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APPENDICES

Appendix A Absorbance Spectra with Increasing the Number of Layer of 10mM PDADMAC/PSS Contain 1M NaCl from UV-Vis Spectrometer

The PEM fabricated by increasing the layers of 10mM PDADMAC/PSS containing 1M NaCl on quartz slide. The deposition time of each layer is 1 min and then, rinses the PEM in water 1 min for 1 time. The growth of PEM thin films were characterized by UV-Vis spectrophotometer to confirm that the film growth with increasing the number of PEM layers. The absorbance spectra under the ultraviolet range shown in Figure A1.

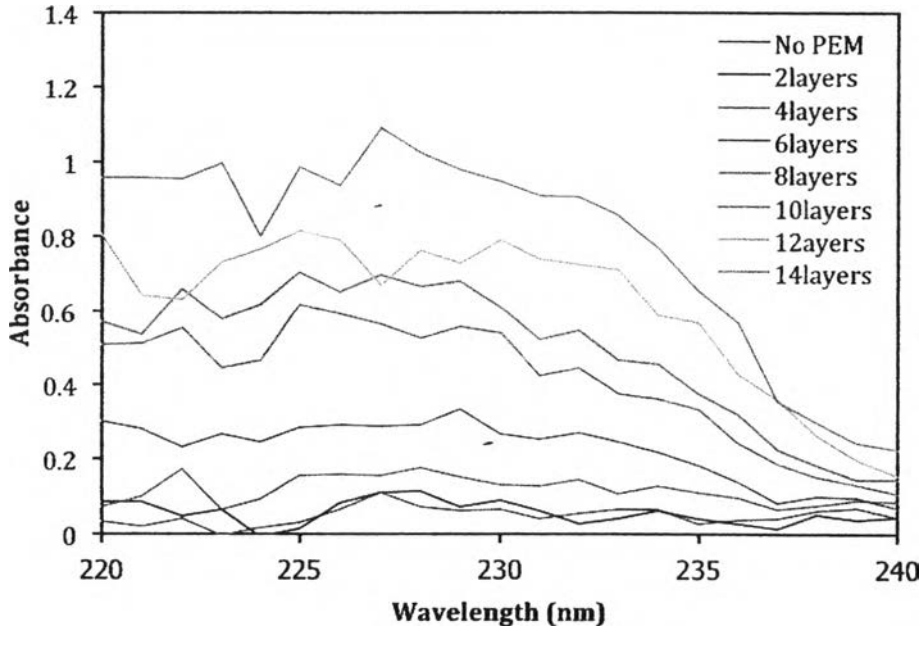


Figure A1 The absorbance of PDADMAC/PSS film on quartz slide with increasing the number of layers.

The absorbance at 230 nm under the ultraviolet range shown in Table A1.

Table A1 The absorbance at 230 nm under the ultraviolet range

Number of layers	0	2	4	6	8	10	12	14
Absorbance	0.067	0.092	0.132	0.269	0.541	0.610	0.790	0.945

The relation between the absorbance at 230 nm with the increasing of PEM layers is show in Figure A2, the absorbance increase with increasing the number of layers in a linear relationship as a equation, that

$$y = 0.0675x - 0.0418 \quad \text{(A1)}$$

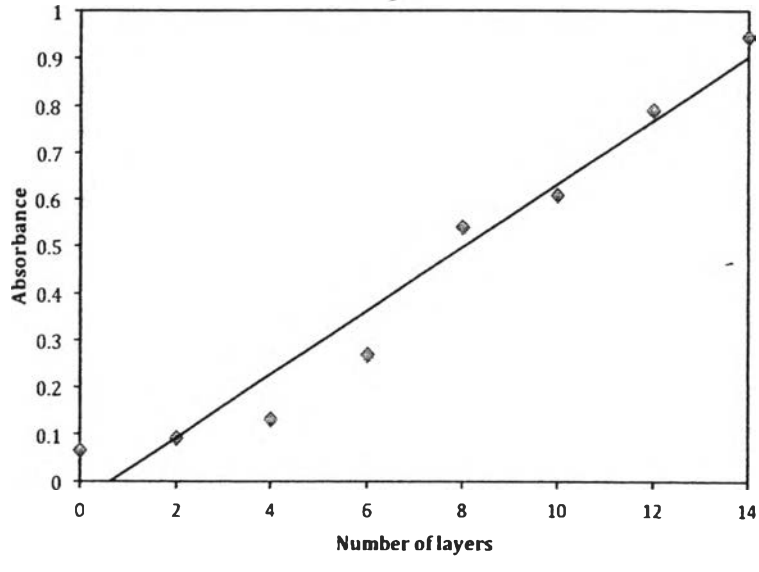


Figure A2 The absorbance at 230 nm of PDADMAC/PSS film on quartz slide with increasing the number of layers.

Appendix B The Increasing of Thickness of 10mM PDADMAC/PSS Contain 1M NaCl when Increase the Number of Layer from Ellipsometry

The thickness of PEM film fabricated by 10mM PDADMAC/PSS contain 1M NaCl deposite by dip-coating on silicon wafer after pre-treatment by piranha and hot ammonia solution was measured by ellipsometry at angle of incidence 60 degrees (Delta: 174-178 and Psi: ~23 for bare silicon wafer) and air-dried every 4 layers. The refrative index (n) is 3.848 and the absorption constant (k) is -0.221. The values of Delta (Δ) and Psi (Ψ) of bare silicon wafer and when increasing the PEM layers and the thickness of films are show in Table B1.

Table B1 The values of Delta (Δ) and Psi (Ψ) of bare silicon wafer and when increasing the PEM layers and the thickness of films

PEM layers	1		2		3		Thickness (nm)
	Δ	Ψ	Δ	Ψ	Δ	Ψ	
Bare-Si	176.719		23.281				0
4	160.530	23.479	164.371	23.369	165.708	23.434	12.3367
8	131.108	26.559	131.937	26.287	132.202	26.541	45.8667
12	107.579	39.798	106.364	40.600	105.861	43.117	92.64
16	251.630	43.470	248.185	41.125	248.685	42.209	157.645
20	194.120	22.417	195.919	22.658	200.304	22.642	129.9567

Multilayer thickness as a function of the number of layers show in Figure B1, the thickness increase with incrasing the number of layer in a linear relationship as a equation, that

$$y = 9.8898x - 17.421 \qquad \text{(B1)}$$

The result was superimposed to the thickness of the number of layers for a 1mM PSS/PDADMAC multilayer with 1.0M NaCl measure by ellipsometer by Dubas *et al.*, 1999. From (B1) equation and calculated the thickness of 13-layer PEM equal to 111.146 nm which can state that the coating of PEM on surface is in nanoscale.

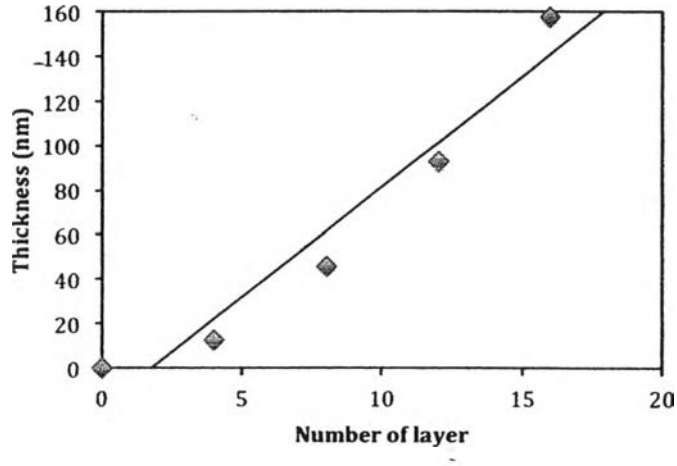


Figure B1 The thickness of 10mM PDADMAC/PSS film on silicon wafer with increasing the number of layers measured by ellipsometry.

Appendix C The Contact Angle of 10mM PDADMAC/PSS Contain 1M NaCl when Increase the Number of Layer

The contact angle measurement of PEM thin film when increase the number of layers is show in Table C1.

Table C1 The contact angle of PEM thin film when increase the PEM layers

PEM layers	1		2		3		Contact angle
	θ Left	θ Right	θ Left	θ Right	θ Left	θ Right	
10	55.62	55.31	55.72	55.71	56.50	52.09	55.16±1.56°
20	38.38	39.44	39.45	42.55	38.51	37.19	39.25±1.82°
30	21.69	23.31	21.58	23.25	23.86	27.00	23.45±1.97°
40	14.60	17.33	18.44	17.33	18.04	19.80	17.59±1.72°

Contact angle as a function of PEM layers show in Figure C1, the contact angle decrease with increasing PEM layer in a linear relationship as a equation, that

$$y = -1.3389x + 67.6 \qquad (C1)$$

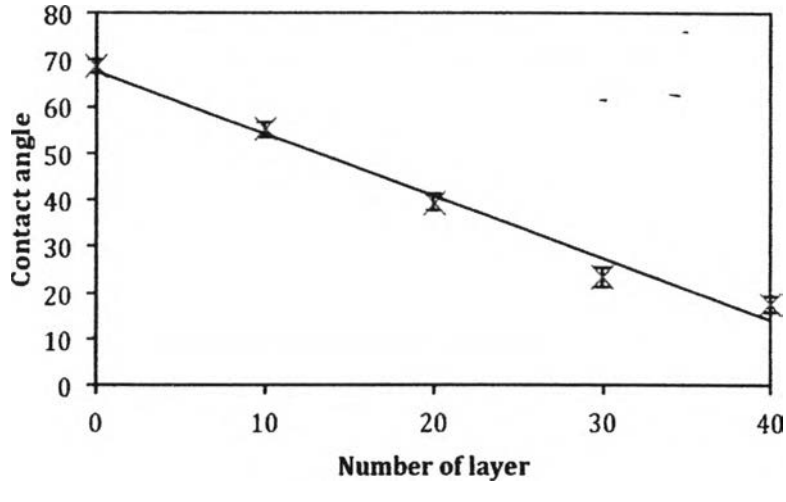


Figure C1 The decreasing of contact angle when increase the number of PEM layer.

