The improvement of chemistry stability and cytocompatibility by incorporation of Ti in $CaSiO_3$

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Introduction: $CaSiO_3$ has been used a potential bioactive material for bone regeneration [1]. A drawback of the $CaSiO_3$ ceramics is that they possess high dissolution rate of calcium (Ca) ions leading to a high pH value environment [2,3] which can disadvantage cell growth. The aim of this study is to minimise the ionic dissolution rate to favour cell growth by incorporating titanium ions into the $CaSiO_3$ material.

Methods: α-$CaSiO_3$ ceramic disks were prepared by uniaxial pressing of chemistry precipitation-derived β-$CaSiO_3$ powders at 200MPa and sintering at 1250ºC for 3 h. Pure sphene ($CaTiSiO_5$) ceramic disks were prepared by uniaxial pressing of sol-gel derived $CaTiSiO_5$ powders at 200MPa and sintering at 1280ºC for 3 h. The prepared ceramics disks were analyzed by X-Ray diffraction full name please (XRD) and scanning electron microscopy (SEM). For the evaluation of the dissolution rate, $CaTiSiO_5$ and α-$CaSiO_3$ ceramic disks were soaked in simulated body fluids (SBF) for 1, 3, 7 and 14 days. Attachement and proliferation of human primary osteoblast cultured on $CaTiSiO_5$ ceramic disks for 3 and 7 days, were evaluated SEM and MTS assay, respectively. .

Results/Discussion:

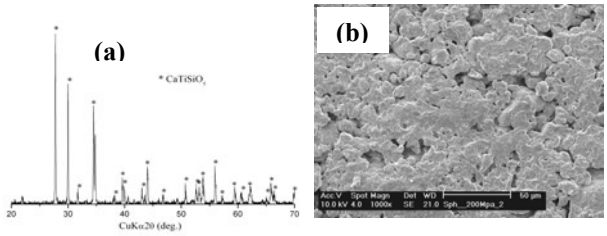

Fig. 1 XRD pattern (a) and SEM microphoto (b) of the sintered sphene ceramics.

XRD pattern and SEM micrograph of the sintered sphene ceramics is shown in Fig. 1. Only sphene peaks exist in the pattern, which indicates that the sintered ceramics are pure sphene ceramics. SEM micrograph showed that most sphene particles were sintered. The changes of ion concentrations and pH value in SBF are shown in Fig. 2. Sphene ceramics possess a slower Ca and Si ions dissolution than those of α-$CaSiO_3$ ceramics. In addition, the pH value in sphene-soaked SBF is significantly lower than that in α-$CaSiO_3$-soaked SBF. Sphene ceramics support osteoblast attachment (Fig 3a) and enhance their proliferation (Fig. 3c) as compared with pure α-$CaSiO_3$ ceramics.

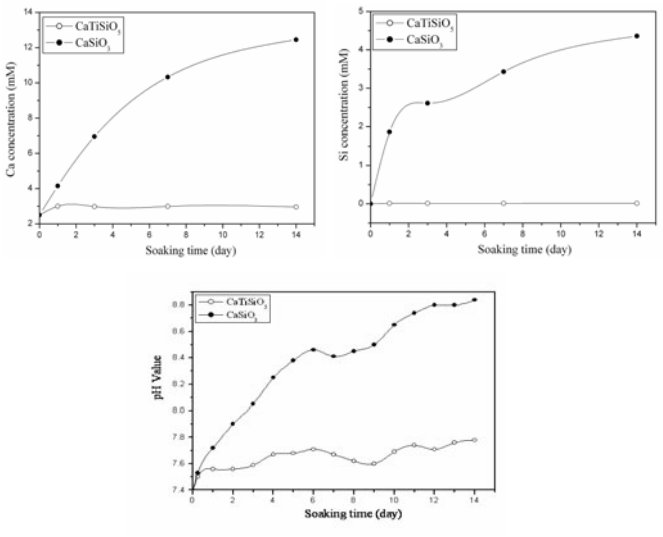

Fig. 2 The change of Ca and Si ion concentrations and pH value SBF after soaking sphene and ceramics α-$CaSiO_3$.

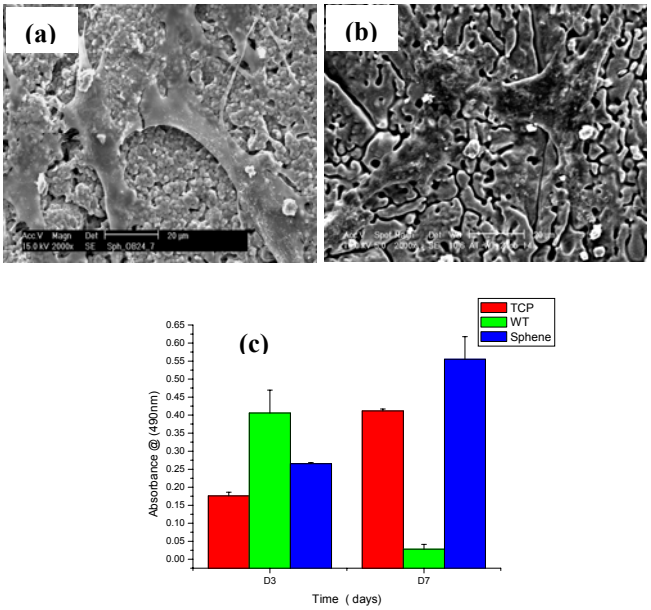

Fig. 3 Human primary osteoblast attachment on sphene (a), α-$CaSiO_3$ (b) ceramics and proliferation (c).

Conclusions: The novel sphene ceramics possess an improved chemical stability and cytocompatibility as compared with $CaSiO_3$ ceramics.

References:

[1] Xue W. Biomaterials. 2005;26:3455-60.
[2] Siriphannon P. J Euro Ceram So 2002;22:511-520.
[3] Iimori Y. J Mater Sci Mater Med 2005;16:73-9.