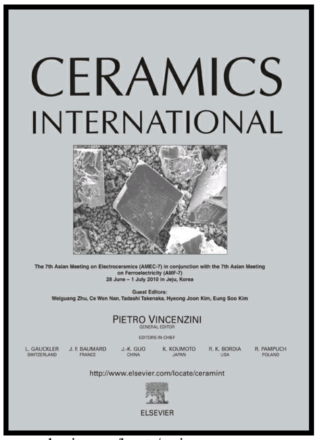
Author's Accepted Manuscript



www.elsevier.com/locate/ceri

Establishing Microstructure-Mechanical Property Correlation in ZrB_2-based Ultra-High Temperature Ceramic Composites

Ambreen Nisar, S. Ariharan, Kantesh Balani

PII: S0272-8842(17)31484-0
DOI: http://dx.doi.org/10.1016/j.ceramint.2017.07.053
Reference: CERI15773

To appear in: *Ceramics International*

Received date: 18 May 2017
Revised date: 7 July 2017
Accepted date: 7 July 2017

Cite this article as: Ambreen Nisar, S. Ariharan and Kantesh Balani, Establishing Microstructure-Mechanical Property Correlation in ZrB_2-based Ultra-Hig Temperature Ceramic Composites, *Ceramics Internationa* http://dx.doi.org/10.1016/j.ceramint.2017.07.053

Establishing Microstructure-Mechanical Property Correlation in ZrB_2-based Ultra-High Temperature Ceramic Composites

Ambreen Nisar, S. Ariharan, and Kantesh Balani*

High Temperature Ceramic Laboratory, Department of Materials Science and Engineering, Indian Institute of Technology Kanpur, Kanpur-208016, India

*Corresponding author. Tel.: +91-5122596194. kbalani@iitk.ac.in (K. Balani)

Abstract

The current work focuses on enhancing the flexural strength and fracture toughness of zirconium diboride (ZrB_2) reinforced with silicon carbide (SiC) and carbon nanotubes (CNT). The flexural strength has shown to increase by ~1.2 times from 322.8 MPa (for ZrB_2) to 390.7 MPa and fracture toughness up to 3 times from 3.2 MPam$^{0.5}$ (for ZrB_2) to 9.5 MPam$^{0.5}$ with the synergistic addition of both SiC and CNT in ZrB_2 matrix through energy dissipating mechanisms such as deflection, branching and strong interfacial bonding evidenced from the transmission electron microscopy (TEM). A modified fractal model is used to evaluate the fracture toughness and delineate the contribution of residual stresses, and reinforcements (SiC and CNT) in enhancing the fracture toughness. Interfacial bonding in terms of a debonding factor was also evaluated by theoretically predicting the elastic modulus and then correlated microstructurally along with the mechanical properties of ZrB_2-SiC-CNT composites.

Keywords: Ultra-high temperature ceramic (UHTC); electron microscopy; four-point bending; fracture toughness; interfaces.

1. Introduction:

The insatiable demand for the development of hypersonic re-entry vehicle-structure thermal protection system mandate the usage of ultra-high temperature ceramic (UHTC) [1, 2] for hostile environmental conditions [3-6]. Zirconium diboride (ZrB_2), a potential UHTC has a