Appendix D Absorbance Spectra of PEM when using Different Tolvent type on the Final Loading Curcumin into PEM from UV-Vis Spectrometer

The 13-layer of 10mM PDADMAC/PSS containing 1M NaCl on glass slide loaded with 0.01% w/v curcumin in difference solvent composition 80:15, 90:10 and 95:5 water:solvent which using EtOH, MeOH and acetone as solvent with loading time 3 hrs. The final amount of curcumin in PEM was characterized by UV-Vis spectrophotometer. The absorbance when increasing % water in three types of solvent shown in Figure D1-D3.

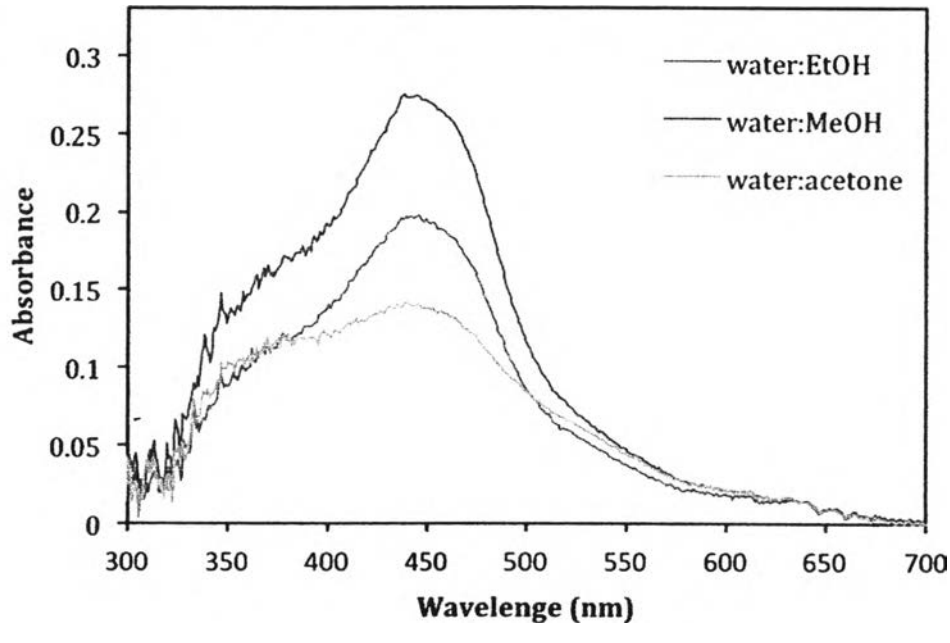


Figure D1 The absorbance of the final curcumin loading into 13-layer of PDADMAC/PSS film using 85:15 water:solvent.

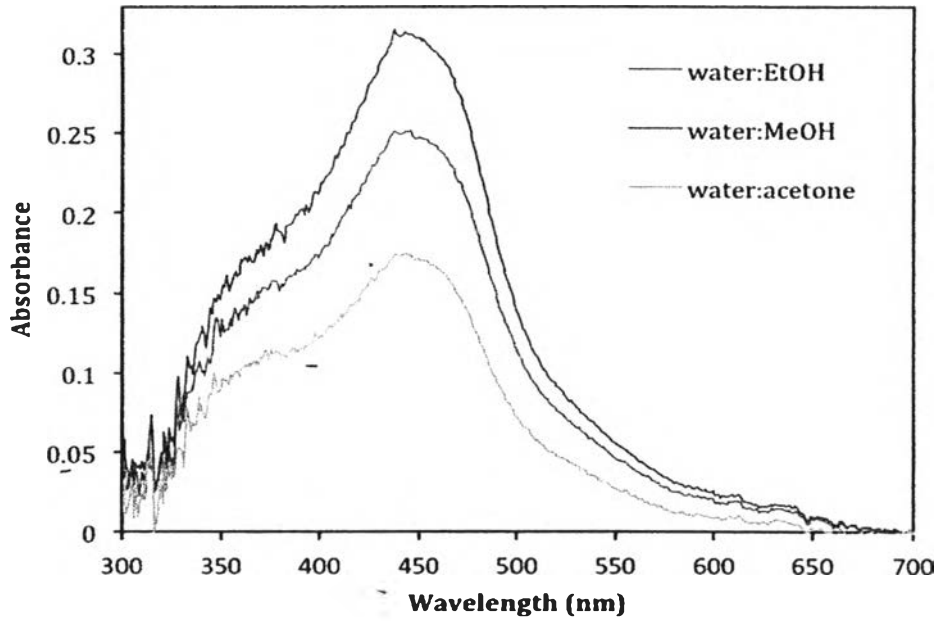


Figure D2 The absorbance of the final curcumin loading into 13-layer of PDADMAC/PSS film using 90:10 water:solvent.

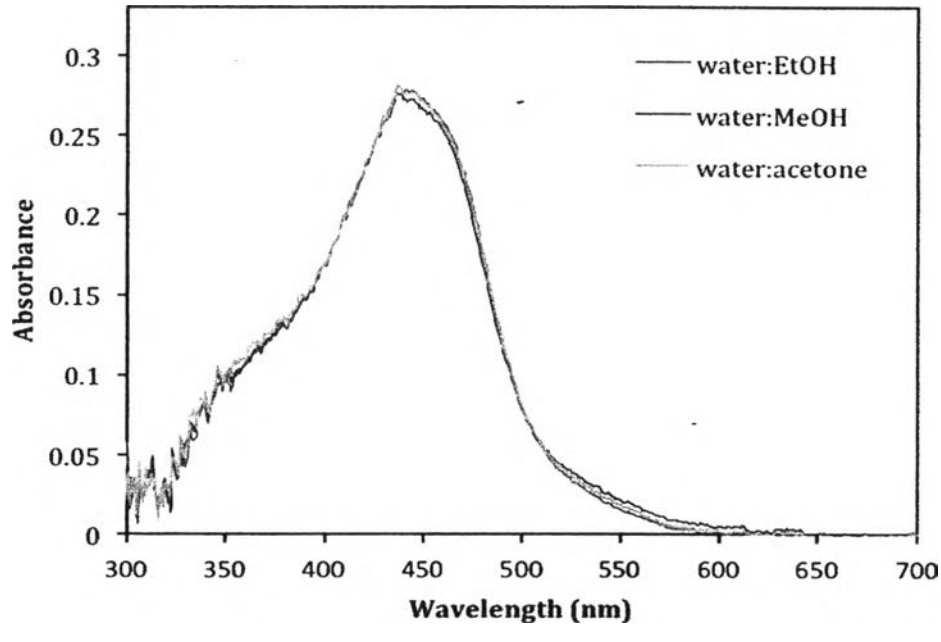


Figure D3 The absorbance of the final curcumin loading into 13-layer of PDADMAC/PSS film using 95:5 water:solvent.

Appendix E Absorbance Spectra of the Final Amount of Curcumin Loaded into PEM by Various Temperature and Solvent Composition from UV-Vis Spectrometer

The PEM were fabricated by 13-layer of 10mM PDADMAC/PSS containing 1M NaCl on glass slide with deposition time 1 min and rinse in water 1 min 1 time. To study the loading of 0.01% curcumin in water:EtOH solvent by various the solvent composition to 50:50, 75:25, 80:20, 85:15, 90:10 and 95:5. The PEM films were dipped in each solution at various temperature 4, 15, 28 and 50°C. Finally, measure the absorbance at various loading time begin with 5, 30 mins, 1, 2 and 3 hrs.

The absorbance spectra of final loaded curcumin in PEM in each solvent composition at 4°C are shown in Figure E1-E5.

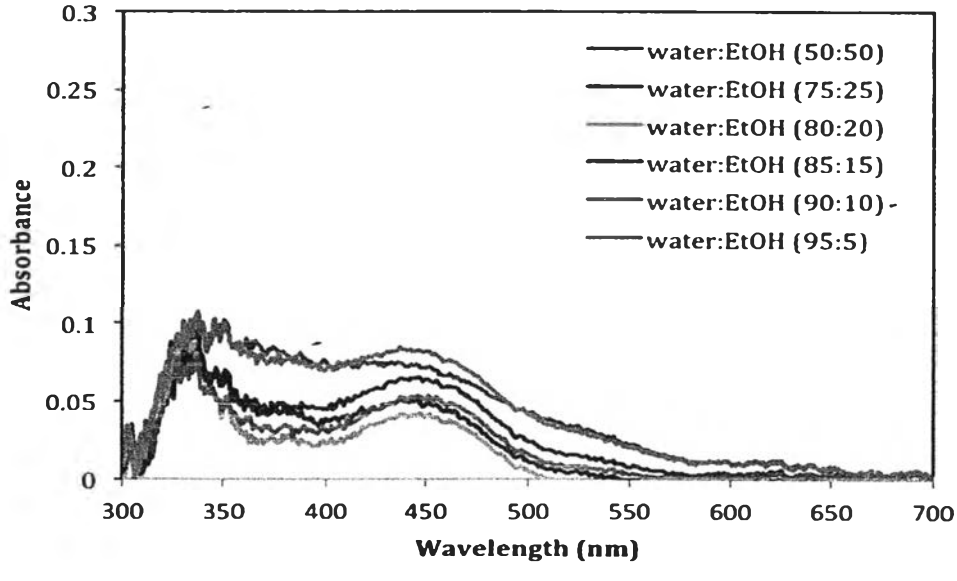


Figure E1 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 4°C when loading time is 5 mins.

