REFERENCES

1. Cheng, Z.; Teoh, S. "Surface Modification of Ultra Thin Poly(ε-caprolactone) Films Using Acrylic acid and Collagen" *Biomaterials* **2004**, *25*, 1991-2001.

2. NG, K. W.; Hutmacher, D. W.; Schantz, J.; NG, C. S.; Too, H.; Lim, T. C.; Phan, T. T.; Teoh, S. H. "Evaluation of Ultra-Thin Poly(ε-Caprolatone) Films for Tissue-Engineered Skin" *Tissue Eng.* **2001**, *7*, 441-455.

3. Dai, N. T.; Williammson, M. R.; Khammo, N.; Adams, E. F.; Coombes, A. G. A. "Composite Cell Support Membranes based on Collagen and Polycaprolactone for Tissue Engineering of Skin" *Biomaterials* **2004**, *25*, 4263-4271.

4. Coombes, A. G. A.; Rizzi, S. C.; Williammson, M. R.; Barralet, J. E.; Downes, S.; Wallace, W. A. "Precipitation Casting of Polycaprolactone for Applications in Tissue Engineering and Drug Delivery" *Biomaterials* **2004**, *25*, 315-325.

5. Hutmacher, D. W.; Schantz, T.; Zein, I.; Ng, K. W.; Teoh, S. H.; Tan, K. C. "Mechanical Properties and Cell Cultural Response of Polycaprolactone Scaffolds Designed and Fabricated via Fused Deposition Modeling" *J. Biomed. Mater. Res.* **2001**, *55*, 203-216.

6. Ma, Z.; Gao, C.; Gong, Y.; Shen, J. "Chondrocyte Behaviors on Poly-L-lactic acid (PLLA) Membranes Containing Hydroxyl, Amide or Carboxyl groups" *Biomaterials* **2003**, *24*, 3725-3730.

7. Zhu, Y.; Gao, C.; Shen, J. "Surface Modification of Polycaprolactone with Poly(methacrylic acid) and Gelatin Covalent Immobilization for Promoting Its Cytocompatibility" *Biomaterials* **2002**, *23*, 4889-4895.

8. Zhu, Y.; Gao, C.; Liu, X.; Shen, J. "Surface Modification of Polycaprolactone Membrane *via* Aminolysis and Biomacromolecule Immobilization for Promoting Cytocompatibility of Human Endothelial Cells" *Biomacromolecules* **2002**, *3*, 1312-1319.

9. Zhu, Y.; Gao, C.; Liu, X.; Shen, J. "Endothelial Cell Functions *in vitro* Cultured on Poly(L-lactic acid) Membranes Modified with Different Methods" *J. Biomed. Mater. Res.* **2004**, *69*, 436-443.

10. Odian, G. "Principle of Polymerization", 3rd ed. Singapore, John Wiley and Son: **1993**, pp. 222.

11. Microscale rapid prototyping, An Introduction to Light Curing Technology, Loctite Corp., Rocky Hill (online)
Available from:
http://www.tufts.edu/as/tampl/program99/finalprojects/mrp/UV_Curing.html

12. Xiao, S. J. "Tailored Organic Thin Films on Gold and Titanium: Peptide-Grafting, Protein Resistance and Physical Characterization" *Thesis*; PhD. *Department of Materials, Swiss Federal Institute of Science and Technology Zürich* **1999**.

13. Hersel, U.; Dahmen, C.; Kessler, H. "RGD Modified Polymers: Biomaterials for Stimulated Cell Adhesion and Beyond" *Biomaterials* **2003**, *24*, 4385-4415.

14. Martino, A. D.; Sittingerc, M.; Risbuda, M. V. "Review Chitosan: A Versatile Biopolymer for Orthopaedic Tissue-Engineering" *Biomaterials* **2005**, *26*, 5983-5990.

15. Alberts, B.; Johnson, A.; Lewis, J.; Raff, M.; Roberts, K.; Walter, P. "Molecular Biology of the Cell" 4th ed. New York: Garland Publishing, **2002**, pp.1084, 1096-1099.

