

# Author's Accepted Manuscript

Processing, Microstructure, and Mechanical Properties of Zirconium Diboride-Boron Carbide Ceramics

Eric W. Neuman, Gregory E. Hilmas, William G. Fahrenholtz



www.elsevier.com/locate/ceri

PII: S0272-8842(17)30320-6  
DOI: <http://dx.doi.org/10.1016/j.ceramint.2017.02.117>  
Reference: CER114733

To appear in: *Ceramics International*

Received date: 24 October 2016  
Revised date: 13 February 2017  
Accepted date: 22 February 2017

Cite this article as: Eric W. Neuman, Gregory E. Hilmas and William G Fahrenholtz, Processing, Microstructure, and Mechanical Properties of Zirconium Diboride-Boron Carbide Ceramics, *Ceramics International*, <http://dx.doi.org/10.1016/j.ceramint.2017.02.117>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and a review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## Processing, Microstructure, and Mechanical Properties of Zirconium Diboride-Boron Carbide

### Ceramics

Eric W. Neuman<sup>1</sup>, Gregory E. Hilmas\*, William G. Fahrenholtz

Department of Materials Science and Engineering, Missouri University of Science and Technology, Rolla, Missouri 65409

\*Correspondence to: 223 McNutt Hall, 1400 N Bishop Ave, Rolla, MO 65409, USA. Tel.: +1-573-341-6102. ghilmas@mst.edu

### Abstract

The processing, microstructure, and mechanical properties of zirconium diboride-boron carbide ( $\text{ZrB}_2\text{-B}_4\text{C}$ ) ceramics were characterized. Ceramics containing nominally 5, 10, 20, 30, and 40 vol%  $\text{B}_4\text{C}$  were hot-pressed to full density at 1900°C. The  $\text{ZrB}_2$  grain size decreased from 4 to 2  $\mu\text{m}$  and  $\text{B}_4\text{C}$  inclusion size increased from 3 to 5  $\mu\text{m}$  for  $\text{B}_4\text{C}$  additions of 5 and 40 vol%  $\text{B}_4\text{C}$ , respectively. Elastic modulus decreased from 525 to 515 GPa and Vickers hardness increased from 15 to 21 GPa as the  $\text{B}_4\text{C}$  content increased from 5 to 40 vol%, respectively, following trends predicted using linear rules of mixtures. Flexure strength and fracture toughness both increased with increasing  $\text{B}_4\text{C}$  content. Fracture toughness increased from 4.1  $\text{MPa}\cdot\text{m}^{1/2}$  at 5 vol%  $\text{B}_4\text{C}$  to 5.3  $\text{MPa}\cdot\text{m}^{1/2}$  at 40 vol%  $\text{B}_4\text{C}$  additions. Flexure strength was 450 MPa with a 5 vol%  $\text{B}_4\text{C}$  addition, increasing to 590 MPa for a 40 vol% addition. The critical flaw size was calculated to be  $\sim 30$   $\mu\text{m}$  for all compositions, and analysis of the fracture surfaces indicated that strength was controlled by edge flaws generated by machining induced sub-surface damage. Increasing amounts of  $\text{B}_4\text{C}$  added to  $\text{ZrB}_2$  led to increasing hardness due to the higher hardness

---

<sup>1</sup> Present address: Sandia National Laboratories, Albuquerque, NM.

Download English Version:

<https://daneshyari.com/en/article/5437936>

Download Persian Version:

<https://daneshyari.com/article/5437936>

[Daneshyari.com](https://daneshyari.com)