

**PREPARATION AND CHARACTERIZATION OF BONE SCAFFOLDS
FROM POLYCAPROLACTONE BY SOLVENT-CASTING AND SOLUTE-
LEACHING TECHNIQUES**

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A Thesis Submitted in Partial Fulfilment of the Requirements
for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma,
Case Western Reserve University and Institut Français du Pétrole

2007

543

550

502009

Thesis Title: Preparation and Characterization of Bone Scaffolds from Polycaprolactone by Solvent-Casting and Solute-Leaching Techniques
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Program: Polymer Science
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Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfillment of the requirements for the Degree of Master of Science.

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ABSTRACT

4872025063: Polymer Science Program

Wipawan Inrung: Preparation and Characterization of Bone Scaffolds from Polycaprolactone by Solvent-Casting and Solute-Leaching Techniques

Thesis Advisors: Assoc. Prof. Pitt Supaphol 99 pp.

Keywords: Solvent Casting and Particulate Leaching /Polycaprolactone /PCL/Hydroxyapatite/HAp/Ipriflavone/Scaffold/Osteoblast

Bone scaffolding materials were fabricated by solvent-casting and solute-leaching techniques from polycaprolactone filled with hydroxyapatite particles (HAp) or ipriflavone (IP). Sucrose, as the porogen, was used to generate an open-pore structure. The pores created by leaching away the sucrose particles were uniformly distributed and interconnected with average pore diameters in the range of 400-500 μm . The pore interconnectivity of the scaffold was found to increase with increasing the amount of sucrose. The increased porosity corresponded to the lower compressive modulus, which was consistent with the inverse tendency observed between porosity and mechanical properties. The incorporation of HAp caused the scaffolds to be more rigid, as HAp obstructed the molecular movement of the matrix. Alkali hydrolysis was performed to improve the hydrophilicity of the PCL scaffolds. Increasing both the concentration of and the submersion time in the NaOH solution caused the water absorption of the scaffolds to increase. In vitro biocompatibility of the PCL scaffolds with or without the incorporation of HAp or IP was tested with mouse osteoblasts (MC3T3-E1). Without HAp or IP, the majority of the cells appeared to be in the spindle shape on the surface of the scaffold. However, the cells expanded over the surface of the scaffolds when either HAp or IP was incorporated.

บทคัดย่อ

วิทยารรณ อินทร์รุ่ง : การผลิตโครงเลี้ยงเซลล์กระดูกของพอลิคาโพรแลคโตนโดยกระบวนการหล่อและใช้สารทำให้เกิดความพรุน (Preparation and Characterization of Bone Scaffolds from Polycaprolactone by Solvent-Casting and Solute-Leaching Techniques) อ.ที่ปรึกษา : รศ. ดร.พิชญ์ ศุภผล 99 หน้า

