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ABSTRACTS

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Calcium Phosphate Powders for Stereolithographic Printing

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Calcium phosphate ceramics is used to replace and reconstruct bone tissue over the past decades. When creating ceramic materials for bone implants capable of providing biological integration with bone tissue, it is important to search for new formulations of the phase composition of such materials, improve their microstructure, create new architectural types of macroporous structure, develop approaches to create materials of macropores. The most promising when creating porous ceramic materials with a given architecture is the method of stereolithographic printing [1].

In the present work, calcium phosphate (CP) powders were obtained from calcium lactate and dibasic ammonium phosphate at different molar ratio of Ca/P. Reaction was carried out in presence of water at room temperature using mechanochemical activation.

The phase composition of powders after synthesis was represented by brushite ($CaHPO_4$ $2H_2O$) at Ca/P=1 and hydroxyapatite ($Ca_9(HPO_4)(PO_4)_5 \cdot xH_2O$) at Ca/P=1.5. Powders also included reaction by-products (namely ammonium lactate $CH_3CHOHCOONH_4$). The phase composition of the powders after heat treatment at 500–700ºC was represented mainly by γ-$Ca_2P_2O_7$ and $Ca_9(HPO_4)(PO_4)_5 \cdot xH_2O$. The powders were colored gray after heat treatment at 500–700ºC owing to the destruction of the reaction by-products presented in synthesized CP powders.

The presence in the powders of related products of the reaction facilitates compaction during pressing, reducing the friction of the powders on the steel form. The colored CP powders can be used for creation of suspensions based on light-cured monomers intended for stereolithographic printing of high quality resolution of semi-finished porous openwork of “polymer/inorganic powder” items which can be converted into ceramic structures via firing.

The phase composition of ceramics obtained from the synthesized powders after calcination at 1100ºC was represented by biocompatible and bioresorbable β-$Ca_2P_2O_7$ and TCP β-$Ca_3(PO_4)_2$ phases. Created CP ceramics based on synthesized colored powders had microporous surface. This microporosity created CP ceramics will provide the surface roughness necessary for the adhesion of proteins and osteoblasts when using as implants. The resulting ceramic materials based on CP from synthetic powders can be used as a material for bone implants.

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