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Yttria/ceria stabilized zirconia composites: evaluation of microstructural, mechanical and color properties for biomedical applications

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3-mol% Yttria-Stabilized Tetragonal Zirconia Polycrystal (3Y-TZP), a ceramic biomaterial, has been widely used in the dentistry field due to its biocompatibility, tooth-like color and mechanical properties [1]. Despite these advantages, its physical and mechanical properties tend to degrade as a result of a low-temperature aging process induced by its sensitivity to low-temperature degradation (LTD) when it is in contact with water that is already at human body temperature [2]. Because of this, many studies have been performed aiming at avoiding this phenomenon by replacing 3Y-TZP by 12 mol% ceria stabilized tetragonal zirconia polycrystal (12Ce-TZP). Nevertheless, compared to 3Y-TZP, 12Ce-TZP has lower strength which is partly related to its larger grain size [3].

In this sense, this work intends to improve the aging resistance without substantially affecting the mechanical strength of zirconia by producing 3Y-TZP/12Ce-TZP composites by cold pressing and sintering technique. The test samples such discs were produced with different amounts of ceria additions (wt. %), powders mixture methods (dry mixing and aqueous medium) and sintering temperatures (1400ºC and 1500ºC). The proposed solution presents two different designs (i) bulks of yttria /ceria stabilized zirconia composites and (ii) layered 3Y-TZP/12Ce-TZP composites on the surface of 3Y-TZP substrates. The samples were characterized regarding microstructural, mechanical and color properties. Results demonstrated that the 3Y-TZP/12Ce-TZP composites produced through the aqueous medium and sintering temperature of 1400ºC presented an improved aging resistance, flexural strength complying the requirements of the ISO 13356:2008 standard and suitable color properties, validating both designs for biomedical applications.

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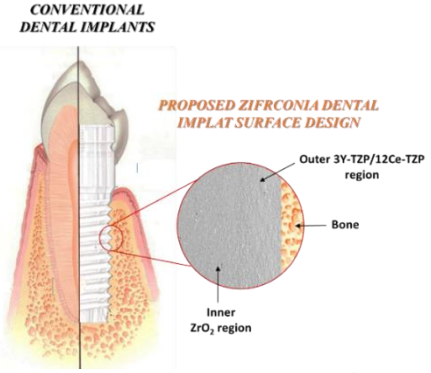

Figure 1. Representative zirconia dental implant surface design based on obtained results.

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