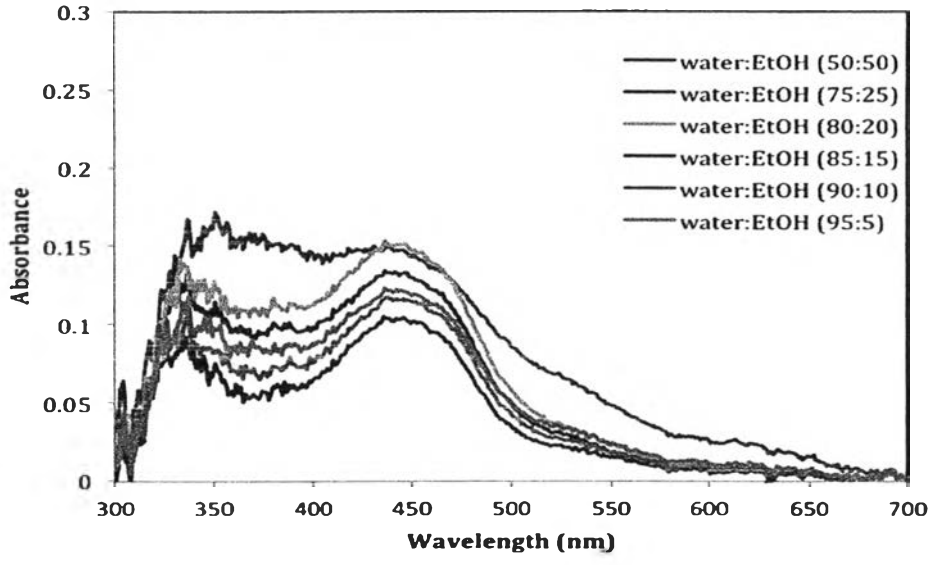


Figure E2 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 4°C when loading time is 30 mins.

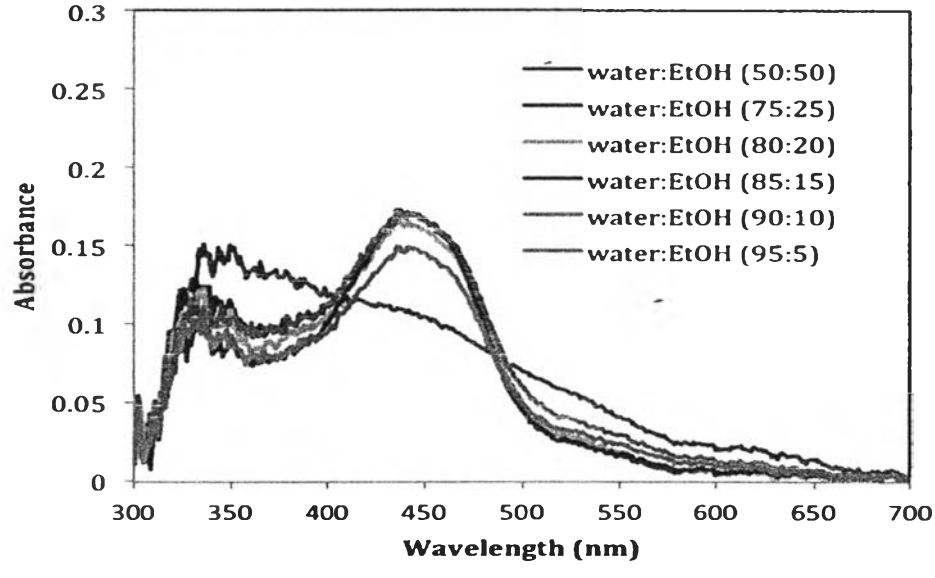


Figure E3 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 4°C when loading time is 1 hr.

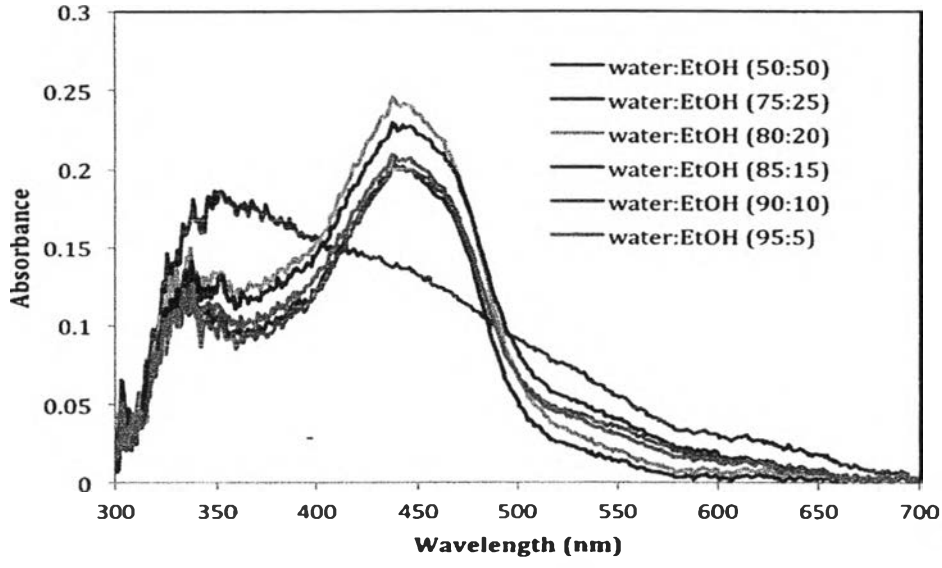


Figure E4 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 4°C when loading time is 2 hrs.

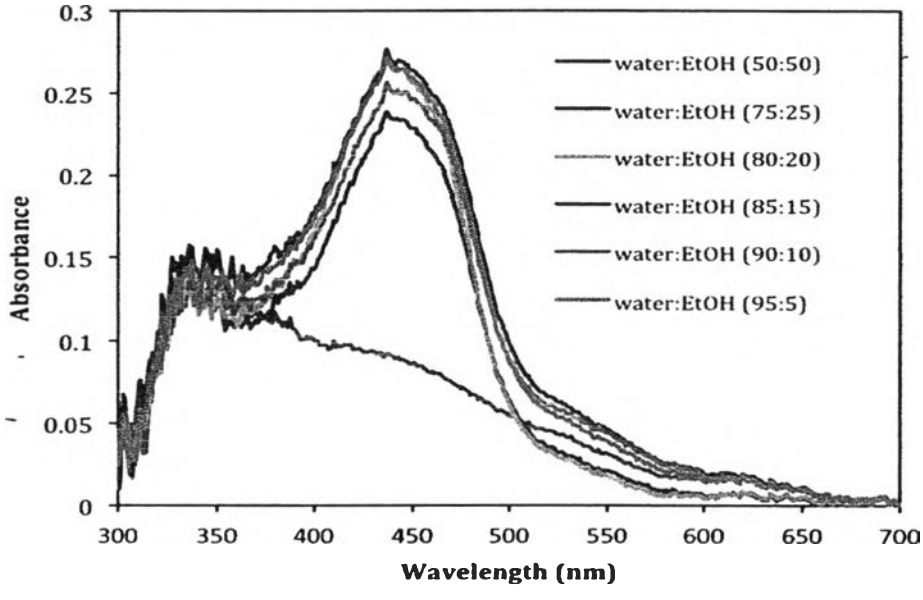


Figure E5 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 4°C when loading time is 3 hrs.

The absorbance spectra of final loaded curcumin in PEM in each solvent composition at 15°C are shown in Figure E6-E10.

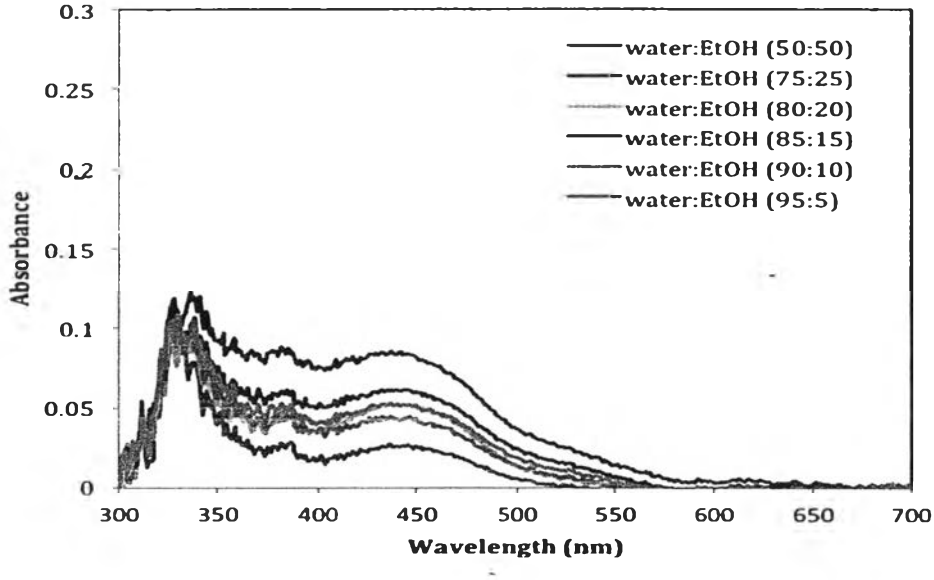


Figure E6 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 15°C when loading time is 5 mins.

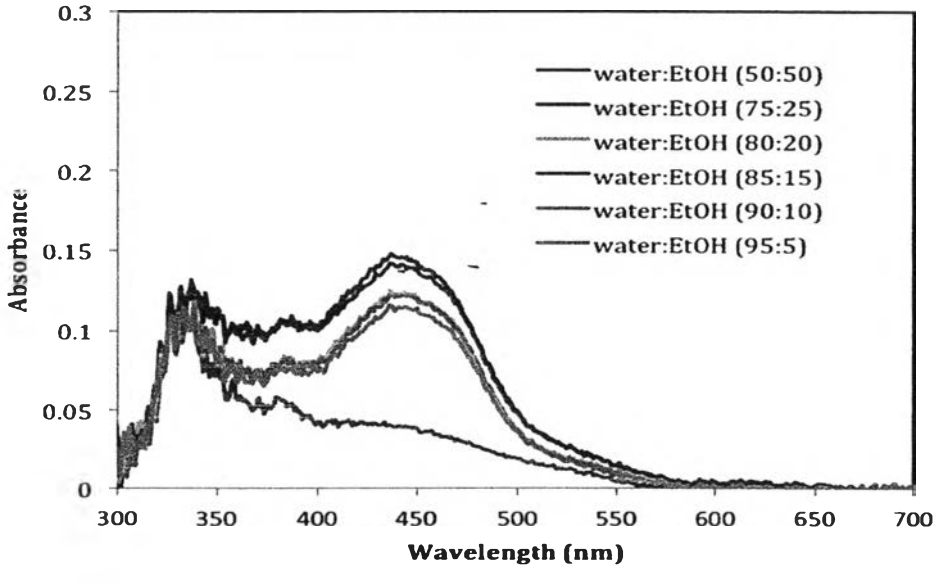


Figure E7 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 15°C when loading time is 30 mins.

