Bioingegneria, biotecnologia e tecnologie per la salute
Bioengineering

DII research group
Chemical Bioengineering & Polymer Engineering Group (PEG)

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Main research topics:

- Innovative biomaterials: synthesis of bioactive peptides and covalent functionalization of surfaces
- Synthesis of DNA mimetics for biosensors
- Matrixes of self-assembling peptides chemoselectively modified for regenerative medicine
- Treatment of animal pericardium for prosthetic heart valves
- Physical and chemical recycling of polymeric materials
- Thermal stability and fire behavior of polymeric materials
- Polymeric nanocomposites
- Polymer and biopolymer processing
- Nanostructured membranes based on nanofibers (electrospinning and electrospraying)

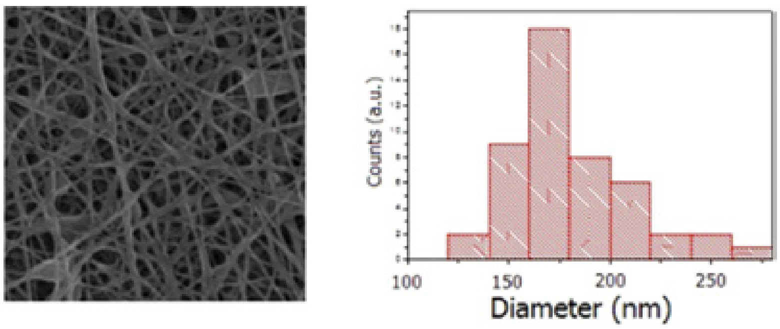
Elecrospun Scaffolds for Osteoblast Cells

Most of the synthetic polymers used in tissue engineering or regenerative medicine are characterized by good mechanical and physical properties but are usually hydrophobic and often lack suitable biocompatible molecular sites for communicating with target cells. For example, poly- -caprolactone (PCL) has been widely used in several biomedical applications due to its biodegradability, biocompatibility, and good mechanical properties. PCL cast films however are not appropriate for cell scaffolding because they are non-porous and therefore prevent nutrients and oxygen from being transported to the cells.

In the last decade, electrospinning has emerged as a new technique able to weave fibers that are structurally similar to the fibrous components of most extracellular matrices (ECMs). Fiber composition, diameter, alignment and scaffold porosity can be tailored to the particular cell or tissue type. In addition, the high area-to-volume ratio offers the possibility to improve surface decoration with protein, peptides or other bioactive molecules. On the other side, hydrogels custom made using physiological fibril-self-assembling peptides (SAPs) are matrices capable of sustaining tissue regeneration on their own

The design of hybrid polycaprolactone (PCL) self-assembling peptides (SAPs) matrices represents a simple method for the modification of synthetic scaffolds, which is essential for cell compatibility. We have investigated the influence of increasing concentrations (2.5%, 5%, 10% and 15% w/w SAP compared to PCL) of three different SAPs (EAK, EAbuK and RGD-EAK) on the physicochemical/mechanical and biological properties of PCL fibers. Our aims were to: i) correct the high hydrophobicity of PCL and lack of biochemical signals; ii) rectify the excessive softness of peptide hydrogels.

We demonstrated that physical-chemical surface characteristics were slightly improved at increasing SAP concentrations: the fiber diameter increased; surface



wettability increased significantly with the first SAP addition (2.5%) and slightly lower for the following ones; SAP-surface density increased but no change in the conformation was registered. These results could allow engineering matrices with structural characteristics and desired wettability according to the needs and the cell system used. Surprisingly, the biological and mechanical characteristics of these scaffolds showed a disjointed trend at increasing SAP concentrations suggesting a correlation between cell behavior and mechanical features of the matrices. As compared with PCL, SAP enrichment increased h-osteoblast adhesion, encoding of specific mRNA levels of osteoblast-related genes and calcium deposition, revealing the potential application of PCL-SAP scaffolds in regenerative medicine.