Nano-sized Porous Calcium Phosphate Ceramics

S. Tepavitcharova[1], D. Rabadjieva[1], K. Sezanova[1], E.Vassileva[2], R. Gergulova[1]

[1]Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, Acad. G. Bontchev Str., Bl. 11, 1113 Sofia, Bulgaria, *E-mail:* stepav@svr.igic.bas.bg
[2]Sofia University "St. Kliment Ohridski", Faculty of Chemistry, Laboratory on Structure and Properties of Polymers, 1, James Bourchier Blvd., 1164 Sofia, Bulgaria

Non-stoichiometric nano-sized apatites are one of the main components that build up the hard bone tissue. Thus nano-sized calcium phosphates with predetermined properties and structures obtained by varying their composition are of continuous interest in the field of the biocompatible materials as they could be used for bone repairing, reconstructive and remodeling applications.

The present study aims to investigate the crystallization of nano-sized precursors for calcium phosphate ceramics preparation. The influence of the reagents and the reaction environment on the composition, crystal size and morphology of the crystallized solid phase was followed in two types of experiments: (i) crystallization in polymer hydrogels by absorption of the reagents one by one and (ii) continuous precipitation. In the first type of experiments two natural polysaccharides (Xanthan Gum and Guar Gum) were used as polymer matrices. In these matrices K_2HPO_4 aqueous solution was pre-absorbed and than $CaCl_2$ solution diffused into the hydrogel. pH of medium was in the range of 3-6 for dicalcium phosphate dihydrate (DCPD) crystallization while for the amorphous calcium phosphate (ACP) formation pH was in the range of 10-12. The calcium phosphate crystallites obtained in Guar Gum were smaller in size than the ones obtained in Xanthan Gum due to the denser hydrogel that Guar Gum forms compared to Xanthan Gum at the same water content.

In the second type of experiments the precipitation was carried out at constant pH 8 but at varying composition of the reaction medium, respectively buffer aqueous solution, propylene glycol aqueous solution (1:5) and oil-in-water emulsion (1:20). The modification of the reaction medium allowed for crystallization of amorphous and small crystals calcium-phosphate precursors in contrast to the crystals obtained in an aqueous media. From thus obtained precursors two types of nano-sized, microporous ceramics were prepared: (i) mono-phased (calcium pyrophosphate) when the precursor was DCPD, and (ii) bi-phased (β-TCP and HA) when the precursor was amorphous or poorly crystalline calcium phosphates. The preparation of these ceramics included the following steps: (i) defined homogenous gel-forming of the precursor in polysaccharide matrix; (ii) lyophilization; (iii) washing; (iv) second lyophilization, and (v) sintering at 1000^{o}C. The samples were characterized by chemical, XRD, FTIR and SEM methods.

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