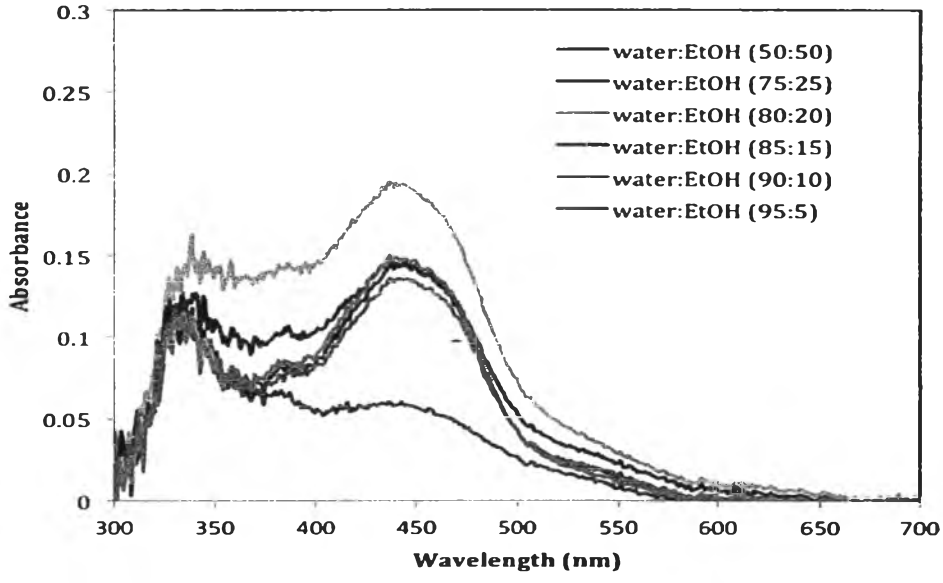


Figure E8 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 15°C when loading time is 1 hr.

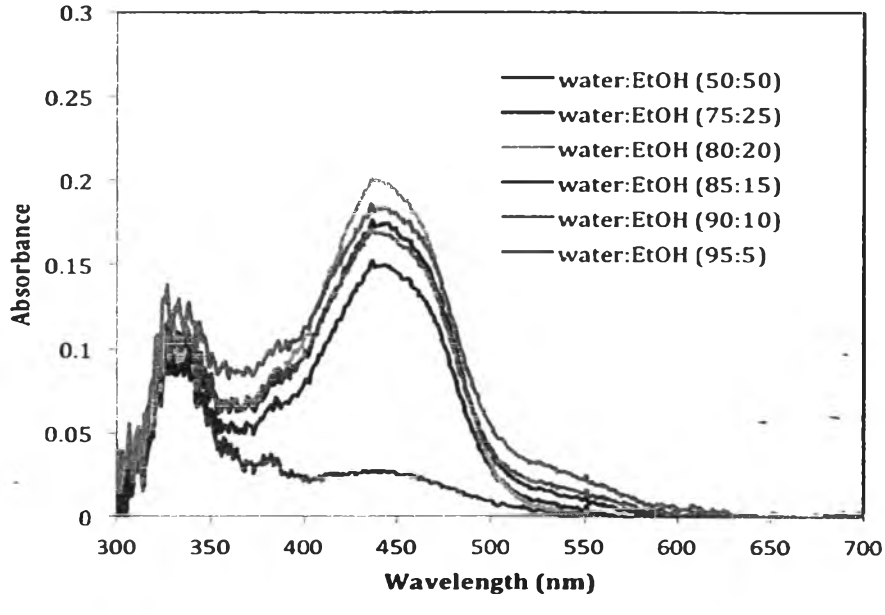


Figure E9 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 15°C when loading time is 2 hrs.

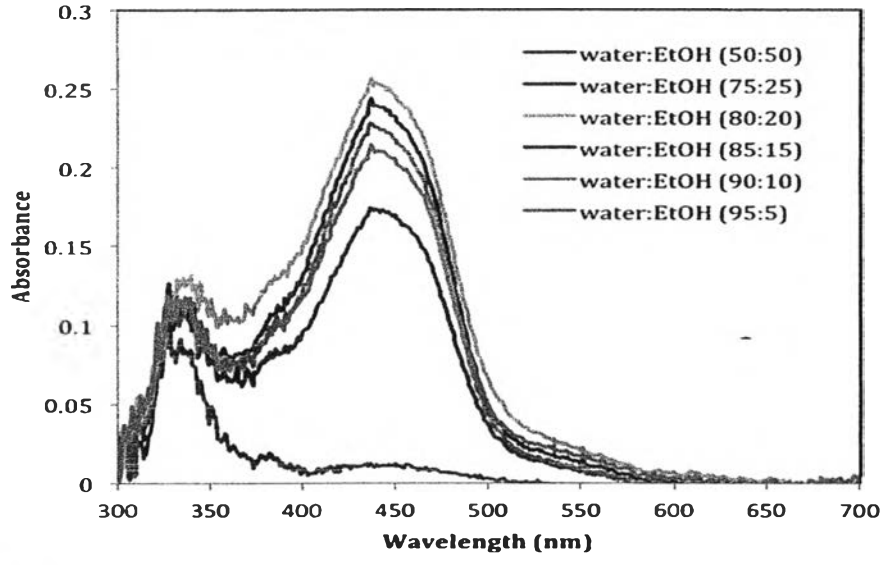


Figure E10 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 15°C when loading time is 3 hrs.

The absorbance spectra of final loaded curcumin in PEM in each solvent composition at 28°C are shown in Figure E11-E15.

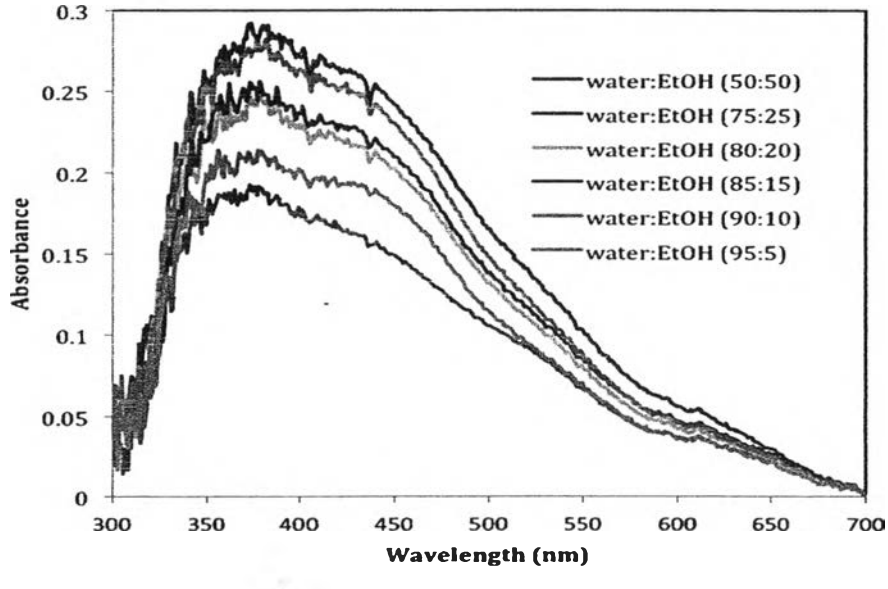


Figure E11 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 28°C when loading time is 5 mins.

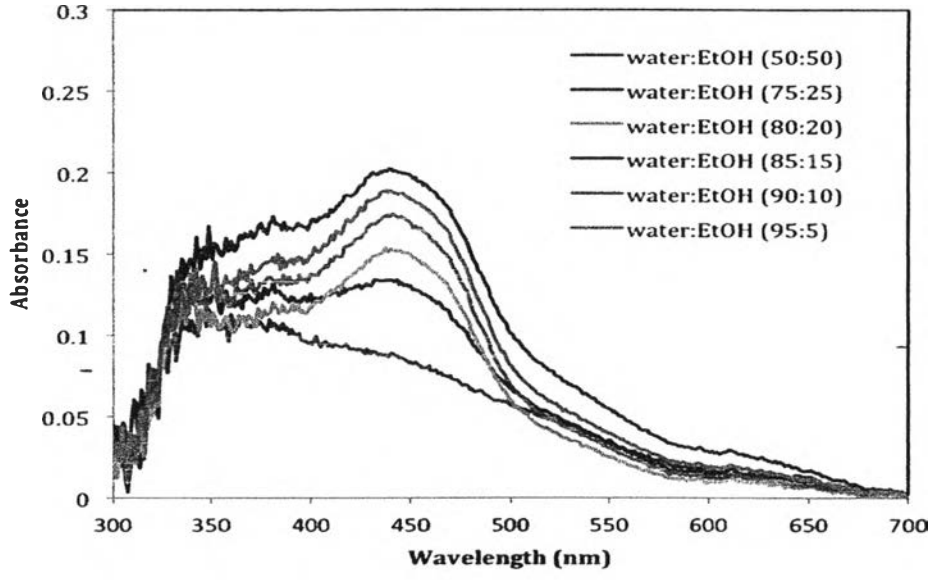


Figure E12 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 28°C when loading time is 30 mins.

