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Novel 3D keratin scaffold design for bone tissue engineering

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In this research work novel 3D scaffold for bone tissue engineering have been produced, characterized and tested using an integrated bio-engineering approach, applying bio-mechanical stimuli generated by a Pulsed Electro-Magnetic Field (PEMF). Keratin 3D scaffolds, namely wool fibril sponges, were prepared by ultrasonic irradiation of wool fibers soaked in clean water, previously swollen in mild alkali. Casting the fibrils suspension produced microporous, biocomposite sponges, made of randomly oriented cortical cells stuck to each other by the hydrolyzed keratin matrix. Nevertheless, controlled-size salt-leaching allowed an additional 3D-tailored macro-porosity, with the aim of matching native bone features for cell proliferation and cell guided tissue formation. Sponges have been characterized for morphology, amino acid composition, thermal and mechanical behavior and *in vitro* ageing performances. In addition, osteoblast cell model (SAOS-2) was cultured onto 3D wool fibril sponge using an integrated bio-engineering approach, applying bio-mechanical stimuli of a PEMF. Mechanical properties of the wool fibril sponges come out in favor of promising applications as bio-absorbable scaffold for bone tissue engineering, since they are easy to handle and resilient in wet conditions. The integrated bio-engineering approach of applying bio-mechanical stimulus from PEMF, in addition to 3D architectural stimulus is given by 3D scaffolds, showed to be a successful solution. In fact, PEMF stimulated an earlier differentiation in osteogenic conditions, showing a perfect synergy between biochemical and mechanical stimuli in acceleration of the differentiation process. Finally, ageing tests revealed that wool fibril sponges, characterized by an exceptional amount of crosslinks that stabilize the keratin structure, are surpassingly stable, showing longer degradation rate compared to commercial collagen. In conclusion, biological, chemico-physical characterization and ageing tests suggest sponges are promising candidate for long term support of *in vivo* bone formation.

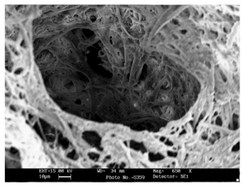

Figure 1: SEM observation of the keratin wool fibril sponge: detail of a pore morphology 650X.

Biography

Alessia Patrucco has completed her PhD in Bioengineering and Bioinformatics and her Master degree in Industrial Biotechnology from the University of Pavia. She is a Researcher at the Institute for Macromolecular Studies (ISMAC) of the Italian National Research Council since 2008. She has been cooperating to national and international research projects in textile and biopolymers field, fulfilling in some cases the role of project manager. She has also been a contract Professor Assistant of the course of textile fibers, internationals MSc in textile engineering at the Polytechnic of Turin and contract Professor in the international master management and textile engineering of the Carlo Cattaneo University.

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