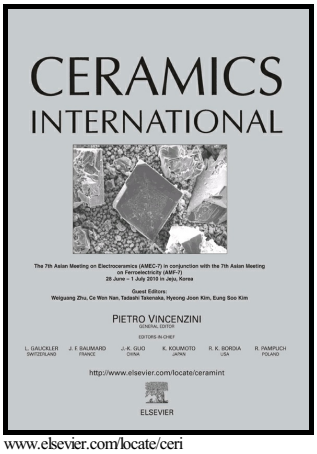


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# Mechanical behavior and microstructure of porous needle: aluminum borate ($Al_{18}B_4O_{33}$) and $Al_2O_3$-$Al_{18}B_4O_{33}$ composites

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**Abstract**
In this article we assess and compare the complex mechanical behavior of two complex microstructure ceramics material formed within the reaction sintering framework
Two comparable pairs of materials with respectively similar microstructures were obtained by reaction sintering from boric acid and alumina. Two single phase porous ceramics were compared with two composite (1:1) porous ceramic. The first and second phases were aluminum borate needles ($Al_{18}B_4O_{33}$) and alumina ($Al_2O_3$).
The four with comparable grain size and analogous apparent porosities: in diameter (≈0.7 μm) and in volume fraction (≈45%). The mechanical behavior was studied by means of the diametral compression test at low displacement rate and explained in terms of the texture, microstructure features evaluated by mercury intrusion porosimetry and scanning electron microscopy.
Single $Al_{18}B_4O_{33}$ phase porous materials presented higher mechanical strengths than the composite materials. Within the respective microstructural configurations the whisker thickness did not affect significantly the mechanical behavior and parameters. A well-defined fragile behavior was observed and described in the composite material. On the other hand the single $Al_{18}B_4O_{33}$ needle porous material presented a distinctive behavior with local discontinuities without loss of integrity in the diametral stress behavior, and achieved strength up to 50% higher than the corresponding composite.

**Key words: Porous ceramics, Aluminum borate, Properties, Mechanical behavior, diametral compression**

## 1. Introduction

Composite materials have an important industrial and technological role in technological ceramics. The designing capability of the manufacturer in properties and behaviors is enhanced by combining two or more different materials. However, the final properties will not always be between the pure material ones; in fact, in several cases the properties are considerably improved. The final properties and behaviors will always be related to the actual microstructural configuration. The actual relation has to be established for better microstructural design.