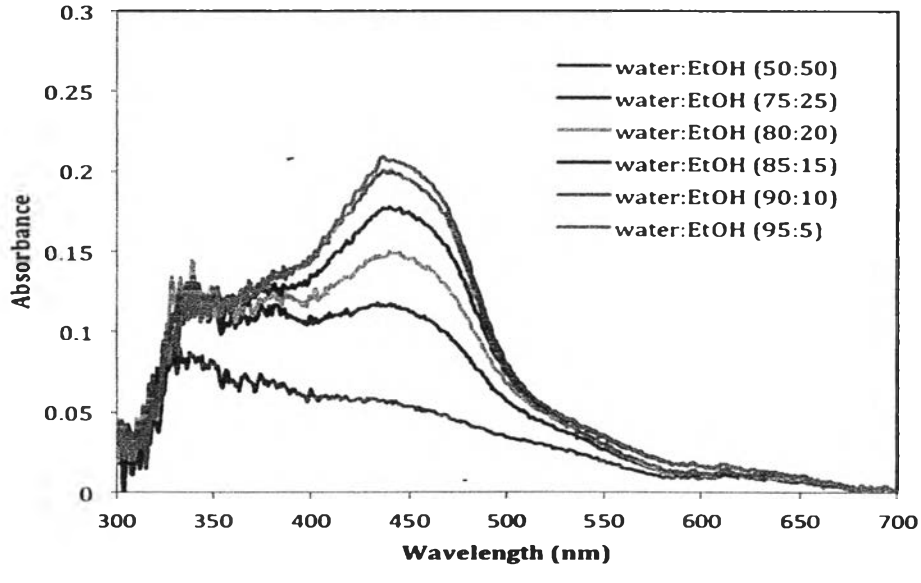


Figure E13 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 28°C when loading time is 1 hr.

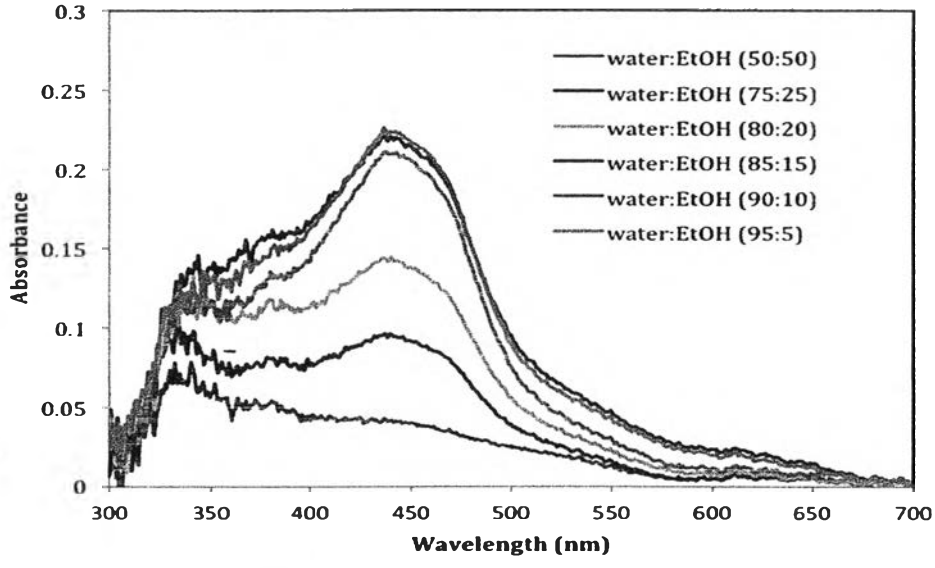


Figure E14 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 28°C when loading time is 2 hrs.

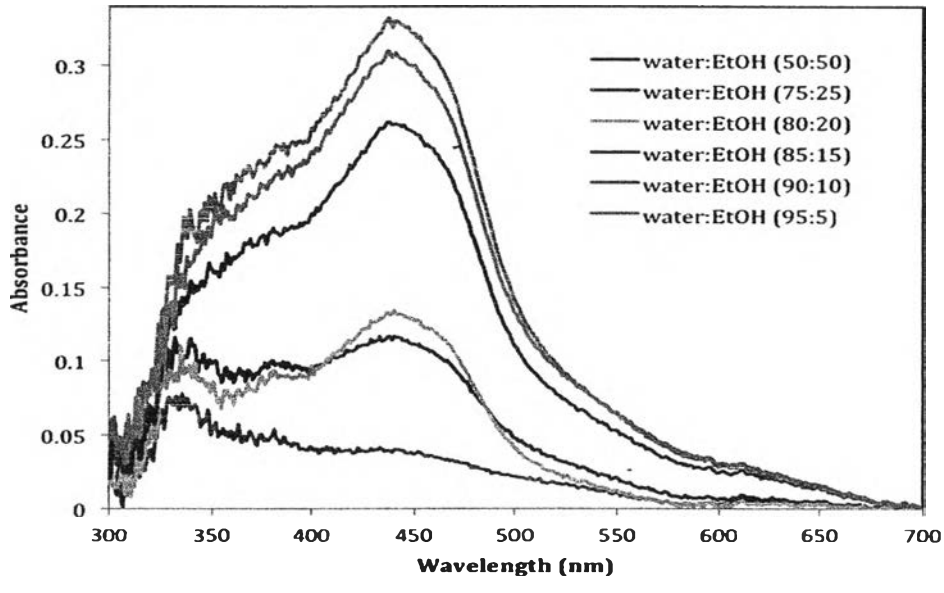


Figure E15 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 28°C when loading time is 3 hrs.

The absorbance spectra of final loaded curcumin in PEM in each solvent composition at 50°C are shown in Figure E16-E20.

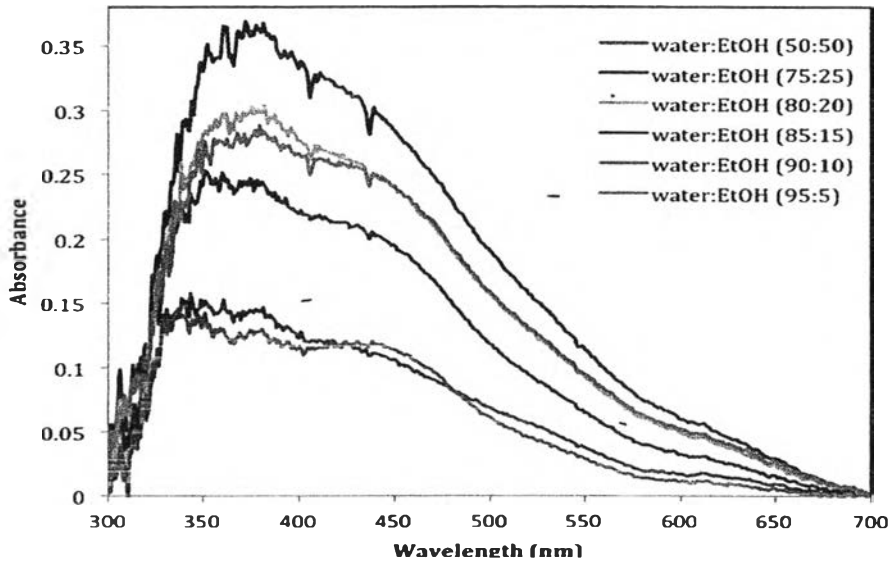


Figure E16 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 50°C when loading time is 5 mins.

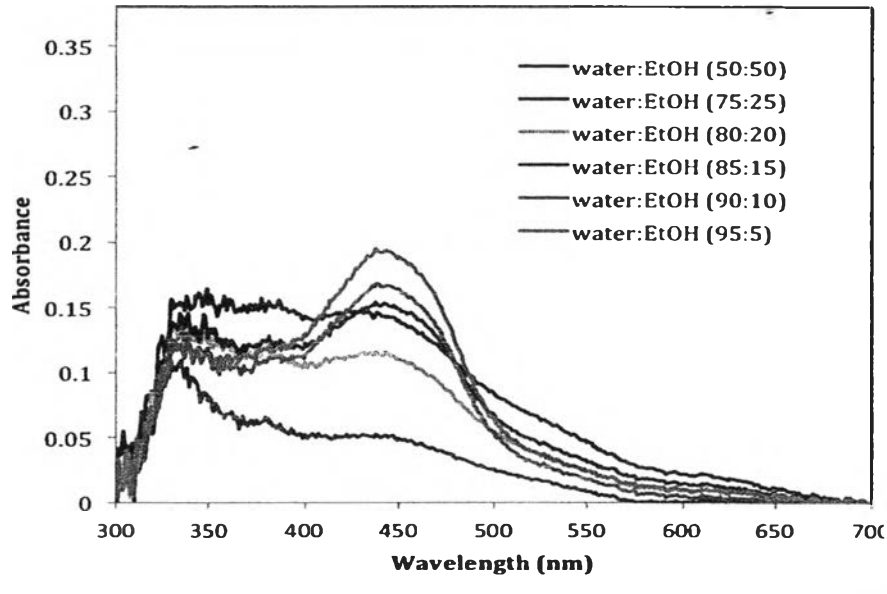


Figure E17 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 50°C when loading time is 30 mins.