โครงเลี้ยงเซลล์กระดูกของพอลิคาโพรแลคโตนผสมไฮดรอกซีเอปาทาइटและอิพริฟลาไวน์ถูกเตรียมขึ้น โดยกระบวนการหล่อและใช้น้ำตาลเป็นสารที่ทำให้เกิดความพรุน พบว่ารูพรุนที่เกิดบนโครงเลี้ยงเซลล์ซึ่งเกิดจากการละลายน้ำตาลออกไปภายหลังจากการขึ้นรูปด้วยพอลิเมอริมีลักษณะเชื่อมต่อกันเป็นอย่างดีและมีขนาดเส้นผ่านศูนย์กลางประมาณ 400-500 ไมโครเมตร ซึ่งความพรุนบนโครงเลี้ยงเซลล์ขึ้นกับปริมาณของน้ำตาลที่ถูกละลายออกไป และความแข็งแรงของโครงเลี้ยงเซลล์จะลดลงเมื่อความพรุนเพิ่มมากขึ้น จากการศึกษาพบว่าอัตราส่วนที่เหมาะสมระหว่างพอลิเมอริและน้ำตาล คือ 1 ต่อ 10 ความแข็งแรงของโครงเลี้ยงเซลล์สามารถถูกปรับปรุงได้โดยการผสมไฮดรอกซีเอปาทาइटในพอลิคาโพรแลคโตน โดยไฮดรอกซีเอปาทาइटจะไปลดการเคลื่อนไหวของสายโซ่พอลิคาโพรแลคโตนมีผลทำให้โครงเลี้ยงเซลล์มีความแข็งแรงเพิ่มมากขึ้น ในงานวิจัยนี้ ประสิทธิภาพการดูดซับน้ำของโครงเลี้ยงเซลล์ของพอลิคาโพรแลคโตนถูกปรับปรุงโดยกระบวนการไฮโดรไลซิสด้วยโซเดียมไฮดรอกไซด์ จากการศึกษาพบว่าความเข้มข้นของโซเดียมไฮดรอกไซด์และเวลาที่ใช้ในการไฮโดรไลซิสมีผลต่อความสามารถในการดูดน้ำของโครงเลี้ยงเซลล์ นอกจากนี้ งานวิจัยได้ศึกษาถึงการตอบสนองทางชีววิทยาของโครงเลี้ยงเซลล์ของพอลิคาโพรแลคโตนผสมกับไฮดรอกซีเอปาทาइटและอิพริฟลาไวน์ ผลของการทดสอบความเข้ากันได้ต่อเซลล์ออสทีโอเบลาจากกระดูกของหนู (MC3T3-E1) พบว่าเซลล์สามารถเกาะได้ดีบนผิวโครงเลี้ยงเซลล์ของพอลิคาโพรแลคโตน แต่เซลล์สามารถแผ่ขยายได้ดีขึ้นบนโครงเลี้ยงเซลล์ของพอลิคาโพรแลคโตนผสมกับไฮดรอกซีเอปาทาइटและอิพริฟลาไวน์ซึ่งแสดงว่าไฮดรอกซีเอปาทาइटและอิพริฟลาไวน์สามารถสนับสนุนการเกาะและแบ่งตัวของเซลล์กระดูกได้ดีขึ้น ซึ่งช่วยสนับสนุนความเป็นไปได้ในการนำโครงเลี้ยงเซลล์ชนิดนี้มาใช้สำหรับเพาะเลี้ยงเนื้อเยื่อกระดูกต่อไป

ACKNOWLEDGEMENTS

The author would like to express her sincere gratitude to her advisors and committees, Assoc. Prof. Pitt Supaphol, Assoc. Prof. Prasit Pavasant and Dr. Damrong Damrongsri for their sincere assistances. They have provided the very useful guidance and the great encouragement throughout this research.

The author would like to express many thanks to all of her colleagues, staff and teachers in the Petroleum and Petrochemical College, Chulalongkorn University who helped her greatly during her studies.

The author is grateful for the scholarship and funding of the thesis work provided by the Petroleum and Petrochemical College; and the National Excellence Center for Petroleum, Petrochemicals and Advanced Materials, Thailand.

The author would like to express many thanks to Ms. Boontharika Chuenjitektaworn in Faculty of Dentistry, Chulalongkorn University who helped her for cell studies.

The author wishes to give thanks to all of her friends for their helps and suggestions.

Finally, the author would like to express her appreciation for greatest love and supporting which she received all of her life from her family, especially her father and her mother.