16. Cooper, G. M. "The Cell: A Molecular Approach" 2nd ed. Washington, D.C., ASM Press: **2000**, pp. 505-506.

17. Gelse, K.; Pöschl, E.; Aigner, T. "Collagens-structure, Function, and Biosynthesis" *Advanced Drug Delivery Reviews* **2003**, *55*, 1531-1546.

18. Ma, Z.; Gao, C.; Ji, J.; Shen, J. "Protein Immobilization on the Surface of Poly-L-lactic acid Films for Improvement of Cellular Interactions" *Eur. Polym. J.* **2002**, *38*, 2279-2284.

19. Wang, X. H.; Li, D. P.; Wang, W. J.; Feng, Q. L.; Cui, F. Z.; Xu, Y. X.; Song, X. H. "Covalent Immobilization of Chitosan and Heparin on PLGA Surface" *Int. J. Biol. Macromol.* **2003**, *33*, 95-100.

20. Zhu, Y.; Gao, C.; He, T.; Shen, S. "Endothelium Regeneration on Luminal Surface of Polyurethane Vascular Scaffold Modified with Diamine and Covalently Grafted with Gelatin" *Biomaterials* **2004**, *25*, 423-430.

21. Weill Medical College of Cornell University (online)
Available from: http://www.med.cornell.edu.html

22. The burn wound, Burnsurgery.org (online)
Available from:
http://www.burnsurgery.com/Betaweb/Modules/skinsubstitutes/sec1.html

23. Howling, G. I.; Dettmar, P. W.; Goddard, P. A.; Hampson, F. C.; Dornish, M.; Wood, E. J. "The Effect of Chitin and Chitosan on the Proliferation of Human Skin Fibroblasts and Keratinocytes In Vitro" *Biomaterials* **2001**, *22*, 2959-2966.

24. Ruszczak, Z. "Effect of Collagen Matrices on Dermal Wound Healing" *Advanced Drug Delivery Reviews* **2003**, *55*, 1595-1611.

25. Lie Ma, L.; Gao, C.; Mao, Z.; Zhou, J., Shen, J.; Hu, X.; Han, C. "Collagen/Chitosan Porous Scaffolds with Improved Biostability for Skin Tissue Engineering" *Biomaterials* **2003**, *24*, 4833-4841.

26. Mao, J.; Zhao, L.; Yao, K. D.; Shang, Q.; Yang, G.; Cao, Y. "Study of Novel Chitosan-Gelatin Artificial Skin *In Vitro*" *J. Biomed. Mater. Res.* **2003**, *64A*, 301-308.

27. Ma, J.; Wang, H.; He, B.; Chen, J. "A Preliminary *In Vitro* Study on the Fabrication and Tissue Engineering Applications of a Novel Chitosan Bilayer Material as a Scaffold of Human Neofetal Dermal Fibroblasts" *Biomaterials* **2001**, *22*, 331-336.

28. Khor, H. L.; Ng, K. W.; Schantz, J. T.; Phan, T. T.; Lim, T. C.; Teoh, S. H.; Hutmacher, D. W. "Poly(ε-caprolactone) Films as a Potential Substrate for Tissue Engineering an Epidermal Equivalent" *Mater. Sci. Eng. C* **2002**, *20*, 71-75.

29. Sarasam, A.; Madihally, S. V. "Characterization of Chitosan-Polycaprolactone blends for Tissue Engineering Application" *Biomaterials* **2005**, *26*, 5500-5508.

30. Groot, J. H. D.; Pennings, A. J.; Coenen, J. M. F. H. "Triple-Layer Artificial Skin: Porous 50/50 Copoly(L-lactide/ε-caprolactone) Template for Neodermis Regeneration" *J. Mat. Sci. Lett.* **1997**, *16*, 152-154.

31. Razzaka, M. T.; Darwis, D.; Zainuddin; Sukirno. "Irradiation of Poly(vinyl alcohol) and Poly(vinyl pyrrolidone) Blended Hydrogel for Wound Dressing" *Radiat. Phys. Chem.* **2001**, *62*, 107–113.

32. Martineau, L.; Shek, P. N. "Evaluation of a Bi-layer Wound Dressing for Burn Care I. Cooling and Wound Healing Properties" *Burns* **2006**, *32*, 70–76.

