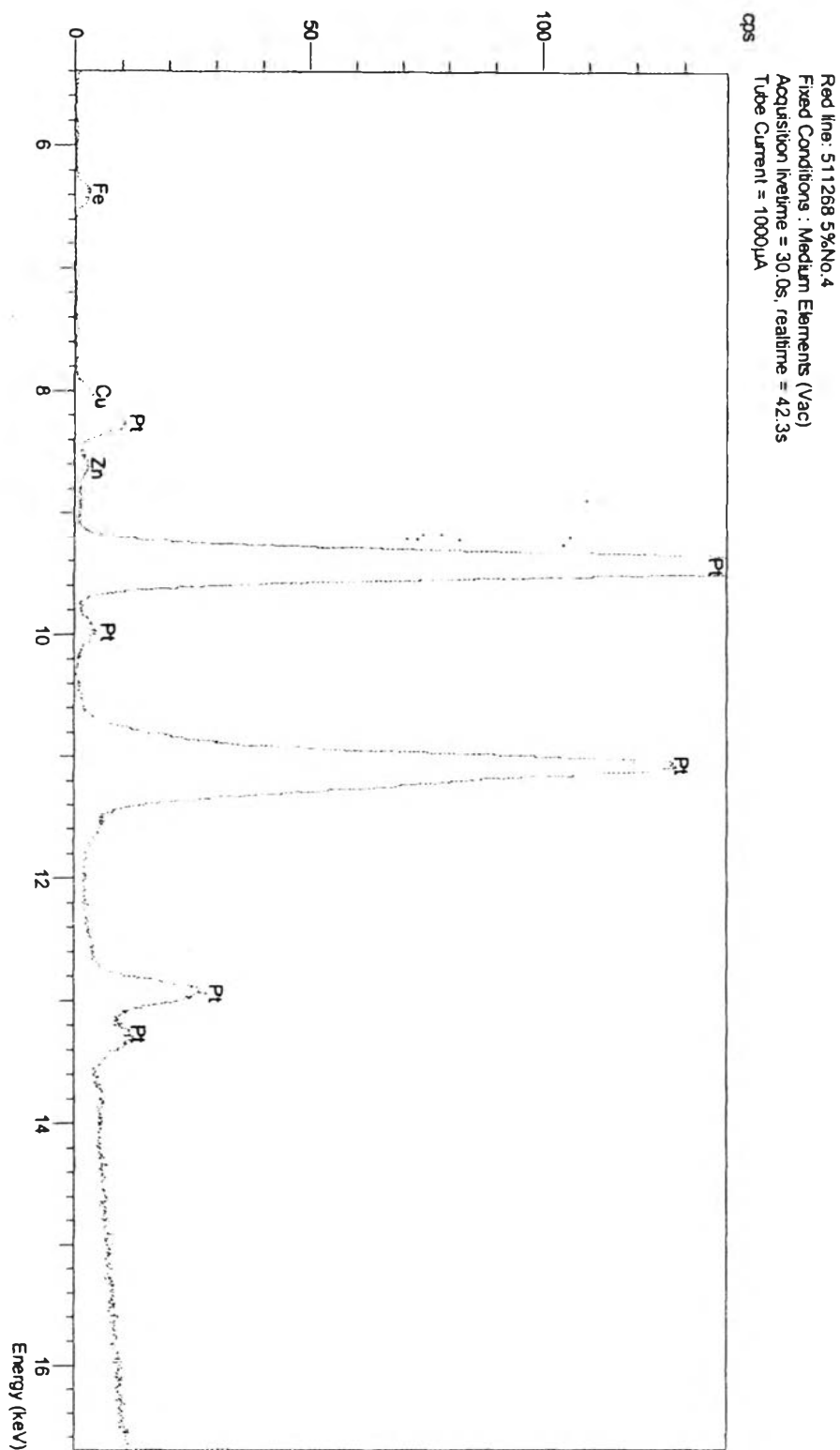


Figure C4 EDX spectrum of PVA with 5% Pt loading.



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