TABLE OF CONTENTS

	PAGE
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgements	v
Table of Contents	vi
List of Tables	viii
List of Figures	ix
Abbreviations	xiii
List of Symbols	xiii
CHAPTER	
I INTRODUCTION	1
II LITERATURE REVIEW	3
III EXPERIMENTAL	30
3.1 Materials	30
3.2 Equipment	30
3.3 Methodology	31
3.3.1 Preparation of Hydroxyapatite	31
3.3.2 Preparation of PCL Scaffold Containing HAp and IP	31
3.3.3 Hydrolysis of PCL Scaffold Containing HAp and IP	31
3.3.4 Characterization of PCL Scaffold Containing HAp and IP	32
3.3.5 Cell Culture	34
3.3.6 Biodegradation of PCL Scaffold Containing HAp and IP <i>in Vitro</i>	35

CHAPTER	PAGE
IV RESULTS AND DISCUSSION	36
4.1 Synthesis of Hydroxyapatite and Characterization of Particles	37
4.2 Preparation and Characterization of Composite Scaffolds	39
4.2.1 Effect of PCL to Sucrose Ratios on Porous Scaffolds	39
4.2.2 Effect of Hydroxyapatite on Porous Scaffolds	43
4.2.3 Effect of NaOH Concentration on Porous Scaffolds	54
4.2.4 Effect of Ipriflavone on Porous Scaffold	61
4.2.5 Cell Culture on the Porous Scaffold	64
4.2.6 Biodegradation <i>in Vitro</i>	66
V CONCLUSION	73
REFERENCES	75
APPENDICES	79
Appendix A PCL to Porogen Ratios	79
Appendix B Various HAp Composition	81
Appendix C The Effect of NaOH Concentration on Porous Scaffolds	84
Appendix D The Effect of Ipriflavone on Porous Scaffolds	88
Appendix E The Degradation of Porous Scaffolds	89
Appendix F Calculation	97
CURRICULUM VITAE	99

LIST OF TABLES

TABLE		PAGE
2.1	Ideal structural parameters of tissue engineering scaffolds	4
2.2	Properties of biodegradable polymers	5
2.3	Currently applied three dimensional scaffold fabrication technologies	8
2.4	The composition of bone	13
2.5	Biomechanical properties of bone	13
2.6	Physicochemical, mechanical, and biological properties of HAp	18
2.7	Comparison of mechanical properties of bones, HAp, PCL, and scaffold materials.	27
4.1	SEM images of the porous PCL scaffolds containing 0-50 wt% HAp with 1:10 (PCL to sucrose ratio)	43
4.2	Characteristic infrared bands of PCL	45
4.3	T _m , T _c and %crystalline of the PCL scaffolds containing 0-50 wt%HAp	52
4.4	Selected SEM images morphological of porous scaffolds with 1:10 (PCL to sucrose ratio) at various hydroxyapatite contents after hydrolysis with 1.0M NaOH	58
4.5	Degree of crystallinity of the porous scaffold containing IP	63
4.6	Selected SEM images morphological of porous scaffolds at various degradation times (1:10)	69

LIST OF FIGURES

FIGURE		PAGE
2.1	Sponge scaffold and fibrous scaffold	7
2.2	Scaffold fabricated porogen size of 38.5-75 and 150-220 μm	12
2.3	The hierarchical structure of bone, from macro to nano assembly	15
2.4	A graphical representation of relationship between toughness and modulus of various HAp based composite materials	16
2.5	Design strategy of tissue engineered nanocomposite bone substitute	17
2.6	Microscopic images of PLGA/HAp	21
2.7	SEM micrographs for 20% PCL/HAp composites by melt processing	21
2.8	Ring opening polymerization of caprolactone	22
2.9	The structural formula of ipriflavone	29
4.1	FT-IR spectrum of the as synthesized HAp powder	37
4.2	WAXD pattern of the as synthesized HAp powder	38
4.3	SEM image of the as synthesized HAp powder	38
4.4	The structure of porous scaffolds	39
4.5	Morphological changes in the porous scaffolds at various PCL to sucrose ratios	40
4.6	Porosity of porous scaffolds at various PCL to sucrose ratios	41
4.7	Density of porous scaffolds at various PCL to sucrose ratios	41