33. Aziz, D. M. "Assessment of Bovine Sperm Viability by MTT Reduction Assay" *Animal Reproduction Science*, **2006**, *92*, 1-8.

34. Chatelet, C.; Damour, O.; Domard, A. "Influence of the Degree of Acetylation on Some Biological Properties of Chitosan Films" *Biomaterials* **2001**, *22*, 261-268.

APPENDICES

APPENDIX A

Ninhydrin Colorimetric Method

The reaction between alpha-amino acid and ninhydrin involve the development of color which can be described by the following five mechanistic steps:

alpha-amino acid + ninhydrin ---> reduced ninhydrin + alpha-amino acid + H_2O (A-1)

alpha-amino acid + H_2O ---> alpha-keto acid + NH_3 (A-2)

alpha-keto acid + NH_3 ---> aldehyde + CO_2 (A- 3)

Step (A-1) is an oxidative deamination reaction that removes two hydrogens from the alpha-amino acid to yield an alpha-imino acid. Simultaneously, the original ninhydrin is reduced and loses an oxygen atom with the formation of a water molecule. In Step (A-2), the NH group in the alpha-amino acid is rapidly hydrolyzed to form an alpha-keto acid with the production of an ammonia molecule. This alpha-keto acid further undergoes decarboxylation reaction in Step (A-3) under heated condition to form an aldehyde that has one less carbon atom than the original amino acid. A carbon dioxide molecule is also produced. These first three steps produce the reduced ninhydrin and ammonia that are required for the production of blue color. The overall reaction for the above reactions is simply expressed in equation (A-4) as follows:

alpha-amino acid + 2 ninhydrin ---> CO_2 + aldehyde + final complex (blue) + $3H_2O$ (A-4)

In summary, ninhydrin, which is originally yellow, reacts with amino acid and turns into deep purple. It is this purple color that is detected in this method. Ninhydrin will react with a free alpha-amino group of NH_2-CHR-COOH. This group is a part of all amino acids, peptides, or proteins. Whereas, the decarboxylation reaction would proceed for a free amino acid and a free amino group at chain end or side chain of protein or peptide, it does not occur for an amino group within peptides and proteins.

Thus, theoretically only amino acids will lead to the color development. However, one should always check out the possible interference from peptides and proteins by performing blank tests especially when such solutions are readily available. For example, one can simply add the ninhydrin reagent to a solution of only proteins and see if there is any color development. There is no excuse for failing to perform such a vital test when the sample mixture contains both proteins and amino acids. There are also reports that chemical compounds other than amino acids also yield positive results.

Although this is a fast and sensitive test for the presence of alpha-amino acids because of the nonselectivity, it cannot be used to analyze the relative individual contents of a mixture of different amino acids. Furthermore, the color intensity developed is dependent on the type of amino acid. Finally, it does not react with tertiary or aromatic amines.

Determination of Amino group on modified PCL film

The quantitative NH_2 amount on aminolyzed PCL film and biomolecule-immobilized PCL was measured by the ninhydrin method. The purple reaction product of ninhydrin with free NH_2 group has the maximum absorbance at 538 nm in the solvent of 1,4-dioxane/isopropanol (IPA) (1/1). Using 1,6-hexamethylenediamine as a standard, a calibration curve was generated as shown in Figure 4.1.

Table A-1 UV absorbance at λ = 538 nm of standard 1,6-hexamethylenediamine solution for generating a calibration curve

1,6-hexamethylenediamine concentration ($x10^{-3}$ M)	Absorbance
0.001	0.012
0.005	0.025
0.010	0.052
0.030	0.164
0.050	0.290
0.100	0.600
0.300	1.489

