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Development and characterization of ceramic composites based on $CaZrO_3$-MgO

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Advanced materials for severe environment conditions, such as high temperature, wear and high erosion and corrosion, are of growing interest, namely for transport and energy industries. 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 based on calcium zirconate ($CaZrO_3$) and magnesium oxide (MgO) are being proposed with suitable thermal, mechanical and chemical properties for severe conditions application.

In the present work, an equimolar composition of $CaZrO_3$-MgO, processed from easily and accessible synthetic raw materials, have been developed and the particle size distribution optimized by milling under controlled conditions. $CaZrO_3$-MgO ceramic composites uniaxially pressed disks have been produced by rate controlled sintering during 2 hours at 1400, 1450 and 1500 ºC, respectively. The physical, microstructural 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 with porosities ranging between ~10 %, for samples sintered at 1400 ºC, to ~100 % theoretical density for samples sintered at 1500 ºC. Diametral compression strength follows the Weibull distribution with characteristic strengths between ~50 and 170 MPa, Vickers hardness reach values above 8 GPa, while the facture toughness present values between 2 and 3 $MPa.m^{1/2}$, for 1400 and 1500 ºC respectively. These results show that the ceramic composites based on $CaZrO_3$-MgO sintering at 1500 ºC proved to be a suitable alternative to high responsibility applications.

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