11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Porous Silicon Carbide: Preliminary Results

Celio A. Costa[(1)], C. P. Chimelli[(1)], C. V. Rocha[(1)*], Aline Fernandes[(1)]

(1) PEMM/COPPE, Universidade Federal do Rio de Janeiro, Centro de Tecnologia, Bloco F, Sala 210, Rio de Janeiro, RJ, 21949-900, Brazil, e-mail: claudiov@metalmat.ufrj.br
* Corresponding author.

Abstract – A ultra pure silicon carbide powder was used to sinter a porous silicon carbide. The purification was done via HF acid and the material was sintered at 1925 ºC. The final density was 67% and the strength was 96 MPa. The porous medium had a size distribution from 10 µm to 2 µm in diameter.

Silicon carbide (SiC) is a structural ceramic with unique properties. It is inert to almost all environments, high strength, wear resistance, elevated thermal conductivity and thermal shock resistant; also, it is able to keep them even at high temperatures. The final density governs these properties, when it is high the applications are directed to seats for mechanical seals, armor plates, nozzles and etc; while when it is low, the use as filters has been an advantage. For this last application, important requirements are uniform and controllable porous, and high strength [1,2].

This study investigated the processing of an ultra pure silicon carbide powder and the mechanical strength of porous SiC material.

A Brazilian silicon carbide powder was purified with HF until the ratio SiC/SiO_2 was 15. It was analyzed by XPS technique and the result was compared to an imported powder which had the ratio SiC/SiO_2 of 5. The purified powder was homogenized (ball milled) with small amount of Al_2O_3 e Y_2O_3 in the eutectic composition in order to reduce the sintering temperature (before the homogenization, Al_2O_3 e Y_2O_3 were planetary milled to reduce the particle size and alloy one to another). The sintering temperature was 1925℃.

The SiC processed had a density of 67%, measured by Arquimed´s method. In figure 1 (left), it is observed a macrostructure composed of porous of about 10 µm in diameter distributed around the sample, and on the right the microstructure had particles linked to each other by small areas and porous that are about 3 µm in diameter. Density levels up to 70% are considered to be in the first stage of sintering, where there is the neck formation and the porosity is connected throughout the sample, forming a porous material. The amount of additives was very small and most of the sintering occurred in solid state, since possible phases formed by the additive may have been evaporated [3]. The average of the four point flexure strength was 96 MPa (from 20 samples), a very good result when compared to other porous SiC materials.

Further study will conducted to better evaluate the effectiveness of this porous medium, for instance, permeability.

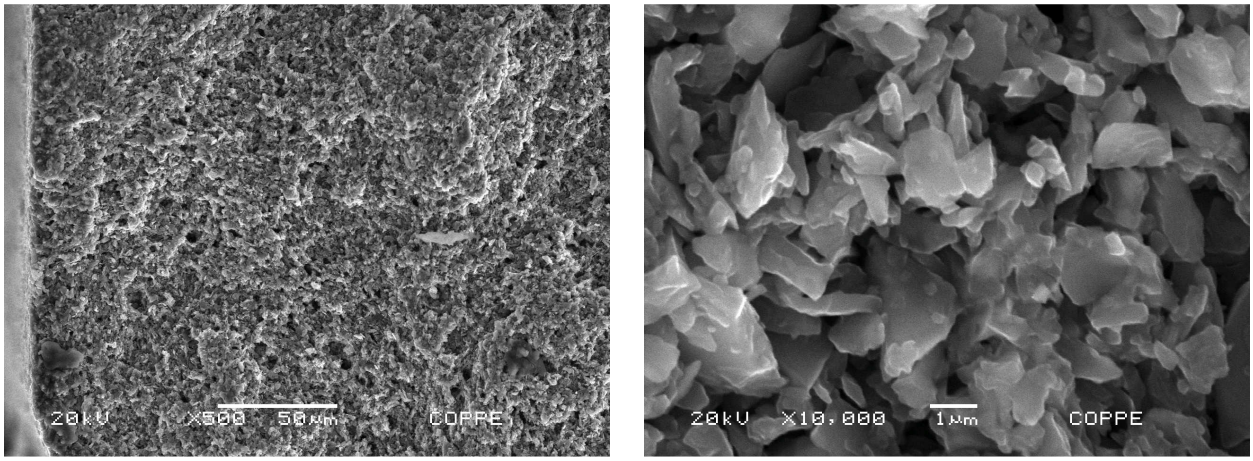

Figure 1- On the left, the macrostructure showing porous size of about 10 µm in diameter, and on the right the microstructure with porous of about 3 µm in diameter.

References

[1] Journal of Porous Materials 11; 265-271, 2004
[2] Journal of the American Ceramic Society, 92 [1], 260-263, 2009
[3] Journal of the European Ceramic Society, 23, 1-8, 2003

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