

ADVANCED CaZrO₃-MgO CERAMIC COMPOSITIONS FOR HIGH RESPONSIBILITY APPLICATIONS

J. Nunes-Pereira¹, Abílio P. Silva^{1(*)}, Pilar Pena², Carmen Baudín²

¹Centre for Mechanical and Aerospace Science and Technologies (C-MAST-UBI), Universidade da Beira Interior, Rua Marquês d'Ávila e Bolama, 6201-001, Covilhã, Portugal

²Instituto de Cerámica y Vidrio, CSIC, Kelsen 5, Madrid 28049, Spain

(*)Email: abilio@ubi.pt

ABSTRACT

The development of new advanced materials for harsh environment operation conditions, such as high temperature, wear and severe erosion and corrosion, is of growing interest, namely for transport and energy industries, due to the ecological and energetic current concerns on a global scale. Particularly, in aerospace industry the increase of working temperature of engines and turbines combined with weight reduction will give rise to higher thrust and lower fuel consumption and consequently less emissions.

In this sense, new ceramic multiphasic composites (CMC) based on calcium zirconate (CaZrO₃) and periclase (MgO) are being proposed with suitable thermal, mechanical and chemical properties for severe conditions application [1-3]. In the present work an equimolar composition of CaZrO₃-MgO have been developed and the particle size distribution optimized by attrition milling under controlled conditions. Heterogeneous ceramic uniaxially pressed disks and bars have been produced by rate controlled sintering at 1400, 1450 and 1500 °C. The microstructural, physical and mechanical properties, have been assessed to evaluate the performance and suitability of the processed materials for high responsibility applications.

A homogeneous microstructure was obtained for all sintering temperature samples (Fig. 1) with porosities ranging between ~10 % for samples sintered at 1400 °C to almost no porosity for samples sintered at 1500 °C. The strength of all samples follows the Weibull distribution with characteristic strengths ranging between ~50 and 170 MPa for 1400 and 1500 °C samples respectively. The Vickers hardness follows the trend of the strength increasing with the increasing of sintering temperature reaching values above 8 GPa for the samples sintered at the highest temperature, while the fracture toughness was similar for all type of samples varying between 2 and 3 MPa.m^{1/2}.

These results show that these CMC, processed from easily and accessible synthetic raw materials, proved to be a suitable alternative to high responsibility applications.

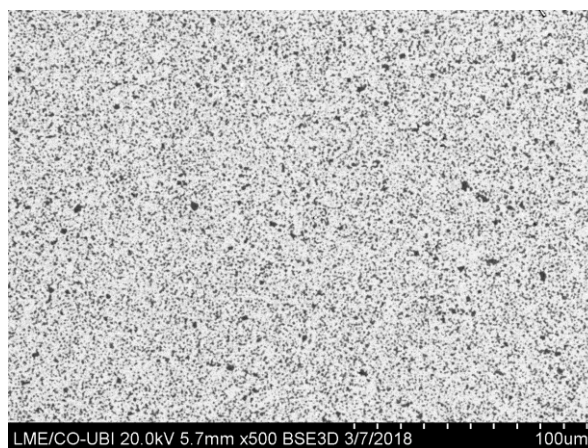


Figure 1: Representative SEM image of the CMC microstructure.

Keywords: Multiphase Ceramics, Rate Controlled Sintering, CaZrO₃-MgO, High Responsibility Application.

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