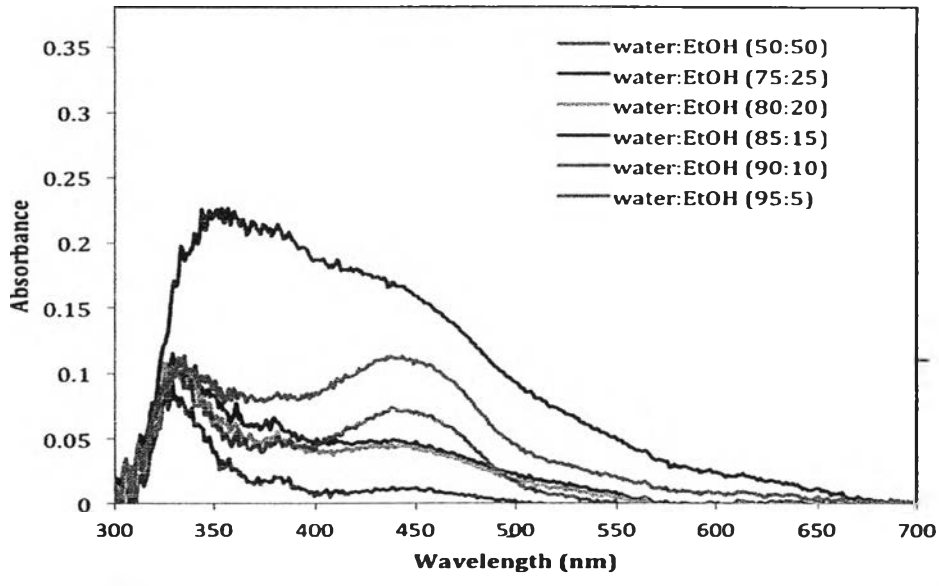


Figure E18 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 50°C when loading time is 1 hr.

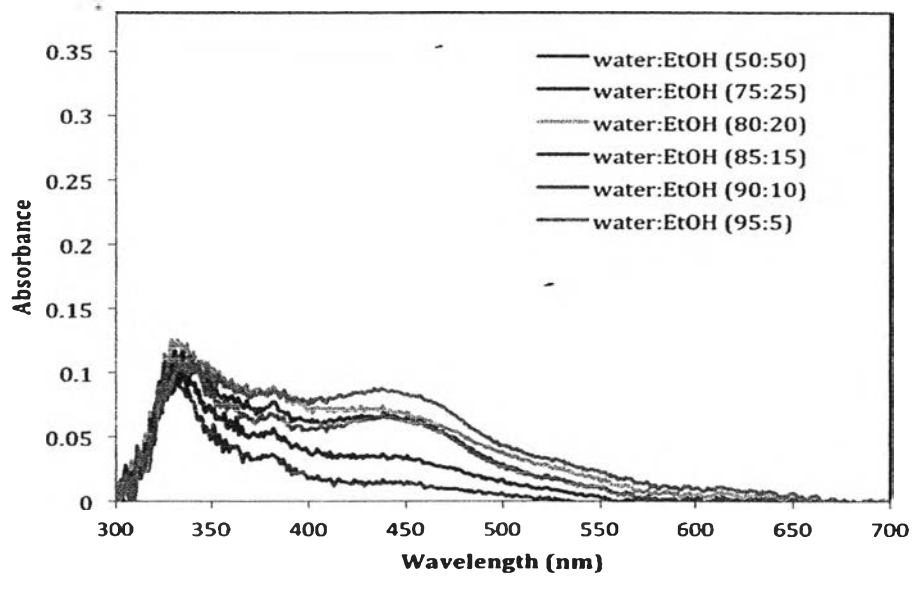


Figure E19 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 50°C when loading time is 2 hrs.

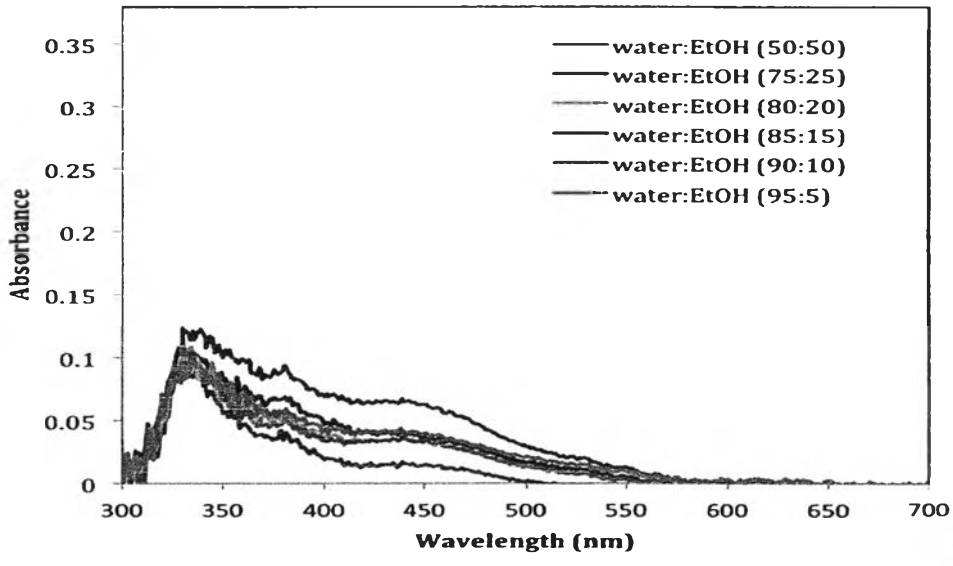


Figure E20 The absorbance spectra of the final loaded curcumin in PEM in each solvent composition at 50°C when loading time is 3 hrs.

The absorbance at 435 nm as a function of time of the loading can state the saturated of curcumin in PEM in each condition. The kinetic property of the loading of curcumin into PEM thin films in each temperature are show in Figure E21-E24.

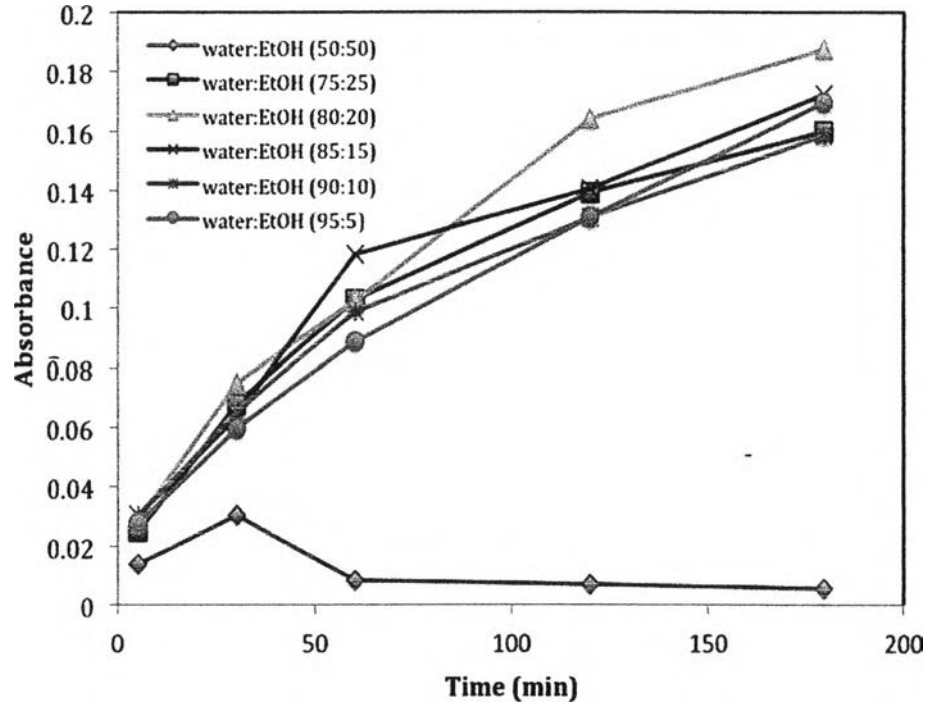


Figure E21 The kinetic property of the loading curcumin into PEM films at 4°C.

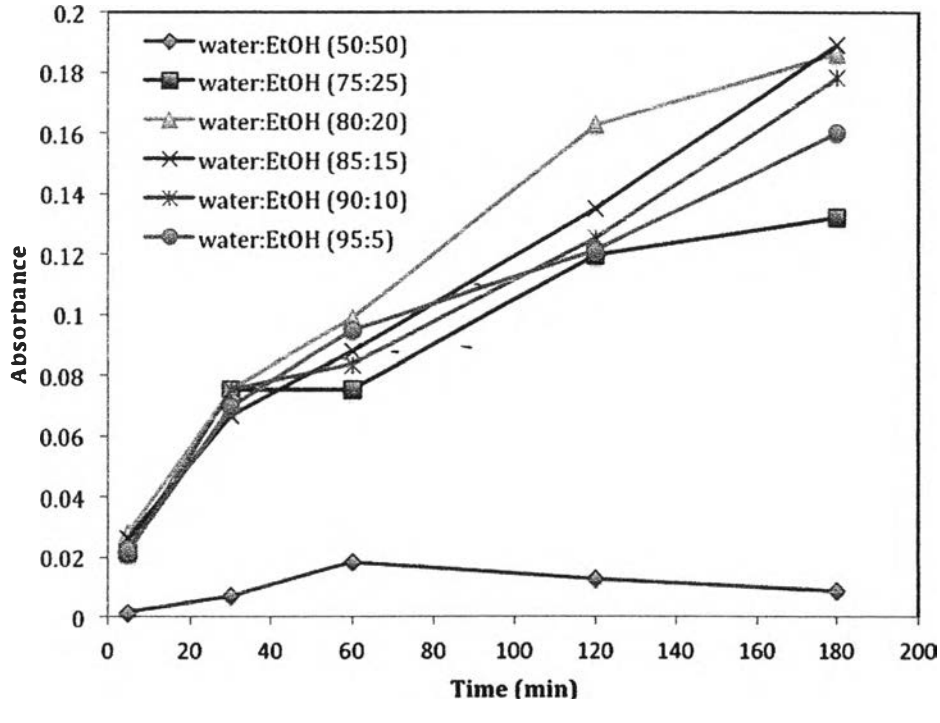


Figure E22 The kinetic property of the loading curcumin into PEM films at 15°C.

