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Microstructure and properties of alumina ceramics prepared from submicrometer alumina powder with $MgO–ZrO_2$ coated on alumina grain surface

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Abstract

For preparing alumina ceramic prosthetic implants with dense microstructure and good mechanical properties, a combined technique of ball–milling, air–blowing, chemical precipitation and calcinations was explored and used to prepare submicrometer alumina powder with $MgO–ZrO_2$ coated on alumina grain surface, and then alumina ceramics were prepared by sintering alumina green bodies made by cold isostatic pressing. Because of the well distribution of ZrO_2 on the surface of alumina grains, the alumina ceramics obtain dense microstructure and excellent mechanical properties. With the increase of molar ratio between ZrO_2 and alumina powder in raw material from 0.02 to 0.08, the alumina ceramics get almost fully dense microstructure and its flexural strength increases from 589 to 637 MPa, its fracture toughness increases from 5.62 to 6.16 $MPa·m^{1/2}$ and its Vickers hardness increases from 17.3 to 17.7 GPa. The alumina ceramics prepared in this work are promising prosthetic implants materials with excellent mechanical properties.

Keywords: Alumina; Zirconia; Chemical precipitation; Microstructure; Mechanical properties

1. Introduction

In the past three decades, alumina ceramics have been used as an ideal bearing surface for prosthetic implants especially for total hip arthroplasty (THA) owing to their inert, hard, and hydrophilic properties [1]. In THA, the wear advantages and little deterioration of mechanical properties of alumina ceramic

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