FIGURE		PAGE
4.8	Compressive modulus of porous scaffolds at various PCL to sucrose ratios	42
4.9	FT-IR spectrums of HAp, PCL and PCL scaffolds containing HAp	45
4.10	Porosity of the porous PCL scaffolds containing 0-50 wt% HAp with 1:10 (PCL to sucrose ratio)	46
4.11	Density of the porous PCL scaffolds containing 0-50 wt% HAp with 1:10 (PCL to sucrose ratio)	47
4.12	Compressive modulus of the porous PCL scaffolds containing 0-50 wt% HAp with 1:10 (PCL to sucrose ratio)	48
4.13	TGA and DTA thermographs of the porous PCL scaffolds containing HAp	49
4.14	The actual and theoretical HAp contents in the composite from TGA thermographs	49
4.15	DSC thermographs of the porous PCL scaffolds containing 0-50wt% HAp during first heating	51
4.16	DSC thermographs of the porous PCL scaffolds containing 0-50wt% HAp during cooling	51
4.17	DSC thermographs of the porous PCL scaffolds containing 0-50wt% HAp during second heating	52
4.18	WAXD patterns of the porous PCL scaffolds containing 0-50 wt% HAp with 1:10 (PCL to sucrose ratio)	53
4.19	Water absorption of the porous PCL scaffolds containing 0-50 wt% HAp with 1:10 (PCL to sucrose ratio)	54
4.20	Water absorption of the porous scaffolds with 1:10 (PCL to sucrose ratio) at various NaOH concentrations	55

FIGURE		PAGE
4.21	Morphological of porous scaffolds with 1:10 (PCL to sucrose ratio) at various NaOH concentrations	56
4.22	The compressive modulus of porous scaffolds with 1:10 (PCL to sucrose ratio) at various NaOH concentrations	57
4.23	Weight loss of porous scaffolds with 1:10 (PCL to sucrose ratio) at various NaOH concentrations	57
4.24	Water absorption of the porous scaffolds with 1:10 (PCL to sucrose ratio) at various hydroxyapatite contents after hydrolysis with 1.0M NaOH	60
4.25	The compressive modulus of porous scaffolds with 1:10 (PCL to sucrose ratio) at various hydroxyapatite contents after hydrolysis with 1.0M NaOH	61
4.26	FT-IR spectrum of PCL containing HAp and IP	62
4.27	The compressive modulus of porous scaffolds at various IP concentrations	63
4.28	The SEM images of MC3T3-E1 cells cultured on the various types of scaffolds that were hydrolyzed with 1.0M NaOH for 6 h (1:10)	65
4.29	The SEM images of MC3T3-E1 cells cultured on the various types of scaffolds that were hydrolyzed with 1.0M NaOH for 24 h (1:10)	66
4.30	The weight loss of the PCL and PCL scaffolds containing 40wt%HAp in PBS solution after hydrolysis with 1.0M NaOH (1:10)	67
4.31	The weight loss of the PCL and PCL scaffolds containing 40wt%HAp in lipase solution after hydrolysis with 1.0M NaOH (1:10)	68

FIGURE		PAGE
4.32	WAXD patterns of degraded PCL scaffolds in lipase solution (1:10)	70
4.33	WAXD patterns of degraded PCL scaffolds containing 40wt%HAp in lipase solution (1:10)	70
4.34	The compressive modulus of the PCL and PCL scaffolds containing 40wt%HAp in PBS solution after hydrolysis with 1.0M NaOH	71
4.35	The compressive modulus of the PCL and PCL scaffolds containing 40wt%HAp in lipase solution after hydrolysis with 1.0M NaOH	71

ABBREVIATIONS

Polycaprolactone	PCL
Ipriflavone	IP
Hydroxyapatite	HAp
Dicalcium phosphate dihydrate	DCPD
Mouse osteoblasts	MC3T3-E1

LIST OF SYMBOLS

Micrometre	μm
Angstrom	A°
Degree	$^\circ$
Milligram	mg
Millilitre	ml
Minute	min
Hour	h
Microlitre	μl