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# Development and characterization of zirconia-alumina composites for orthopedic implants

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## ABSTRACT

In this study, three different grades of alumina toughened zirconia composites (ATZ) (from 80-90 wt% of alumina), and three grades of zirconia toughened alumina (ZTA) from 80-90 wt% of zirconia were developed. Two types of stabilized zirconia were used: 3 mol% yttria stabilized zirconia used on the ATZ, and 2 mol% yttria stabilized zirconia for the ZTA. The composite powders were obtained by spray-drying with a controlled granulometric distribution. Uniaxial and cold isostatic pressing were performed. High density ceramics with densification above 97 % were obtained after a low temperature sintering (1400°C) leading to enhanced mechanical properties. Higher values of fracture toughness and flexural strength were achieved for the ATZ samples (up to 5 MPa.m<sup>1/2</sup> and 1394 MPa respectively), while ZTA samples presented higher values of hardness (up to 1846 HV).

Aging tests showed that ZTA samples did not present monoclinic zirconia after 96 hours.

MTT and alkaline phosphatase activity assays were performed on the sintered samples. This study shows that ATZ and ZTA composites with good mechanical properties, aging resistance and osteoblastic cytocompatibility can be attained.

*Keywords*—ZrO<sub>2</sub>, Y<sub>2</sub>O<sub>3</sub> stabilized ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, biomedical applications.

## 1. INTRODUCTION

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