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## A High Strength Alumina-Silicon Carbide-Boron Carbide Triplex Ceramic

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### Abstract

A ceramic particulate composite composed of oxide, and carbide ceramics was found to have high strength, hardness, and fracture toughness values. A composition consisting of  $\text{Al}_2\text{O}_3$  with 15 vol% SiC and 15 vol%  $\text{B}_4\text{C}$  additions was produced by hot-pressing at  $1650^\circ\text{C}$  for 30 min, with full density reached after  $\sim 5$  min at temperature. Both WB and  $\text{WB}_2$  were observed, with the W source presumably being an impurity from WC milling media, and  $\text{Al}_{18}\text{B}_4\text{O}_{33}$  was also detected following densification. Strength was  $\sim 880$  MPa, which is greater than values reported for comparable composites of  $\text{Al}_2\text{O}_3$  containing 30 vol% SiC or  $\text{B}_4\text{C}$ . Vickers hardness was  $\sim 21$  GPa, and fracture toughness was  $\sim 4.5$   $\text{MPa}\cdot\text{m}^{1/2}$ , comparable to values reported for the binary mixtures. The strength-limiting calculated critical flaw size of the material was either similar to the size of the SiC/ $\text{B}_4\text{C}$  clusters or microcracking at grain boundaries. The latter resulted from thermal expansion mismatch between the  $\text{Al}_2\text{O}_3$  matrix and SiC/ $\text{B}_4\text{C}$  reinforcing phases.

Keywords: aluminum oxide, silicon carbide, boron carbide, strength, microstructure, hot-pressing

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