Engineering of Aerogels for Biomedical Applications Linked to Ageing of Population

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Healthcare sector is seeking the development of novel solutions linked to ageing population in order to provide improved performance and durability, using advanced and environmentally-friendly technologies and customized with a high-resolution to the patient needs. In this work, innovative materials based on the use of aerogel technology were developed for certain biomedical applications linked to this new healthcare context: (1) bone grafts with dual porosity for regenerative medicine [1], (2) medicated dressings for advanced treatments of chronic wounds [2,3], and (3) porous drug carriers for non-invasive pulmonary delivery [4]. (i) For regenerative medicine, starch aerogel scaffolds endowed with macroporosity were prepared using zein protein as a sacrificial porogen. Morphological and mechanical properties of the aerogels were preserved after the sterilization treatment. *In vitro* tests highlighted the cytocompatibility of these scaffolds. (ii) For wound treatments, chitosan aerogel particles were loaded with an antibiotic drug (vancomycin). The obtained nanostructured materials were advantageous for the correct management of wounds and the vancomycin release profile was suitable for the local treatment in wounds to prevent infections. (iii) For pulmonary delivery, alginate aerogel microparticles were produced by inkjet printing followed by supercritical drying. This approach allowed a digitally controlled processing of aerogels with narrow particle size distribution and high spatial resolution. Aerogels loaded with a bronchodilator drug (salbutamol sulfate) had excellent aerodynamic properties and provided a local and sustained pulmonary drug delivery. *In vitro* tests showed that these aerogels were compatible with two different human lung epithelial cell lines.

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