Bio-Inspired & Bio-Mimetic Hybrid Materials Based On Polymer Nanocomposites

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The development of bio-hybrid materials represents an emerging and interdisciplinary topic in the border of Life Sciences, Material Sciences and Nanotechnology [1]. These materials are prepared by assembling of molecular or polymeric species of biological origin to inorganic substrates through interactions at the nanometric scale. They are receiving increasing interest due to their incidence in a wide range of applications, mainly in regenerative medicine and drug vectorization and delivery, where the employment of biocompatible materials is usually required. The preparation of bioinspired or biomimetic materials following the examples found in Nature, as for instance, bone [2], ivory [3] and nacre [4], is of special interest because the resulting bio-hybrids may be provided of improved mechanical properties together with biocompatibility and, in some cases, other interesting features such as functional behaviors. In this context the combination of biopolymers, such as chitosan, alginate, gelatin and carragenates, with calcium carbonate generated from ammonium carbonate and calcium chloride results in the formation of $CaCO_3$ as amorphous phases or crystals (Fig. 1). The nature of the biopolymer and the reaction time determine the possibility to stabilize the metastable phase vaterite instead of calcite, which is the one usually formed by combination of the reagents in the adopted experimental conditions.
More complex bio-hybrid systems resulting from the combination of polysaccharides, such as chitosan, and the microfibrous silicate sepiolite [5], can be also used as scaffolds in biomineralization processes. The use of cryogenic procedures in the preparation of this type of bio-nanocomposite allows the organization of the systems with a hierarchical distribution of pores that resembles the one of bone tissue structure (Fig. 2). Due to the biocompatibility of these porous bionanocomposites they can be also used as support for the immobilization of bioactive species including enzymes and living cells.

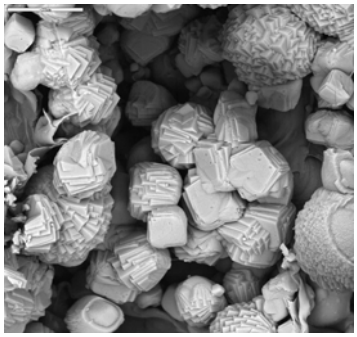

Fig. 1 SEM image of the bio-hybrid alginate-$CaCO_3$

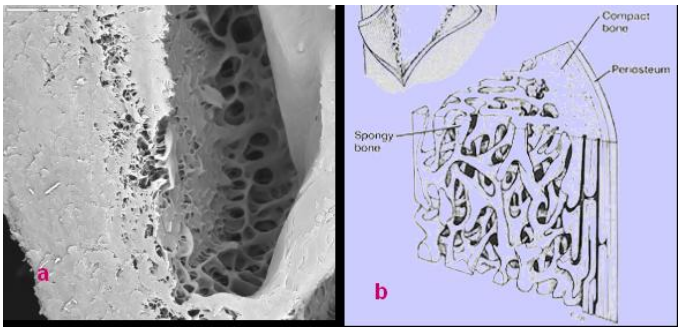

Fig. 2 a) bio-nanocomposite based on chitosan- sepiolite; b) natural bone tissue

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