Bioactive nanoglasses and xerogels (SiO_2–CaO and SiO_2–CaO–P_2O_5) as promising candidates for biomedical applications

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Streszczenie

A binary and ternary system of highly bioactive nanoparticles of xerogel (88SiO_2–12CaO (wt.%), solvXG88, 78SiO_2–16CaO–6P_2O_5, solvXG78P6) and glass (69SiO_2–25CaO–6P_2O_5, solvBG69P6) were prepared following an unconventional solvothermal path of the synthesis. These nanosized (<50 nm), non-spherical in shape and mesoporous materials with different compositions greatly enhanced the formation process of hydroxyapatite (HA) in simulated physiological fluids compared to reference 45S5 glass, commonly used in orthopedics and dentistry. The deposition of a HA layer on the glasses was analyzed by various techniques, namely XRD, IR-ATR, ^{31}P CP-MAS NMR, EDS analyses, SEM, and HR-TEM imaging. For both types of nanoparticles (glass and obtained at lower temperature xerogels) superior apatite-mineralization ability in time as short as 4 h in the physiological-like buffer was achieved thus, exceeded the bioactivity of the 45S5 glass. This unique bioactivity was complemented by biocompatibility with human dermal fibroblasts and MC3T3 mouse osteoblast precursors, verified in a wide range of concentrations, as well as hemocompatibility studies. The most promising candidate which can compete with clinically used Bioglass is solvXG78P6.

Słowa kluczowe

Nanoglass, Xerogel, Bioactivity, Biocompatibility, Hemocompatibility, Biomaterials

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