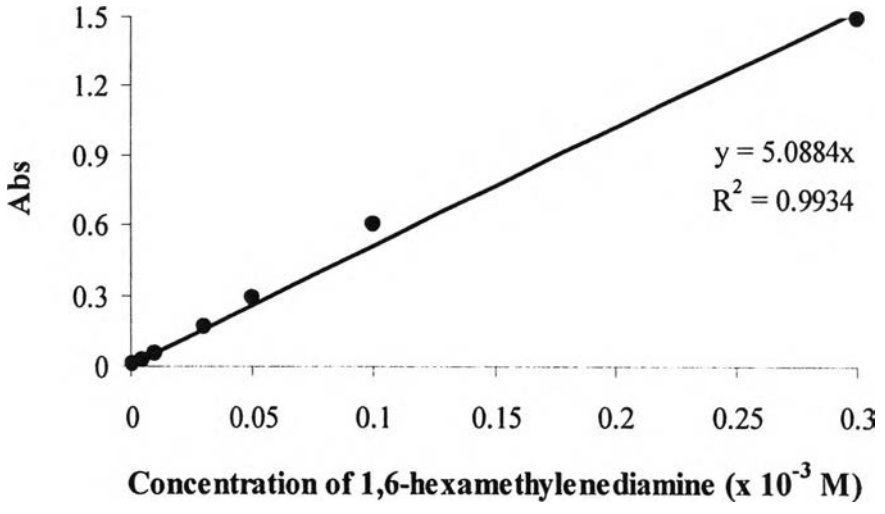

Figure A-1 Calibration curve of UV absorbance as a function of 1,6-hexamethylene diamine concentration analyzed by ninhydrin method

The amount of amino group (C) obtained from the calibration curve was then calculated by these following equations:

$$NH_2 \text{ concentration} = \left[\frac{C \text{ (mmol/L)}}{1000 \text{ (mmol/mol)}}\right] \times \left[\frac{1}{1000} \text{ (L/mL)}\right] \times 2 \text{ (mL)}$$

$$NH_2 \text{ concentration per surface area} = \frac{NH_2 \text{ concentration (mol)}}{\text{Sample area (cm}^2\text{)} \times 2}$$

Toluidine Blue O Method

Toluidine blue O method is a method used for determination of the amount of carboxyl groups. The complex formed by the carboxyl group and toluidine blue o has the λ_{max} at 633 nm.

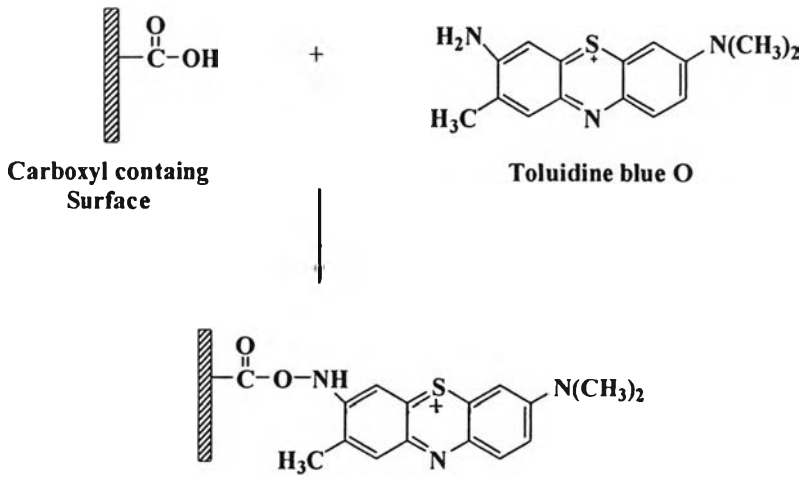

Figure A-2 Formation of the complex between toluidine blue O and carboxyl group

Determination of Carboxyl group on PCL-*g*-PAA film

The quantitative density of COOH groups grafted on PCL membrane was determined by the reaction with toluidine blue o, generating the absorbance at 633 nm. The COOH content was obtained from a calibration plot of the optical density versus dye concentration assuming a 1:1 stoichiometric ratio (Figure A-3) between the dye and the COOH group.

