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MICROSTRUCTURED POLYMER/HYDROXYAPATITE COMPOSITE MATERIALS

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Materials based on combination of bioactive inorganic materials and biodegradable polymers are widely used for prosthetics and implants [1]. Amongst many inorganic materials, calcium phosphates are noteworthy because of their abundance in the hard tissues of living organisms. One of them, the hydroxyapatite (HAP), is well-known for its osteoconductive effect and is used for bone tissue engineering [2]. It is used as the main material or as a coating for parts of the implants with both applications providing basis for growth of bone and dental tissues. However, HAP mechanical properties are not ideal: like many ceramic materials it is brittle and have low fracture toughness [3]. To overcome these problems, polymers are added to the composition of the implant materials. Addition of biodegradable polymer improves toughness and provides necessary osteointegration of the implant after the degradation. Moreover, polymers open possibility for addition of antimicrobial drugs that prevent inflammation processes in the surrounding tissues and prevent rejection of the implant [4]. Depending on the bonding of the drug to the materials (covalent or electrostatic), the antibiotic can be released in a controlled manner, depending on the pH and the presence of lipases [5].

We have prepared composites containing different amounts of hydroxyapatite and biodegradable polymers, both non-modified and chemically modified. We have chosen ε-polylysine, polyvinyl alcohol, and polyvinyl alcohol modified with succinate moieties [6]. Blends were prepared using different approaches: suspension of pre-synthesized HAP [7] in polymer solution or *in situ* syntheses of HAP in the presence of polymers, and studied to determine their physical and chemical properties. Spray-drying of the suspension gives agglomerates with non-uniform particle size while the composites obtained by *in situ* syntheses upon spray-drying gave microparticles with nanocrystalline HAP embedded in the polymer matrix. The size distribution and forms of particles depend on the used polymer. In the case of succinate-modified polyvinyl alcohol, all obtained materials were probed for the content of free succinic acid/calcium succinate that can be formed due to alkaline hydrolysis during the *in situ* formation of HAP in polymer solution. The results of XRD studies of the obtained materials before and after pyrolysis indicate that no free calcium succinate is formed.

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References:

[1] R. E. McMahon, L. Wang, R. Skoracki, A. B. Mathur, *J. Biomed. Mater. Res. Part B* **2013**, *101B,* 387–397.
[2] A. Singh, *Bull. Mater. Sci.* **2012**, *35,* 1031–1038.
[3] L. Hench, *J. Am. Ceram. Soc.* **1991**, *74,* 1487–1510.
[4] L. G. Harris, R. G. Richards, *Injury Int. J. Care Injured* **2006**, *37,* 3-14; G. Schmidmaier, M. Lucke, B. Wildemann, N. P. Haas, M. Raschke, *Injury Int. J. Care Injured* **2006**, *37,* S105-S112; A. El-Ghannam, K. Ahmed, M. Omran, *J. Biomed. Mater. Res. Part B: Appl. Biomater*. **2005**, *73B,* 277-284.
[5] V. V. Komnatnyy, W.-C. Chiang, T. Tolker-Nielsen, M. Givskov, T. E. Nielsen, *Angew. Chem. Int. Ed.* **2014**, *53*, 439-441.
[6] M. Sanchez-Chaves, F. Arranz, M. Cortazar, *Polymer* **1998**; *39,* 2751-2757.
[7] L. Stipniece, K. Salma-Ancane, N. Borodajenko, M. Sokolova, D. Jakovlevs, L. Berzina-Cimdina, *Ceram. Int.* **2014**, *40,* 3261-3267.