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Preparation of hydroxyapatite from industrial waste phosphogypsum by hydrothermal method, its application in waste treatment

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Phosphogypsum (PG) is an industrial waste derived from the production of phosphoric acid where the phosphate ore is dissolved in sulfuric acid. About 5 tons of phosphogypsum are produced for every ton of P_2O_5 manufactured. Worldwide PG production is huge, and it is estimated that 200,000 tons are produced annually in phosphoric acid plants. In fact, 85% of the worldwide production remains at present stored into piles near the factory that occupy considerable land resources, or completely discharged into water, which lead to serious contamination. In consequence, valorizing and minimizing the negative effects of this hazardous waste increasingly grab the attention of researchers all around the world. In the present work, the conversion of an industrial sub-product phosphogypsum (PG) into hydroxyapatite (H-Ap) was investigated. Hydrothermal synthesis was applied by reacting PG with a salt at different times, temperatures, while adjusting pH using sodium hydroxide solution NaOH (1 M). The obtained H-Ap exhibited a hexagonal structure, a high purity and nanorod- like shaped of 44 nmx12 nm. The prepared nano-hydroxyapatite was characterized by X-ray diffraction (XRD), Fourier transformed-infrared spectroscopy (FT-IR), transmission electron microscopy (TEM) and scanning electron microscopy (SEM). The findings showed that PG recycling could be accomplished using an easy synthesis route with relatively cheap reactants in order to produce nano-crystalline H-Ap. The elaborated hydroxyapatite powder was used as en effective adsorbent of organic dyes/heavy metals from wastewater.

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Designing novel gelatin-based hydrogels for soft tissue engineering

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Driven by enormous potential of hydrogels, novel gelatin-based biocompatible hybrid hydrogels were developed under mild condition using poly(ethylene glycol) diglycidyl ether (PEG) as a cross-linking agent. Chitosan (CH) and hydroxyethyl cellulose (HEC) were added to tune the structural stability, mechanical properties and degradation resistance as well as to better mimic the native extracellular matrix (ECM). Post-curing was essential to achieve suitable structural stability, tunable mechanical strength and controlled degradation resistance of the hydrogels. Structural features and cross-linking interaction of the hydrogels were confirmed by infrared spectroscopy. Mechanical properties were measured by uniaxial tensile tests, and the characterization revealed non-linear and J-shaped stress-strain curves for all hydrogels, similar to those found for native ECM. Structural integrity of these hydrogels was confirmed by the hydrolytic degradation test as well as by the variation of mechanical properties over time. Degradation study demonstrated that the mass loss and change in mechanical properties were dependent on hydrogel compositions and cross-linking. Biological evaluation of the hydrogels was conducted using rat myoblasts and human fibroblasts cell lines. The results showed that the hydrogel scaffolds were not toxic to cells; all of them allowing cell adhesion and proliferation. Hence, these hydrogels might have a great potential for use in the soft tissue engineering applications.

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