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Continuous Multilayered Composite PVA Hydrogel as Cartilage Substitute

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Cartilage is a highly organized avascular soft tissue that assembles from nano-to macro-scale to produce a complex structural network. To mimic cartilage tissue, we developed a stable multilayered composite material (MSC), characterized by a tailored gradient of mechanical properties. MSCwas obtained through a multistep procedure. A mixture of PVA and HA nanocrystals (nHA/PVA molar ratio of 0.015) was crosslinked using tri-sodium tri-metaphosphate (STMP), the crosslinking agent, added in a molar ratio 1:1 with PVA (PS11HA)(first layer). The second layer was obtained by crosslinking PVA directly on the surface of first layer without addition of the inorganic phase but with the same PVA/STMP molar ratio of the first layer (PS11). The same procedure was then applied to crosslink a third layer, which was produced with a greater PVA/STMP molar ratio (2:1). MSC can be considered a promising potential substitute for damaged cartilage tissue, since it mimics the gradient of water content and rheological properties strictly comparable with those of cartilage in terms of complex modulus (G*: 0.032±0.003 MPa; cartilage: G*: 0.03±0.003 MPa) and recovery (70% recovery after just 0.1 s). The presence of nano-hydroxyapatite in its bottom layer stimulate the adhesion to bone, whereas the uppermost soft layer represents an ideal environment for interaction with cartilage guaranteeing a lubricant action as confirmed by the good cytocompatibility shown by MSC (layer PS21) and MSC (layer PS11HA) towards chondrocytes and osteoblasts, respectively, and by the increased BALP production in samples containing nHA in comparison with samples without nHA.

Biography:

Gemma Leone is a researcher at the University of Siena. Her research activity is focused on the synthesis and the physico-chemical and rheological characterization of natural or synthetic macromolecular based bi-dimensional or three-dimensional surfaces, which can be utilized as cell scaffolds or drug vehicles. Her main research fields concern: I) Development of new polysaccharide –based hydrogels for soft tissue regeneration II) Protein adsorption studies on biomaterials III) Synthesis and physico-chemical and rheological characterization of polyvinylic hydrogels as ophthalmological devices IV) Development of model systems for saccharide based biosensors