Accepted Manuscript

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PII: S0925-8388(17)32670-1

DOI: 10.1016/j.jallcom.2017.07.285

Reference: JALCOM 42701

To appear in: *Journal of Alloys and Compounds*

Received Date: 7 February 2017

Revised Date: 10 July 2017

Accepted Date: 28 July 2017

Please cite this article as: A. Mirza, M. Riaz, R. Zia, T. Hussain, F. Bashir, Effect of temperature on mechanical and bioactive properties of glass-ceramics, *Journal of Alloys and Compounds* (2017), doi: 10.1016/j.jallcom.2017.07.285.

EFFECT OF TEMPERATURE ON MECHANICAL AND BIOACTIVE PROPERTIES OF GLASS-CERAMICS

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ABSTRACT

Melt-derived glass ceramics were prepared having the following chemical composition $33SiO_2$-21CaO-$32.5Na_2O$-$12P_2O_5$-1.5MgO (mol %). Samples were sintered at three different temperatures (750, 800, and 850^oC). Thermal, structural, and bioactivity analyses were carried out using TGA-DSC, XRD, and in vitro immersion tests, respectively. XRD results indicated that $CaSiO_3$ was the major phase while $Na_2Ca_2Si_3O_9$ was the minor phase in a glass matrix. The crystallite size and degree of crystallization increased with sintering temperature. Additionally, SEM images showed grain growth and reduction of pores with increasing sintering temperature. The bioactivity of the specimens were assessed by XRD; all specimens exhibited hydroxyapatite phase on their surfaces after immersion in a simulated body fluid, indicating the bioactive nature of the material. Further, the sample sintered at 750^oC was observed to be more bioactive as indicated by crystallization of $Ca_{10}(PO_4)_6(OH)_2$ on its surface. These results indicate that sintering at high temperature increases the crystallinity, microhardness and chemical stability of this bioactive glass ceramic.

Keywords: crystallinity, grain growth, bioactivity, apatite

1. INTRODUCTION

Recently, calcium silicate based glass ceramics have been regarded as potential candidate for bone replacement and regeneration due to its excellent biocompatibility and bioactivity. Controlled surface crystallization of calcium silicate glass ceramics develop such versatile mechanical properties that it can be utilized as dental implant or as coating of implant [1-3]. Crystallization improves mechanical properties, enhances stability to physiological conditions [4-5]. Bioactivity is an essential property of glass-ceramics used as bio-implant. Bioactivity is