

BIOACTIVE CERAMICS OBTAINED FROM CALCIUM AND SILICON OXIDES USING PULSED ND:YAG LASER

J.S. Galindo-Valdés[1], D.A. Cortés-Hernández[1], J.C. Ortiz-Cuellar[2], E. De la O-Baquera[1], J.C. Escobedo-Bocardo[1]

[1] CINVESTAV-IPN, Coahuila, México, salvador.galindo@cinvestav.mx
[2] Facultad de Ingeniería, Universidad Autónoma de Coahuila, Coahuila, México

ABSTRACT

An alternate route of β-wollastonite synthesis by pulsed laser method was developed. A mixture of CaO-SiO_2 (molar ratio 1:1) was uniaxially pressed to obtain disks of 10 mm in diameter, which were laser-treated. A pulsed Nd:YAG laser equipment, was used under the following parameters: 70% of average power, 8 ms of pulse duration, 8 Hz of frequency and 0.7 mm/s of travel speed. *In vitro* bioactivity assessment was performed by immersing pulsed laser-treated samples in a simulated body fluid (SBF) for 3, 7, 14 and 21 days. The disks surface was analyzed by XRD, SEM and EDS before and after laser treatment and after immersion in SBF. The changes in the concentration of Ca, Si and P in the remaining SBFs were measured by ICP. After laser treatment, β-wollastonite with a globular morphology was formed as a result of the interaction between calcium and silicon oxides and the heat supplied by the laser. After 21 days of immersion in SBF, a dense and homogeneous apatite layer was formed on the laser-treated sample. The feasibility to synthesize β-wollastonite using laser treatment was demonstrated. Besides, the obtained results showed that apatite can be formed on the surface of the laser-treated samples after only 3 days of immersion in SBF. The spherical morphology of the layer formed after 21 days of immersion in SBF resembles that of the apatite formed on the existing bioactive systems.

Keywords: Bioactive ceramics, β-wollastonite, Nd:YAG laser, *In vitro* bioactivity assessment, SBF, Apatite formation.

INTRODUCTION

Bioactive ceramic materials, when implanted, generate a biological response at the interface between tissue and material, which causes the formation of an apatite layer. This layer promotes the chemical bond to the surrounding tissue [1, 2]. Some biomaterials obtained from calcium and silicon oxides are highly bioactive and show faster apatite formation than other ceramics and bioactive glasses [3]. β-wollastonite is one of these biomaterials that can be obtained from these oxides.

The high-temperature phase of wollastonite, β-wollastonite, is a bioactive ceramic that bonds to bone tissue through an apatite layer formed on its surface when implanted. This apatite is chemically and structurally similar to the mineral phase of the bone [1, 4, 5]. Nowadays, there are several synthesis methods to obtain β-wollastonite such as sol-gel [6], hydrothermal [7], microwaves-assisted techniques [8] and solid-state reaction [4] which lead to the obtention of β-wollastonite with different morphology, crystallinity, purity and physical properties.

The Nd:YAG laser emits a beam of high coherence and directionality capable of affecting small areas in short periods of time. The material to be irradiated by the laser experiences a heat transfer by conduction [9], which implies possible phase, morphological and physical transformations. In this work, an alternate route of β-wollastonite synthesis using the pulsed laser method has been studied. The potential application of this material obtained by laser treatment is as bioactive coating on metallic implants.

ISBN: 987-1-7752455-7-5