

Engineered & Chemically Modified Porous Cellulose Fibrous Networks For Controlled Cell Adhesion

D. M. Kalaskar, J. E. Gough, R. V. Ulijn, W.W. Sampson, S. J. Eichhorn*

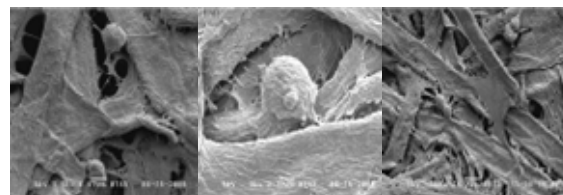
School of Materials, University of Manchester, Grosvenor Street, Manchester, M17HS, UK

INTRODUCTION: This study uses an interdisciplinary approach to investigate the potential of cellulose based fibrous scaffolds for controlled mammalian cell attachment and proliferation. Fibrous networks can be made with varying porosity and mass per unit area. Interconnectivity between pores can be tailored to manipulate the distance between pores to provide the opportunity for cells to bridge between them. Even though cellulose has been used as material for tissue engineering, a complete study of fibrous networks for this purpose in terms of geometry and surface chemistry has not been addressed to date. Thus an attempt has been made to enhance the inherent properties of cellulose fibre surfaces. Furthermore, the potential this of this technology as a high throughput process for tissue engineering scaffolds is discussed as a standard papermaking processes can be used to generate these structures.

METHODS: By introducing charge on a scaffold material cell adhesion is improved. Glycine residues are coupled to the hydroxyl surface of cellulose to introduce charge, showing increased cell growth. Similarly glycine residues were coupled as Fmoc-Gly via carboxylate termini using a conventional ester coupling method followed by removal of Fmoc in piperidine to expose amino groups. In present study 3T3 Murine Fibroblast cell were used. Cell morphology was studied by using Scanning Electro Microscopy. Cell penetration studies were done by using confocal laser scanning Microscopy.

RESULTS: Chemical modification is achieved by using glycine and 9-fluorenylmethoxycarbonyl (Fmoc) protected glycine, using a conventional ester coupling method. Deprotection of Fmoc is carried out by using 20% piperidine to expose glycine. The use of ToF-SIMS (Time of flight Secondary ion mass spectrometry) has confirmed the presence of both species. Fibroblast cells are cultured onto the scaffolds, and cell attachment and proliferation are assessed by using scanning electron microscopy and confocal laser scanning microscopy. It is shown that glycine treatment favours cell attachment on the surface of the fibres, and Fmoc treatment the aggregation of cells in the porous structure of the networks.

DISCUSSION & CONCLUSION: In present study, amino acids are used to modify fibrous cellulose scaffolds, where capability of Fmoc (fluorenylmethoxycarbonyl) functionality to render hydrophobic surface was achieved successfully. The ability to 'switch-off' the 'surface activity' of the cellulose fibres using Fmoc-protected glycine, so that cells aggregate within the pores. Similarly, by simple chemical modification to deprotect Fmoc, surface can be activated with glycine for cellular proliferation. The modification is shown to be capable of binding protein to cellulose surfaces without recourse to complex chemistry.



(a) (b) (c)

Fig. 1: Scanning Electron micrographs of cell attachment to a cellulose scaffold. (a) untreated cellulose, (b) cellulose sample modified with Fmoc protected glycine, (c) glycine modified cellulose sample

FUTURE WORK: Cell binding can also be improved by introducing different functionalities such as aliphatic, aromatic, polar, basic, acid groups. In addition the effect of conventional functional peptides such as RGD can also be tried in future with cellulose for improving cell adhesion .

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