Physico-Chemical nanomaterials science

Resorbable bioceramic scaffolds based on nanostructured biogenic hydroxyapatite for bone tissue engineering

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The new challenge in biomaterials is the stimulation of the body's own regeneration mechanism to reconstruct diseased or damaged bone to its original state and function. Highly porous bioceramic scaffolds provide a framework for good conditions for biofluids transport and cell infiltration. Hydroxypaptite (HA) ceramics in the field of biomedical applications have attracted wide attention. HA is characterized by its high biocompatibility and close chemical similarity to hard human bone tissue. However, although HA is bioactive, its reactivity, the rate of bonding and integration with bone is relatively low. One way to improving the bioactive behavior of HA is to modify its composition with various chemical elements, including silicon. The important role of silicon in processes of bone tissue mineralization is well-known. On the other hand, a positive effect of silicon on the bone tissue metabolism is of a great interest.

The replica foam method (sintering temperature 850 °C) was used for scaffold preparation using slurry of nanostructured biogenic HA powder, which were doped with 5 wt. % of silica Aerosil 200®. Obtained samples were analyzed with optical microscopy, XRD analysis and IR spectroscopy. The compressive strength was determined by performing uniaxial tests on cubic samples. Bioresorption of materials was estimated by their solubility in saline at 36.5±0.5 °C.

The XRD patterns of bioceramics show the presence only HA phase, which was confirmed by IR spectroscopy results. Prepared bioceramic scaffolds characterized interconnected macroporous structure. The mechanical properties of the bioceramics are in line with cortical bone.

Prepared scaffolds could be a good candidate for cell loading, drug delivery and reconstructive surgery for filling cavities of non-loaded defective bone.

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