

## Fibroin hydrogels for biomedical applications: preparation, characterization and *in vitro* cell culture studies

A. MOTTA<sup>1,\*</sup>, C. MIGLIARESI<sup>1</sup>, F. FACCIONI<sup>2</sup>, P. TORRICELLI<sup>3</sup>, M. FINI<sup>3</sup>  
and R. GIARDINO<sup>3</sup>

<sup>1</sup> *Department of Materials Engineering and Industrial Technologies, University of Trento, via Mesiano 77, 38050 Trento, Italy*

<sup>2</sup> *Department of Biomedical Sciences, University of Verona, Policlinico GB Rossi, via delle Menegone 10, Verona, Italy*

<sup>3</sup> *Experimental Surgery Department, Research Institute Codivilla-Putti, IOR, via da Barbiano, Bologna, Italy*

Received 1 October 2003; accepted 29 January 2004

**Abstract**—Silk fibroin hydrogels prepared either by treating a 2% (w/v) silk fibroin aqueous solution at 4°C (thermgel) or by adding 30% (v/v) of glycerol (glygel), were characterized by using Environmental Scanning Electron Microscopy (ESEM), Fourier Transform Infrared Spectroscopy (FT-IR), Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA) and molecular weight determination. The preparation procedure affected morphology and molecular weight of hydrogels, with no or negligible differences being displayed by FT-IR and DSC analyses. While thermgel presented a well uniform porous structure, the morphology of glygel appeared to be non-porous and heterogeneous. Glygel presented lower water content and lower degradation temperatures, associated with the presence of glycerol but likely also to less-organized protein structures. Cytotoxicity tests with human osteoblast-like cells indicated that both gels were not cytotoxic, while cell cultures pointed out a faster cell proliferation on glygel and a higher cell activation and differentiation on thermgel. These gels could be used as scaffolds able to promote *in situ* bone regeneration.

*Key words:* Silk; fibroin; hydrogels; cell cultures; biocompatibility.

### INTRODUCTION

Silk is a natural fiber produced by spiders and some insects. Silkworms have been cultivated to produce silk in early Chinese civilizations, then the cultivation spread all over the world, since the middle age contributing to the present role of the silk

---

\*To whom correspondence should be addressed. E-mail: [antonella.motta@ing.unitn.it](mailto:antonella.motta@ing.unitn.it)