

SURFACE MODIFICATION OF POLYURETHANE SCAFFOLDS WITH NATURAL POLYMERS: THE USE OF SILK FIBROIN

P.Petrini, S.Bozzini, S.Farè & M.C.Tanzi

Dept. of Bioengineering, Politecnico di Milano, Italy.

INTRODUCTION: In this work, silk fibroin, a protein extracted from *Bombyx Mori* silk and sericin-deprived, was used as coating to modify the surface properties of polyurethane (PU) membranes and foams (2D SF/PU and 3D SF/PU).

Silk fibroin (SF) is a highly promising protein: due to its structural properties and its ability to promote cell adhesion, SF has been the object of increasing interest as a potential biomaterial for tissue regeneration and repair [1,2].

The possibility to modify polyurethane membranes and foams could be of interest for the preparation of scaffolds for tissue regeneration.

METHODS: *Bombyx Mori* silk solution was prepared by dissolution in 9.3M LiBr as previously described [3].

2D-substrates were obtained by solvent casting from a THF:Diox (2:1) solution of Bionate 80A (PTG, USA). 3D-substrates were prepared by reacting a polyol mixture (component A, Elastogran, Italy) with polymeric MDI (B141, BASF). Fe-acetylacetonate as catalyst and water (5% w/w_A) as expanding agent were used.

Both 2D and 3D PU substrates were coated with SF by dipping in a 3-4% w/w fibroin solution in water. Some samples were then immersed in methanol and allowed to dry at room temperature. The morphology of MeOH treated and not samples was observed by SEM.

SF/PU scaffolds were characterized by ATR FT-IR (FT-IR Magna 560 Nicolet). The SF-coating morphology was investigated by SEM (Stereo Scan S360, Cambridge Instruments).

To test the SF-coating stability, SF/PUs, both treated and not treated with MeOH, were immersed in PBS at 37°C for increasing times (6 hours÷14 days). The PBS extracts were analyzed by UV and the SF-concentration drawn from calibration curves [3].

RESULTS: The presence of an homogeneous coating layer (thickness ~200-600 nm) was observed at SEM. ATR FT-IR of SF/PU 2D scaffold showed the presence of bands which can be attributed to SF, with a small contribution of the polyurethane substrate.

The SF released in physiological-like conditions, was lower than 8% (w/ w_{coating}). The methanol treatment induced β -form crystallization, as can be observed by ATR FT-IR. As a consequence, the release of SF was lower, with a decreased rate. The morphology of the coating was not affected by methanol treatment, as shown in SEM images at high magnification (fig 1).

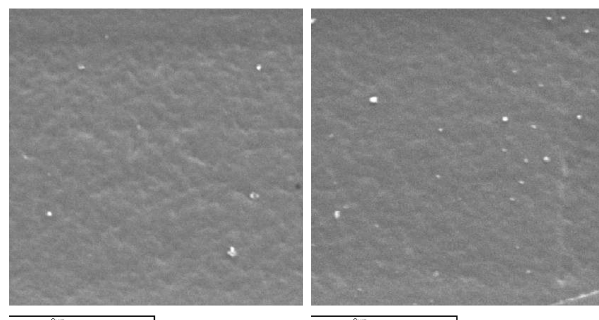


Fig. 1: SEM images(10.000 x) of 2D/SF PU, MeOH-treated (left) and not treated (right).

DISCUSSION & CONCLUSIONS: The dipping technique for the preparation of 2D and 3D SF/PU scaffolds allowed to obtain a thin homogeneous coating with a good stability in physiological-like conditions.

Parallel studies showed that SF-coating enhanced the cellular adherence to the substrate, and promoted higher proliferation rates of human adult fibroblasts [4]. This enhanced cell growth was coupled with a more intense metabolic activity. In addition, HAFs cultured on all types of substrates were never found to secrete any assayable amount of the main pro-inflammatory cytokines [4].

All the obtained results indicate that 2D and 3D SF-coated PU substrates are potentially suitable as scaffolds for Tissue Engineering applications.

REFERENCES: ¹Inouye K. Et Al., *J. Biochem. Biophys. Methods*, 37, 159-164, 1998. ²Sofia S., McCarthy M.B., Gronowicz G., Kaplan D.L., *J. Biomed. Mater. Res.*, 54(1), 139-148, 2001. ³Petrini P., Parolari C., Tanzi M.C., *J. Mater. Sci.: Mat. in Med.*, 12, 849-853, 2001. ⁴Chiarini A., Petrini P., Bozzini S., Dal Prà I, Armato U., *Biomaterials* 24, 789-799, 2003.

ACKNOWLEDGEMENTS: Supported by MIUR, Italy (PRIN 99 funds).