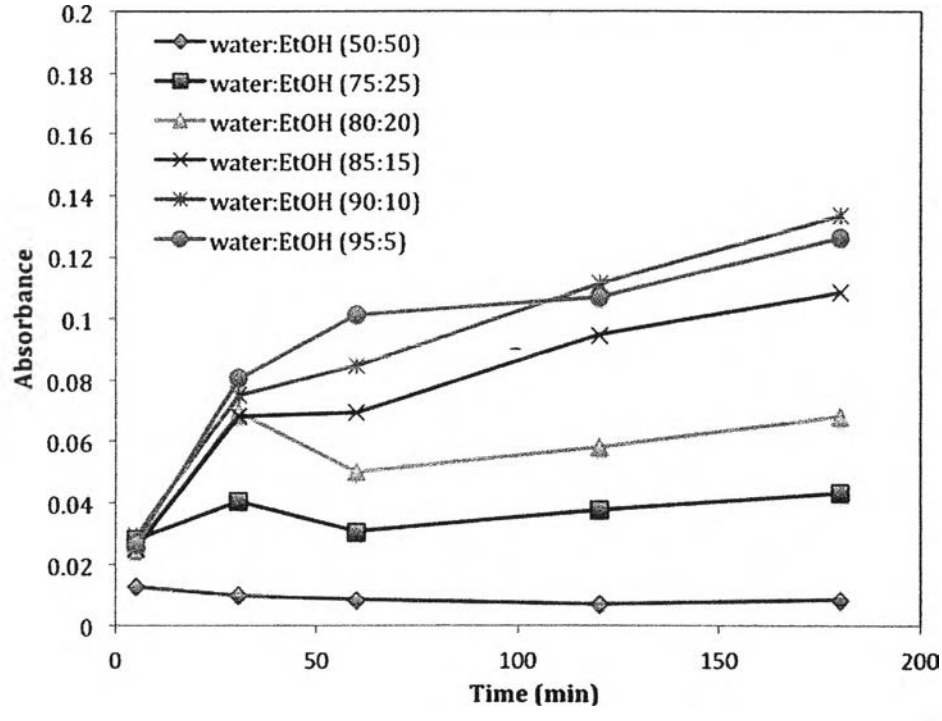


Figure E23 The kinetic property of the loading curcumin into PEM films at 28°C.

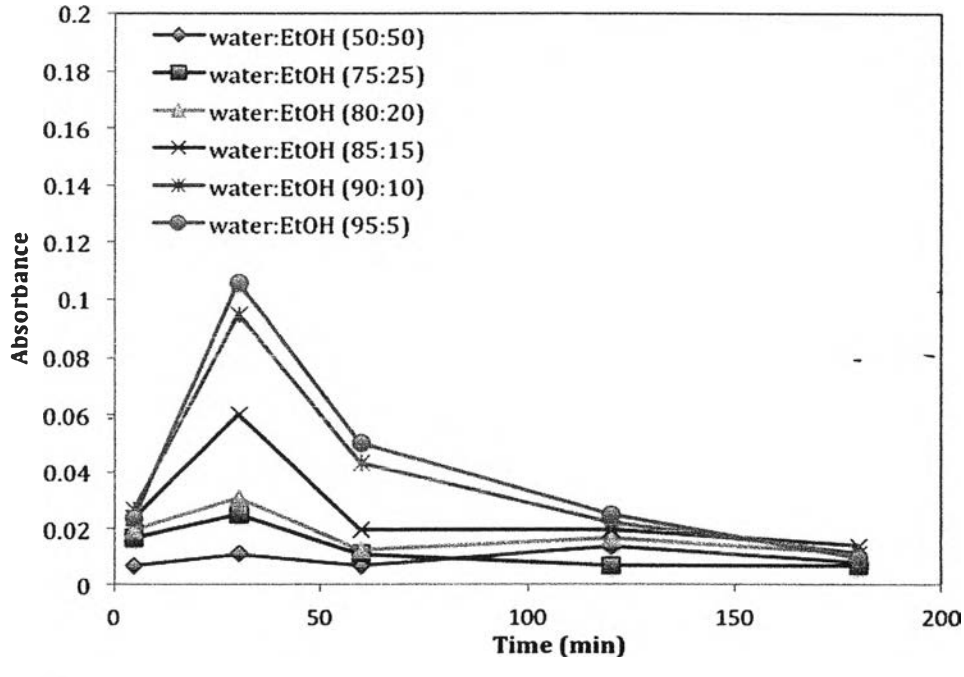


Figure E24 The kinetic property of the loading curcumin into PEM films at 50°C.

Appendix F Absorbance Spectra of the Final Amount of Curcumin Loaded into PEM after Surfactant Modification from UV-Vis Spectrometer

The 9-layer PEM fabricated by 10mM PDADMAC/PSS containing 1M NaCl on glass slide were dipped into SDS surfactants in water at concentration of 0.725, 1.5, 3, 6, 10, 14, 18 and 22mM for 1 hour. Then, loading with 0.01% w/v curcumin at 90:10 water:EtOH solvent for 3 hours. The absorbance spectra of the final loaded curcumin in PEM with SDS show in Figure F1.

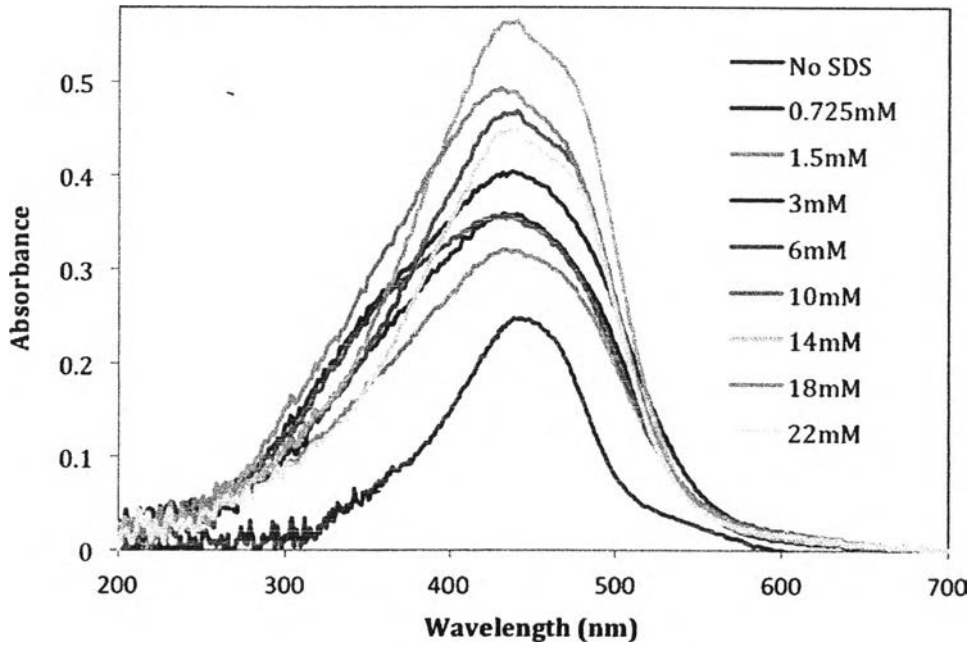


Figure F1 The absorbance spectra of the final loaded curcumin in PEM with SDS.

The 8-layer PEM were dipped into CTAB surfactants in water at concentration of 0.125, 0.25, 0.5, 1, 2 and 4mM for 1 hr. Then, loading with 0.01% w/v curcumin at 90:10 water:EtOH solvent for 3 hrs. The absorbance spectra of the final loaded curcumin in PEM with CTAB show in Figure F2.

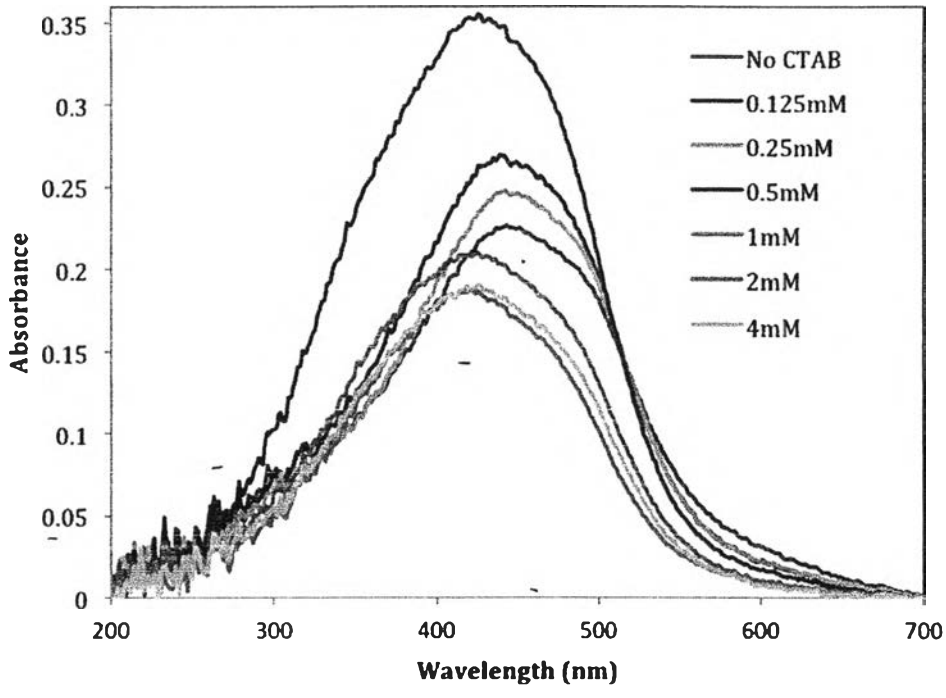
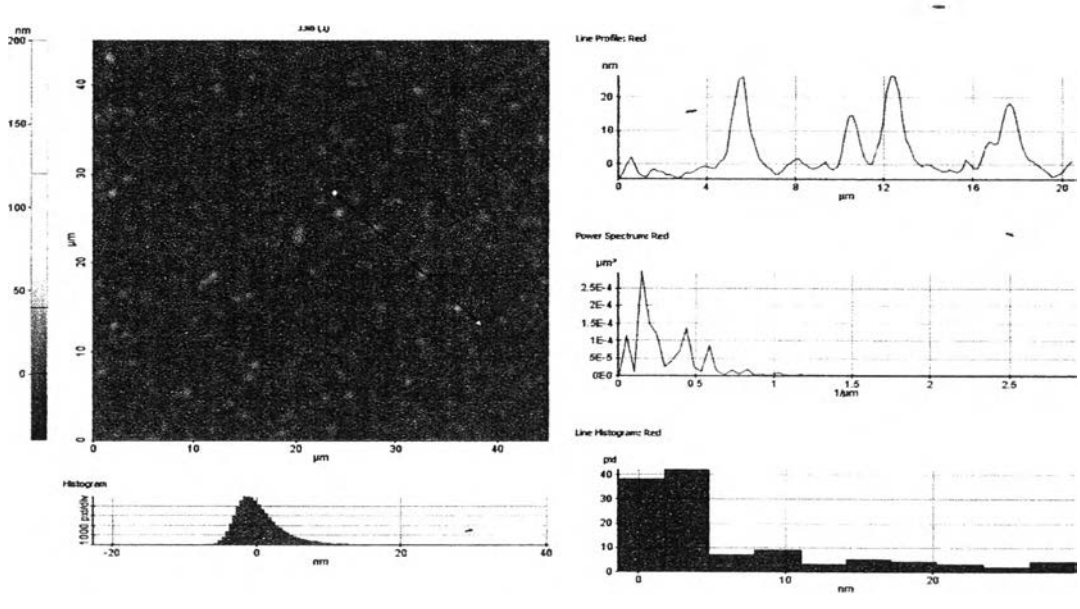


