

Accepted Manuscript

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PII: S0928-4931(17)33964-4
DOI: doi:[10.1016/j.msec.2018.05.016](https://doi.org/10.1016/j.msec.2018.05.016)
Reference: MSC 8571
To appear in: *Materials Science & Engineering C*
Received date: 2 October 2017
Revised date: 21 March 2018
Accepted date: 3 May 2018

Please cite this article as: Basam A.E. Ben-Arfa, Isabel M. Miranda Salvado, José M.F. Ferreira, Robert C. Pullar , Enhanced bioactivity of a rapidly-dried sol-gel derived quaternary bioglass. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Msc(2017), doi:[10.1016/j.msec.2018.05.016](https://doi.org/10.1016/j.msec.2018.05.016)

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Enhanced bioactivity of a rapidly-dried sol-gel derived quaternary bioglass

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Abstract

Novel quaternary (67Si-24Ca-10Na-8P) glass powders were successfully synthesised by sol-gel followed by two alternative drying schedules, conventional drying (CD) and an innovative fast drying (FD) process (200 times quicker). The glasses were thermally stabilised at 550 °C, and then characterised by different complementary techniques. The samples showed very similar silica network structures, with the FD one having slightly lower degree of polymerisation than the CD sample. This less polymerised, more open, network structure exhibited an improved bioactivity in simulated body fluid (SBF), probably also due to the apparent presence of poorly crystalline HAp in the stabilised glass powder. In contrast, the CD glass exhibited an unwanted secondary crystalline silica phase. Both glasses showed excellent biomineralisation upon immersion in SBF, being more pronounced in the case of FD with clear evidence of HAp formation after 4 h, while equivalent signs in the CD samples were only noticed after longer immersion periods between 8 h and 1 week.

Keywords: Glass; Glass-ceramics; Crystallisation; Bioactivity; Hydroxyapatite

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