• 系統編號	RN9607-0283		
• 計畫中文名稱	以電氣紡絲進行生物降解性纖維多向配向薄膜的製備及對細胞行為之影響		
• 計畫英文名稱	Preparation and cell behavior of biodegradable membrane with multi-directional aligned electrospun fiber		
• 主管機關	行政院國家科學委員會	• 計畫編號	NSC94-2213-E038-007
• 執行機構	臺北醫學大學醫學研究所		
• 本期期間	9408 ~ 9507		
• 報告頁數	10 頁	• 使用語言	中文
• 研究人員	曾厚; 何元順 Tseng, How; Ho, Yuan-Soon		
• 中文關鍵字	組織工程; 電氣紡絲; 接觸導引; 平滑肌細胞		
• 英文關鍵字	Tissue engineering; Electrospinning; Contact guidance; Smooth muscle cell		
• 中文摘要	組織工程的主要目的在於，當生物體受到外來傷害時能在受傷的部位中以生醫材來創造一個二維或三維的空間，使其有利於組織的修復或再生。而為達此目的，生醫材料常被應用作為細胞基質使特定細胞進行貼附，並進一步地增生、遷移及分化成特定的細胞、組織或器官後再回植至受創部位，使之得以再生。另一方面，眾所皆知的在這些創傷癒合的過程中細胞間質(extracellular matrix)對於細胞的行為伴演著舉足輕重的角色。因此為了製備理想的人工細胞間質，以應用於組織工程上，使其再生器官與人體組織結構相近，以達到仿生的概念，將是值得進一步深入研究的方向。在人體中有許多組織是具有特定性的配向結構，例如，韌帶、肌腱與皮質骨等，而這樣的配向結構除了提供全方位活動與抗壓外，有些學者甚至發現細胞的行為會因外在環境的刺激，盡其可能的往刺激方向移動，這樣的刺激包含了化學性、結構性與機械性等因子，而這樣的理念統稱為『接觸導引(contact guidance)』，且逐一的應用於組織工程之上。本研究以不同生物可吸收性降解材料聚左乳酸(PLLA)與聚丁烯琥珀酸己二酸共聚物(PBSA)經電氣紡絲(electrospinning)製備奈/微米纖維狀生物支架以應用在組織工程上，並以乾式成膜手法製備平面薄膜，比較纖維母細胞在上述的三維(3D)與二維(2D)基材上細胞貼附和細胞成長兩種行為。 實驗結果發現在 PLLA 溶液部分，纖維直徑為因濃度升高而增加。電壓升高，纖維直徑變低。不過當電壓在 20kV 時，飛行軌跡(jet)會產生散射情況，無法有效地累積於集板上易使得讓膜厚變薄，也就是說當電壓增加情況下，易使得紡口產生不穩定現象，直接影響纖維粗細與薄膜結構。PBSA 部分在 10w/v%_10kV 時，由於電場驅動力不足，故形成顆粒狀高分子，當電壓升高逐漸形成紡錘狀纖維與連續狀纖維。接著我們添加 DMF，改善溶液本身性質(表面張力與揮發速度)，在相同的環境下進行測試，結果經 SEM 觀察，發現平均直徑可達 300-400nm。乾式成膜實驗中，發現 PLLA 本身的分子糾結能力強(氫鍵)亦形成平滑狀表面，PBSA 則具有粗糙的表面微型結構。本研究希望觀察細胞在微米、奈米、順向型纖維與平面狀結構的各種行為，未來將可應用於組織工程上基材製備的考量。		

- 英文摘要

The main goal of tissue engineering is to set up a two- or three-dimensional biomaterial architectural interface for tissue cell to repair its own damaged part to original structural and morphological entity and, ultimately, function. To accomplish such tasks, biomaterials is utilized as a supporting as well as functional matrix for cell attachment in target organ/tissue, inducing cell proliferation, migration and differentiation to a specific functional cell, and multiplying into specific tissue and organ thereafter. On the other hand, it is also well known that in the living system, the extracellular matrix (ECM) plays an important role in controlling cell behavior. The ECM is composed of a basement membrane and interstitial complex chemically and physically cross-linked network of proteins and glycosaminoglycans. All of these features are in the nanometer-sized range. Although much smaller than the cells which are most in micro range, the 2 ECM serves to organize cells in space; to provide them with environmental signals to direct site-specific cellular regulation; and to separate one tissue space from another. Therefore, in order to create an ideal scaffold which serves as a artificial ECM for tissue engineering, it is important to replicate the dimension of ECM. A unique technology, electrospinning, can serve this purpose to fabricate porous scaffold with micro-/nano-sized fibrous structure. The potential of applying bionanotechnology in tissue engineering is huge in that it cannot only mimic the nanosized dimension of natural ECM, but can also form a defined architecture to guide cell growth and development as needed. The established contact guidance theory illustrates that a cell has the maximum probability of migrating in preferred directions which are associated with chemical, structural and/or mechanical properties of the substratum. It was reported that the arrangement of cells in controlled two- and three-dimensional architecture has beneficial effects on cell differentiation, proliferation and functional longevity. The influence of polymer concentration and applied voltage on the formation of electrospun membranes was examined. The electrospun membrane with a fibrous architecture was not formable at a lower polymer concentration and a lower applied voltage. With increasing PBSA concentration and applied voltage, fibrous structure was successfully produced. It was concluded that within the range of applied voltage examined, PBSA microfibrous scaffold was fabricated successfully only when 20% concentration was employed, whereas PLLA microfibrous scaffold was formable at 10%, 15% or 20%. At the concentration that has desirable extent of intermolecular intertwine to form fibrous structure, the applied voltage of electrospinning will determine the diameter of resulting fibers.The finest fiber diameter could be produced is about 1 .mu.m when PLLA was dissolved in CH2Cl2. The properties of electrospun membranes are improved when DMF/CH2Cl2 was used. Not only the fiber diameter of both PLLA and PBSA was reduced with the addition of DMF, the pore size of both scaffolds was also reduced. With regards to cell adhesion and proliferation, it was found that cells attached more on the PBSA-ESM than on the PLLA-ESM. PLLA-ESM demonstrated 60% increase of cell attachment than casting film, whereas it exhibits 47% increase for PBSA-ESM compared to PBSA-CS. These results further confirmed that 3D scaffold was able to facilitate cell attachment in a greater extent than 2D membrane.