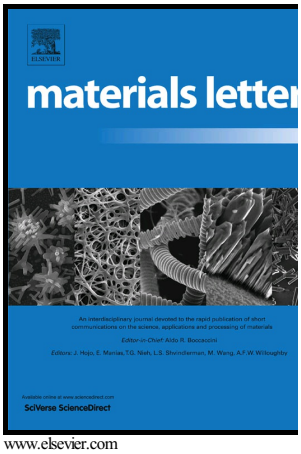

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Muralithran G. Kutty, Sarit B. Bhaduri, Huan Zhou, Alireza Yaghoubi

PII: S0167-577X(15)30492-4
DOI: http://dx.doi.org/10.1016/j.matlet.2015.08.136
Reference: MLBLUE19497

To appear in: *Materials Letters*

Received date: 27 May 2015
Revised date: 20 July 2015
Accepted date: 27 August 2015

Cite this article as: Muralithran G. Kutty, Sarit B. Bhaduri, Huan Zhou and Alireza Yaghoubi, *In situ* measurement of shrinkage and temperature profile in microwave- and conventionally-sintered hydroxyapatite bioceramic, *Material Letters,* http://dx.doi.org/10.1016/j.matlet.2015.08.136

In situ measurement of shrinkage and temperature profile in microwave- and conventionally-sintered hydroxyapatite bioceramic

Muralithran G. Kutty[1,2], Sarit B. Bhaduri[3], Huan Zhou[3,4] and Alireza Yaghoubi[5]*

[1]Department of Restorative Dentistry, Faculty of Dentistry, University of Malaya, Kuala Lumpur 50603, Malaysia

[2]Department of Materials and Metallurgical Engineering, University of Idaho, Moscow, ID 83844, USA

[3]Multi-functional Materials Laboratory, University of Toledo, Toledo, OH 43606, USA

[4]Institute of Biomedical Engineering and Health Sciences, Changzhou University, Changzhou, Jiangsu 213164, China

[5]Center for High Impact Research, University of Malaya, Kuala Lumpur 50603, Malaysia

*Correspondence to: yaghoubi@siswa.um.edu.my
Tel.: +60173470750
Fax: +60379677727

Abstract

The clear advantages of microwave (MW) sintering in terms of energy savings as well as superior mechanical properties have led to the popularity of this technique in recent years, especially in the bioceramics community. However to date, no study has established a systematic comparison between the sintering behavior of the most commonly used bioceramic, hydroxyapatite (HA), during MW and conventional sintering. Here, we utilize *in situ* dilatometry along with optical pyrometry to monitor the rate of shrinkage and temperature profile for various sintering conditions of HA. Temperature-dependent dielectric measurements indicate that microwave coupling occurs around 900 °C and the maximum linear shrinkage is reached, on average, 4 times faster in MW sintering. Finally we show that by tuning the MW power, one can effectively benefit from the non-linear increase in relative permittivity to exert control over the evolution of microstructures and hence achieve the desired combination of physical properties for personalized biomedical applications.

Keywords: Biomaterials; Metallurgy; Dielectrics; Sintering; Thermal analysis; Dilatometry

1. Introduction

The dominant mode of heat transfer in primary stages of conventional sintering is convective and therefore temperature gradient in the sample can widely vary before the surface is sufficiently heated and thermal conduction takes over. In microwave (MW) sintering on the contrary, dielectric heating gives rise to a nearly uniform