Table A-2 UV absorbance at $\lambda = 633$ nm as a function of toluidine blue o concentration

Toluidine blue o concentration ($x10^{-3}$ M)	Absorbance
0.001	0.013
0.005	0.112
0.007	0.177
0.010	0.216
0.030	0.939
0.050	1.490

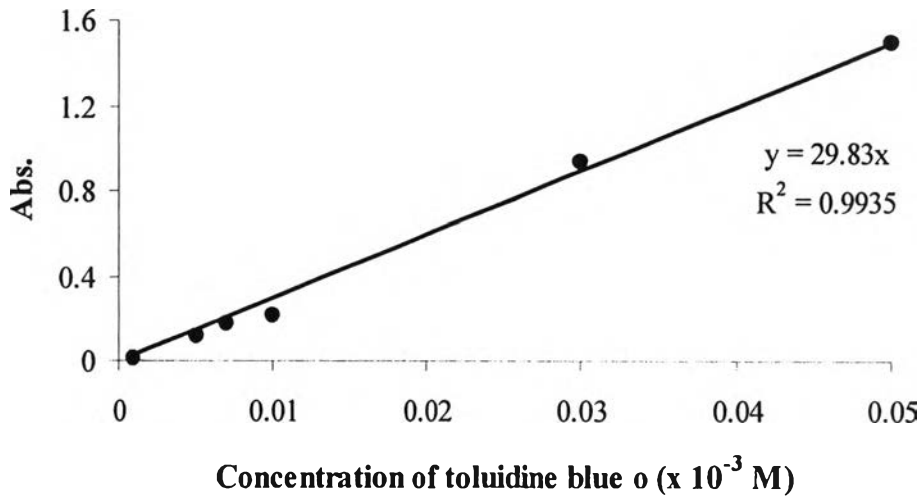

Figure A-3 Calibration curve of UV absorbance as a function of toluidine blue o concentration

APPENDIX B

Table B-1 Water contact angle and amount of amino group of PCL films after reaction with 1 M 1,6-hexamethylenediamine/IPA as a function of reaction time

Aminolyzing time (h)	Water contact angle (degree)		NH_2 concentration/surface area ($x10^{-8}$ mol/cm^2)
	θ_A	θ_R	
0	85 ± 1.3	50 ± 1.3	0 ± 0.0
1	79 ± 2.9	47 ± 2.3	1.8 ± 0.1
2	77 ± 2.1	46 ± 1.9	2.8 ± 0.3
4	75 ± 2.7	44 ± 2.1	3.8 ± 0.4
8	75 ± 2.3	43 ± 2.4	4.4 ± 0.3
12	76 ± 2.4	44 ± 1.6	5.0 ± 0.5
24	78 ± 2.4	45 ± 2.1	5.8 ± 0.3

Table B-2 Water contact angle and amount of amino group of PCL films after reaction with 1,6-hexamethylenediamine/IPA for 8 h as a function of amine concentration

Amine concentration (M)	Water contact angle (degree)		NH_2 concentration/surface area ($x10^{-8}$ mol/cm^2)
	θ_A	θ_R	
0.00	85 ± 1.3	50 ± 1.3	0 ± 0.0
0.25	82 ± 1.6	47 ± 3.2	0.6 ± 0.1
0.50	78 ± 2.1	45 ± 2.4	0.8 ± 0.1
1.00	75 ± 2.3	43 ± 2.4	4.4 ± 0.3
1.50	73 ± 1.9	42 ± 1.5	6.3 ± 0.2
2.00	73 ± 2.3	43 ± 1.8	12.2 ± 0.9
3.00	74 ± 3.2	45 ± 3.3	14.7 ± 0.7

Table B-3 Water contact angle of aminolyzed PCL films after the reaction with a solution of 0.1 M DSC/DMSO as a function of activation time

Activation time (h)	Water contact angle (degree)	
	θ_A	θ_R
0.00	73 ± 1.9	42 ± 1.5
0.50	78 ± 2.4	43 ± 1.5
0.75	87 ± 2.4	43 ± 1.7
1.00	89 ± 2.1	45 ± 1.1
2.00	89 ± 1.9	43 ± 1.9
3.00	91 ± 2.6	44 ± 1.1

Table B-4 Advancing water contact angle (θ_A) and amount of amino group of activated aminolyzed PCL films after the reaction with 10 mg/mL collagen solution as a function of immobilization time

Immobilization time (h)	θ_A (degree)	NH_2 concentration/surface area ($x10^{-8}$ mol/cm^2)
0	89 ± 2.1	-
4	67 ± 2.4	0.71 ± 0.1
8	62 ± 1.9	1.03 ± 0.2
24	59 ± 1.3	1.31 ± 0.1
48	60 ± 2.4	1.38 ± 0.2

