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In vitro bioactivity and stem cells attachment of three-dimensionally ordered macroporous bioactive glass incorporating iron oxides

Thanida Charoensuk [a], Chitnarong Sirisathitkul [a] ✉, Upsorn Boonyang [a], Innocent J. Macha [b, 1], Jerran Santos [b], David Grossin [c], Besim Ben-Nissan [b]

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Abstract

Three-dimensionally ordered macroporous bioactive SiO_2-CaO-Na_2O-P_2O_5 glass (3DOM-BG) is synthesized by using the sol-gel method. After an *in vitro* test in simulated body fluid (SBF), the hydroxyapatite (HAp) crystalline phase is clearly formed on its surface as confirmed by X-ray diffractometry (XRD) and Raman spectroscopy. Magnetic 3DOM-BG/Fe samples are synthesized by partial substitution of SiO_2 with iron oxide. Whilst the HAp layer is not confirmed, energy dispersive spectroscopy (EDS), Fourier transform infrared spectroscopy (FTIR) and XRD analysis reveal calcium phosphate layer on the surface of 3DOM-BG/Fe samples after the SBF soaking. The growth of HAp-like layer is slower with increasing iron oxides. The initial mechanism that thought to induce bone formation is reduced due to the replacement of Ca^{2+} with Fe ions in the glass network. The formation of HAp-like layer is modified by the sedimentation of Ca and P while the nonmagnetic 3DOM-BG forms the calcium phosphate by the ionic exchange following the *Hench mechanism*. The adult human adipose tissue-derived stem cells (hADSCs) can be closely attached and well spread on the flat-plate of all 3DOM-BG/Fe and 3DOM-BG. Without detectable cytotoxicity possibly induced by iron oxides, the osteoblast can be grown and proliferated. In addition to these bioactivity and biocompatibility, porous structures can allow their possible use in targeted drug delivery and magnetic properties of 3DOM-BG/Fe can essentially be implemented in

hyperthermia therapy.

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Keywords

Magnetic bioactive glass; Mesopore; Macropore; *In vitro* bioactivity; Stem cells attachment

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[1] Currently at the University of Dar es Salaam, Dar es Salaam, Tanzania.

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