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Microstructural and mechanical study of ZrO_2-Y_2O_3 sintered at different times and sintering temperatures

F. R. Silva[(1)*], L. C. Pereira[(1)], R. S. A. Reis[(2)] and W. Acchar[(3)]

(1) PEMM/COPPE, Federal University of Rio de Janeiro, Cid. Universitária – Centro de Tecnologia-Bloco F, sala F-210, Ilha do Fundão – Caixa Postal 68505, Rio de Janeiro, Brazil, CEP: 21941-972, frsilva@dentsply.com.br
(2) UNIGRANRIO, University of Grande Rio, Rio de Janeiro, Brazil, CEP: 25071-200, rreis@dentsply.com.br
(3) PPGCEM-UFRN, Federal University of Rio Grande do Norte, Natal-RN, Brazil, CEP:59072-970, acchar@dfte.ufrn.br
* Corresponding author.

Abstract – The Zirconium oxide with ytria has been widely used at dentistry due to its excellent mechanical properties and aesthetics. It is shown in Table 2 that this strength is directly linked to the sintered temperature. Different types of fracture surface (fracture origin) can be shown in this study (Figure 1).

ZrO_2 based ceramic material has been intensively studied due to their excellent mechanical properties [1]. ZrO_2 has been used as a dental ceramic material as a substitute to the usual prosthetic metallic structure due to their good biocompatibility, clinical longevity and high mechanical strength [2]. Studies have demonstrated that the good mechanical properties of this class of material is associated to martensitic transformation in the zirconium oxide grains that occurs into the ceramic material during the mechanical loading [3,4].

Several dental industries have developed the production of zirconium oxide bodies through the CAD/CAM systems. This study has the objective to investigate the mechanical strength and microstructure of zirconium oxide with yttria sintered at different temperature and time.

The material used in this work was collected directly from Cercon (Dentsply). Six zirconium oxide blocks were cut and separated in three groups (G1, G2 and G3). The sintering conditions used in this work are shown in table 1. The sintered materials were characterized by density, X-ray diffraction, vickers hardness and scanning electronic microscopy. The test of flexural strength used in this study was four points bending, whose results are more sensitive to defective surface when compared with biaxial test. The results show that the properties are strongly dependent on the sintering conditions (table 2). Images with examples of fracture origins can be shown in Figure 1 and 2.

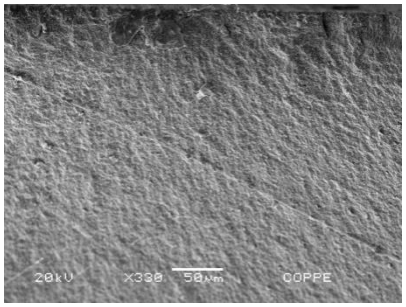

Figure 1- Example of machining or handling damage.

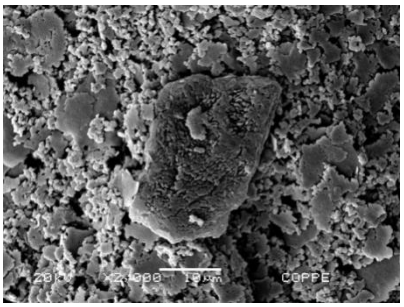

Figure 2- Example of agglomerates.

Table 1: Sintering conditions.

	G1	G2	G3
Temperature [°C]	1350	1500	1500
Time [min]	120	120	460
Ramp [°C/min]	11	12	7

Table 2: Physical and mechanical results.

Properties	G1	G2	G3
Dureza H_V (GPa)	9,61	11,73	10,62
Densidade (g/cm^3)	5,768	5,775	5,518
Resistência Flexural (MPa)	522,77	557,05	609,16

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