Table B-5 Advancing water contact angle (θ_A) and amount of amino group of activated aminolyzed PCL films after the immobilization with biomolecules for 24 h as a function of biomolecule concentration

Biomolecule concentration (mg/mL)	θ_A (degree)		
	Collagen marine	Chitosan (MW = 15,000)	Chitosan (MW = 83,000)
1	69 ± 1.9	74 ± 1.3	76 ± 1.7
3	65 ± 1.7	71 ± 1.1	70 ± 1.5
5	61 ± 2.1	72 ± 2.2	71 ± 2.3
7	62 ± 1.6	73 ± 2.3	71 ± 2.6
10	59 ± 1.3	72 ± 2.5	73 ± 1.8

Table B-6 Amount of amino group on activated aminolyzed PCL films after the immobilization with biomolecules for 24 h as a function of biomolecule concentration

Biomolecule concentration (mg/mL)	NH_2 concentration/surface area ($x10^{-8}$ mol/cm^2)		
	Collagen marine	Chitosan (MW = 15,000)	Chitosan (MW = 83,000)
1	0.49 ± 0.01	0.11 ± 0.01	0.21 ± 0.02
3	0.63 ± 0.01	0.23 ± 0.02	0.27 ± 0.01
5	1.05 ± 0.02	0.22 ± 0.01	0.30 ± 0.02
7	1.26 ± 0.02	0.23 ± 0.03	0.28 ± 0.03
10	1.31 ± 0.01	0.25 ± 0.01	0.31 ± 0.03

Table B-7 Water contact angle and amount of carboxyl group of PCL-*g*-PAA films as a function of photo-oxidation time. The graft copolymerization was conducted in 10% AA solution at 30°C for 1 h

Photo-oxidation time (h)	Water contact angle (degree)		COOH concentration/surface area ($x10^{-8}$ mol/cm^2)
	θ_A	θ_R	
0.00	85 ± 1.3	50 ± 1.3	0 ± 0.0
0.25	67 ± 1.8	30 ± 3.2	6.3 ± 0.5
0.50	45 ± 3.3	0 ± 0.0	9.1 ± 0.4
1.00	62 ± 1.1	32 ± 2.3	8.8 ± 0.5
2.00	70 ± 1.5	34 ± 3.1	6.2 ± 0.3

Table B-8 Water contact angle and amount of carboxyl group of PCL-*g*-PAA films as a function of grafting time. The graft copolymerization was conducted in 10% AA solution at 30°C after photo-oxidation for 30 min

Grafting time (h)	Water contact angle (degree)		COOH concentration/surface area ($x10^{-8}$ mol/cm^2)
	θ_A	θ_R	
0.00	85 ± 1.3	50 ± 1.3	0 ± 0.0
0.50	61 ± 2.6	34 ± 2.3	4.1 ± 0.4
0.75	55 ± 2.7	25 ± 2.7	5.9 ± 0.2
1.00	45 ± 3.3	0 ± 0.0	9.1 ± 0.4
2.00	58 ± 3.1	31 ± 1.4	7.8 ± 0.4
3.00	68 ± 3.7	32 ± 2.5	7.1 ± 0.3

Table B-9 Water contact angle and amount of carboxyl group of PCL-*g*-PAA films as a function of acrylic acid concentration. The graft copolymerization was conducted at 30°C for 1 h after photo-oxidation for 30 min

Acrylic acid concentration (%)	Water contact angle (degree)		COOH concentration/surface area ($x10^{-8}$ mol/cm^2)
	θ_A	θ_R	
0	85 ± 1.3	50 ± 1.3	0 ± 0.0
1	66 ± 2.6	30 ± 2.3	3.2 ± 0.3
5	61 ± 2.7	28 ± 2.7	6.6 ± 0.5
10	45 ± 2.6	0 ± 0.0	9.1 ± 0.4
15	54 ± 3.1	27 ± 1.4	6.3 ± 0.3