Figure F2 The absorbance spectra of the final loaded curcumin in PEM with CTAB.

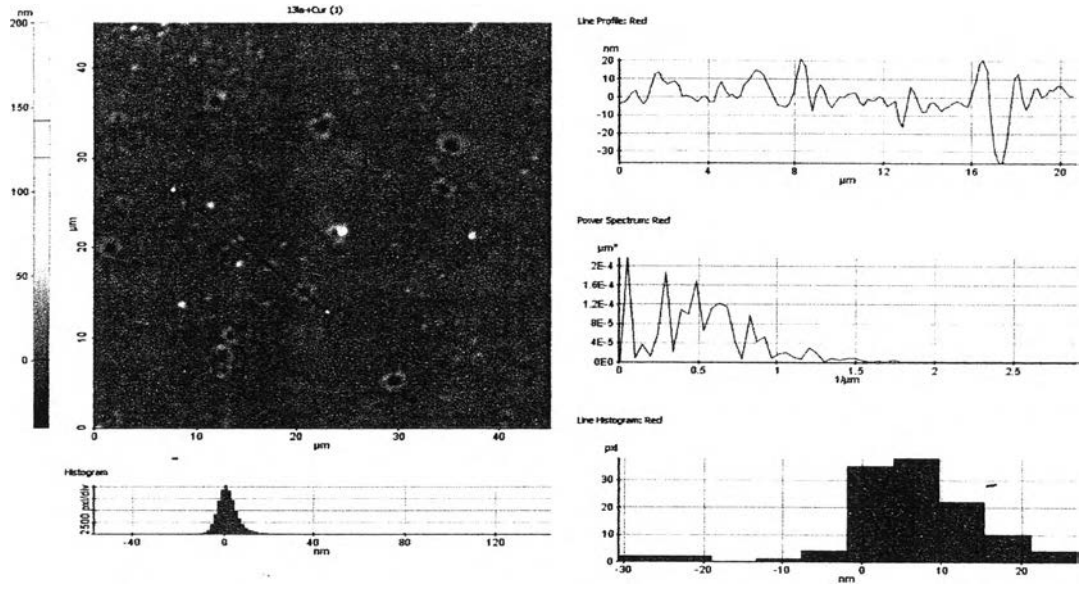
Appendix G AFM Images and Characterization Data of PEM Surface Modification by SDS Surfactant

The 13-layer PEM fabricated by 10mM PDADMAC/PSS contain 1M NaCl on glass slide were dipped into 10mM SDS surfactants in water for 1 hr. Then, loading with 0.01% w/v curcumin at 90:10 water:EtOH solvent for 3 hrs.



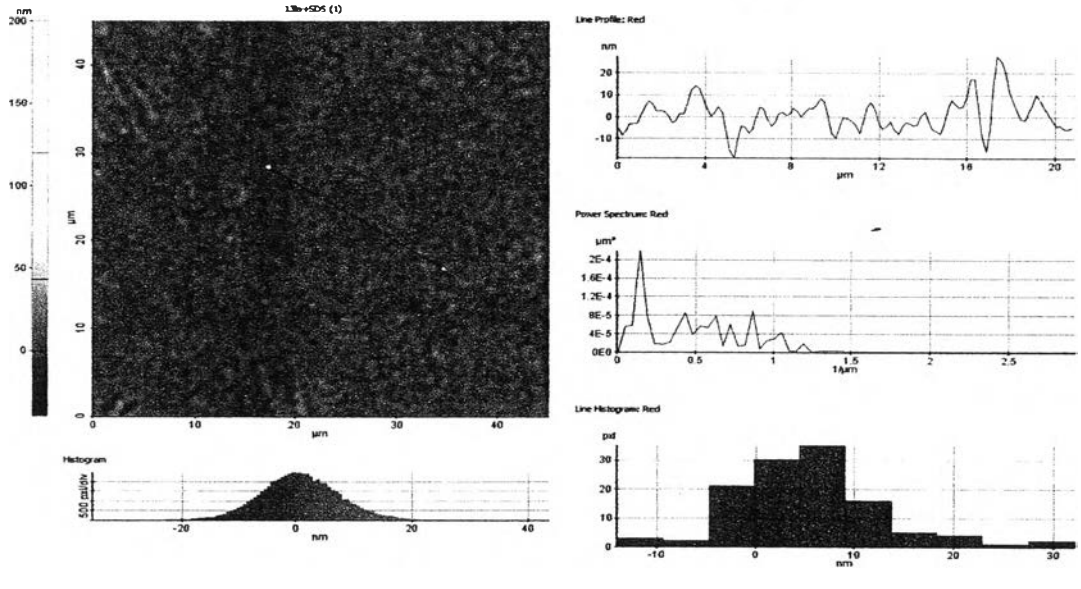
Statistics	Min(nm)	Max(nm)	Mid(nm)	Mean(nm)	Rq(nm)
Red line	-4.460	26.385	10.962	2.784	7.448
Whole region	-23.134	39.710	- 8.288	0	4.012

Figure G1 Characterization data of 13-layer 10mM PDADMAC/PSS contain 1M NaCl PEM.



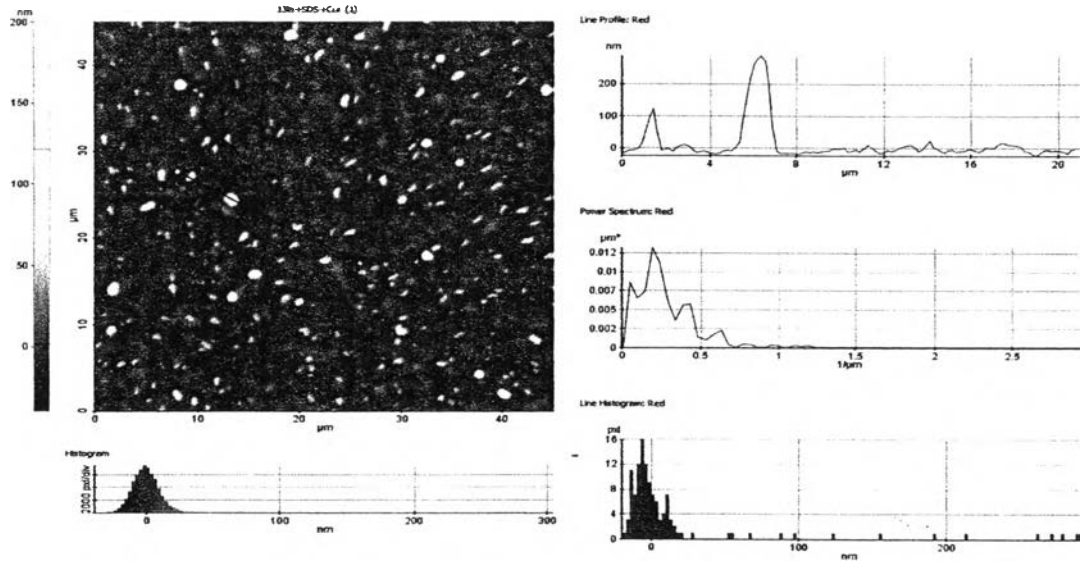
Statistics	Min(nm)	Max(nm)	Mid(nm)	Mean(nm)	Rq(nm)
Red line	-36.388	21.042	-7.673	0.275	9.076
Whole region	-58.574	142.422	41.924	0	6.207

Figure G2 Characterization data of PEM after loading 0.01%w/v curcumin 3 hrs.



Statistics	Min(nm)	Max(nm)	Mid(nm)	Mean(nm)	Rq(nm)
Red line	-18.626	27.459	4.416	0.683	7.418
Whole region	-35.843	42.897	3.527	0	7.062

Figure G3 Characterization data of PEM immersed in 10mM SDS for 1 hr.



Statistics	Min(nm)	Max(nm)	Mid(nm)	Mean(nm)	Rq(nm)
Red line	-22.562	287.031	132.235	12.802	60.486
Whole region	-40.873	302.103	130.615	0	21.198

Figure G4 Characterization data of PEM immersed in SDS and loading with curcumin.

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Proceedings:

1. Saikaew, R., and Dubas, S. T. (2014, April 22) Improved Loading of Hydrophobic Molecules in Polyelectrolyte Multilayers Thin Films using the Layer-by-Layer Surface Modification. Proceedings of The 5th Research Symposium on Petrochemicals and Materials Technology and The 20th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

Presentation:

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