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GBS - Graded Biomimetic Scaffold for Osteochondral repair

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The main challenge in biomaterials for osteochondral repair is to regenerate two adjacent tissues (cartilage and bone) and their interface (mineralized cartilage). The need to provide nutrients and oxygen by rapid new vascularization is a key factor for the success of the implants. We propose a biomimetic tri-layered scaffold, which mimics the chemical, physical and topographical cues of the natural osteochondral region. Three collagen-based materials were synthesized mimicking the cartilage, the mineralized cartilage and the subchondral bone natural layers. To mimic the gradient of mineralization, a nano-structured Magnesium Hydroxyapatite phase was directly nucleated on the organic template (type I collagen), by a biologically inspired process. Mesoporous silicon-PLGA composite microspheres (PLGA-pSi) were synthesized through a modified S/O/W emulsion method. The pSi protects the payload from the acidic environment of the PLGA coating and provides a double controlled release. PLGA-pSi were integrated into the biomaterials and a graded monolithic scaffold was generated through layer by layer assembly and freeze casting. Thus, a triple controlled release of growth factors for new vascularization was generated, mimicking the biochemical gradients which occur during the regeneration process. The scaffold was characterized and the internalization rate of PLGA-pSi of different diameter and charge has been investigated to evaluate the internalization rate by two lines of macrophages, through SEM, confocal and live microscopy.

The ultimate goal of our investigation is to precisely regulate the temporal and spatial gradients of growth factors, a crucial step to enhance the signaling capability of scaffolds for tissue regeneration.

Biography

Silvia Minardi has completed with honors her M.Sc. in Biotechnology at University of Milan - Bicocca (Italy) in 2010 and she is a PhD student in Chemical Sciences at University of Bologna (Italy). She started working at Institute for Science and Technology for Ceramics (ISTEC - Italy) since College. In 2011 she joined the Biomaterial Team at ISTEC, with a fellowship released by the National research Council of Italy as Graduate Research Fellow and she started to work at The Methodist Hospital Research Institute (TMHRI, Houston, TX) in a collaboration program between the two institutes.

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