Table B-10 Water contact angle of PCL-*g*-PAA films after the reaction with aqueous solution of 0.1 M NHS/0.4 M EDCI as a function of activation time

Activation time (h)	Water contact angle (degree)	
	θ_A	θ_R
0.00	45 ± 1.9	0 ± 0.0
0.50	54 ± 2.4	32 ± 2.3
0.75	58 ± 2.9	35 ± 2.4
1.00	70 ± 2.1	38 ± 2.7
2.00	68 ± 2.4	37 ± 2.1
3.00	67 ± 1.9	38 ± 2.1

Table B-11 Advancing water contact angle (θ_A) and amount of amino group of activated PCL-*g*-PAA films after the reaction with 10 mg/mL collagen solution as a function of immobilization time

Immobilization time (h)	θ_A (degree)	NH_2 concentration/surface area ($x10^{-8}$ mol/cm^2)
0	70 ± 2.1	-
4	54 ± 2.2	1.12 ± 0.1
8	48 ± 2.1	1.43 ± 0.1
24	34 ± 2.3	1.77 ± 0.2
48	34 ± 1.9	1.78 ± 0.2

Table B-12 Advancing water contact angle (θ_A) of activated PCL-*g*-PAA films after the immobilization with biomolecules for 24 h as a function of biomolecule concentration

Biomolecule concentration (mg/mL)	θ_A (degree)		
	Collagen marine	Chitosan (MW = 15,000)	Chitosan (MW = 83,000)
1	59 ± 2.6	72 ± 1.5	67 ± 1.1
3	46 ± 2.3	69 ± 2.4	62 ± 2.1
5	35 ± 2.4	70 ± 2.4	63 ± 2.1
7	36 ± 1.3	69 ± 1.6	64 ± 1.3
10	34 ± 2.3	67 ± 1.7	63 ± 1.6

Table B-13 Amount of amino group on activated PCL-*g*-PAA films after the immobilization with biomolecules for 24 h as a function of biomolecule concentration

Biomolecule concentration (mg/mL)	NH_2 concentration/surface area ($x10^{-8}$ mol/cm^2)		
	Collagen marine	Chitosan (MW = 15,000)	Chitosan (MW = 83,000)
1	0.95 ± 0.1	0.51 ± 0.08	0.58 ± 0.09
3	1.24 ± 0.1	0.78 ± 0.03	0.87 ± 0.04
5	1.66 ± 0.2	0.77 ± 0.05	0.87 ± 0.06
7	1.75 ± 0.1	0.76 ± 0.05	0.89 ± 0.03
10	1.77 ± 0.2	0.78 ± 0.05	0.88 ± 0.05

APPENDIX C

Table C-1 Keratinocyte (HEK001) cell adhesion and proliferation on modified and unmodified PCL films

Materials	12 h Adhesion		2 day Proliferation		4 day Proliferation	
	Abs	% relative to TCPS	Abs	% relative to TCPS	Abs	% relative to TCPS
TCPS	0.437 ± 0.05	100 ± 11	0.470 ± 0.02	100 ± 5	0.549 ± 0.05	100 ± 9
PCL	0.268 ± 0.01	61 ± 3	0.294 ± 0.01	62 ± 2	0.310 ± 0.04	56 ± 7
Aminolyzed PCL	0.388 ± 0.03	77 ± 7	0.342 ± 0.01	73 ± 3	0.352 ± 0.06	64 ± 10
Aminolyzed PCL-collagen marine	0.339 ± 0.03	78 ± 7	0.345 ± 0.02	73 ± 4	0.357 ± 0.03	65 ± 5
Aminolyzed PCL-collagen type I	0.385 ± 0.03	88 ± 7	0.392 ± 0.03	83 ± 7	0.403 ± 0.03	73 ± 6
Aminolyzed PCL-collagen type IV	0.356 ± 0.04	82 ± 9	0.383 ± 0.03	81 ± 6	0.399 ± 0.05	73 ± 9
Aminolyzed PCL-chitosan 15000	0.339 ± 0.03	78 ± 6	0.352 ± 0.04	75 ± 8	0.375 ± 0.04	68 ± 8
Aminolyzed PCL-chitosan 83000	0.354 ± 0.04	81 ± 9	0.360 ± 0.03	77 ± 6	0.391 ± 0.02	71 ± 3
PCL-g-PAA	0.396 ± 0.02	91 ± 5	0.405 ± 0.03	86 ± 6	0.411 ± 0.03	75 ± 5
PCL-g-PAA-collagen marine	0.384 ± 0.04	88 ± 10	0.394 ± 0.02	84 ± 4	0.412 ± 0.04	75 ± 8
PCL-g-PAA-collagen type I	0.450 ± 0.02	103 ± 4	0.461 ± 0.02	98 ± 4	0.470 ± 0.01	86 ± 2
PCL-g-PAA-collagen type IV	0.410 ± 0.02	94 ± 5	0.451 ± 0.04	96 ± 9	0.459 ± 0.03	84 ± 5
PCL-g-PAA-chitosan 15000	0.335 ± 0.04	77 ± 9	0.404 ± 0.01	86 ± 2	0.418 ± 0.03	76 ± 6
PCL-g-PAA-chitosan 83000	0.380 ± 0.04	87 ± 9	0.414 ± 0.01	88 ± 3	0.419 ± 0.03	76 ± 5

