

FABRICATION OF BIOACTIVE ZIRCONIA BY DEPOSTION OF LOW CRYSTALLINE HYDROXYAPATITE PARTICLES USING SOLUTION TREATMENT

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ABSTRACT

Yttria stabilized zirconia (YSZ) is an attractive candidate as a bioceramic owing to its mechanical and aesthetic property for orthopedic and dental applications. In this work, we aimed to fabricate bioactive YSZ by treating with an aqueous solution containing calcium, phosphate and magnesium ions. By this simple treatment, precipitates consisted of low crystalline hydroxyapatite were deposited on the surface of the YSZ samples and subsequently, in-vitro bioactivity analysis was done by SBF method. Results showed that the YSZ samples were fully covered with hydroxyapatite in 1 day SBF immersion and showed high apatite-forming ability.

Keywords: Bioactivity, yttria stabilized zirconia, low crystalline hydroxyapatite, Ca-P solution treatment

INTRODUCTION

Zirconia is a biocompatible bioceramics [1], when stabilized by the addition of yttria into tetragonal phase (YSZ), it shows high fracture toughness and flexural strength. This enhanced mechanical property is due to the phase transformation toughening, from tetragonal to monoclinic in the structure that increases crack propagation resistance [2]. YSZ is widely being used as a hip joint replacement and lately, as dental implants due to higher esthetic restoration compared to metals [1, 3]. However, YSZ is inherently bio-inactive, which means it lacks direct bone-bonding ability. One of the methods to induce bioactivity to bioinert material is to coat with suitable bioactive material such as calcium phosphate, hydroxyapatite and bioactive glass. Various methods such as sputtering [4] and plasma spraying [5] have been employed to provide suitable coating of bioactive materials on zirconia surface. Another approach is surface functionalization or formation of functional groups on the surface which act as sites for apatite nucleation [6]. Among various methods, biomimetic Ca-P coatings such as simulated body fluid (SBF) or modified SBF treatments [7-9] are the simplest method to impart bioactivity to bioinert materials. SBF developed by kokubo et. al has inorganic ion concentration similar to human blood plasma and has widely been used to test in-vitro bioactivity of a material[10] .In this work, we aimed to impart bioactivity to YSZ using by treating with solution containing calcium (Ca), phosphate and magnesium (Mg) ions. Mg is an abundant, biofunctional cation in human body. It promotes bone cells activation and proliferation; influences bone mineralization, growth and strength [11, 12]. Calcium phosphate layer was deposited on to the surface of the YSZ samples and subsequently in-vitro bioactivity analysis was done by SBF soaking method.

METHODS

A solution containing $K_2HPO_4 \cdot 3H_2O$, $MgCl_2 \cdot 6H_2O$ and $CaCl_2$ was prepared in distilled water having concentration mentioned in the Table 1. The pH was adjusted to 8.2 using 1 M HCl and Tris- buffer at

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