Table C-2 Fibroblast (L929) cell adhesion and proliferation on modified and unmodified PCL films

Materials	12 h Adhesion		2 day Proliferation		4 day Proliferation	
	Abs	% relative to TCPS	Abs	% relative to TCPS	Abs	% relative to TCPS
TCPS	0.275 ± 0.04	100 ± 14	0.336 ± 0.01	100 ± 4	0.767 ± 0.04	100 ± 5
PCL	0.191 ± 0.01	69 ± 2	0.234 ± 0.01	70 ± 3	0.503 ± 0.03	66 ± 4
Aminolyzed PCL	0.221 ± 0.03	80 ± 10	0.283 ± 0.03	84 ± 8	0.630 ± 0.07	82 ± 9
Aminolyzed PCL-collagen marine	0.227 ± 0.02	83 ± 8	0.297 ± 0.02	88 ± 6	0.596 ± 0.03	78 ± 3
Aminolyzed PCL-collagen type I	0.273 ± 0.04	99 ± 13	0.288 ± 0.02	86 ± 5	0.607 ± 0.04	79 ± 5
Aminolyzed PCL-collagen type IV	0.253 ± 0.03	92 ± 10	0.265 ± 0.03	79 ± 8	0.638 ± 0.04	83 ± 5
Aminolyzed PCL-chitosan 15000	0.259 ± 0.03	94 ± 11	0.278 ± 0.03	83 ± 8	0.654 ± 0.08	85 ± 10
Aminolyzed PCL-chitosan 83000	0.271 ± 0.02	98 ± 6	0.295 ± 0.04	88 ± 11	0.631 ± 0.02	82 ± 2
PCL-g-PAA	0.261 ± 0.01	95 ± 4	0.278 ± 0.04	83 ± 12	0.557 ± 0.05	73 ± 7
PCL-g-PAA-collagen marine	0.241 ± 0.03	88 ± 10	0.303 ± 0.03	90 ± 10	0.586 ± 0.10	76 ± 13
PCL-g-PAA-collagen type I	0.285 ± 0.01	104 ± 4	0.323 ± 0.04	96 ± 12	0.625 ± 0.04	82 ± 5
PCL-g-PAA-collagen type IV	0.279 ± 0.03	102 ± 9	0.299 ± 0.02	89 ± 5	0.614 ± 0.04	80 ± 5
PCL-g-PAA-chitosan 15000	0.253 ± 0.03	92 ± 10	0.284 ± 0.04	85 ± 12	0.579 ± 0.03	76 ± 4
PCL-g-PAA-chitosan 83000	0.297 ± 0.03	108 ± 11	0.311± 0.01	93 ± 4	0.602 ± 0.04	79 ± 6

VITAE

Miss Waradda Mattanavee was born in Chonburi, Thailand, on September 11th, 1980. She received Bachelor Degree of Science (Industrial Chemistry) from Department of Chemistry, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang in 2003. In the same year, she started as a Master Degree student with a major in Program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University and completed the program in 2006.