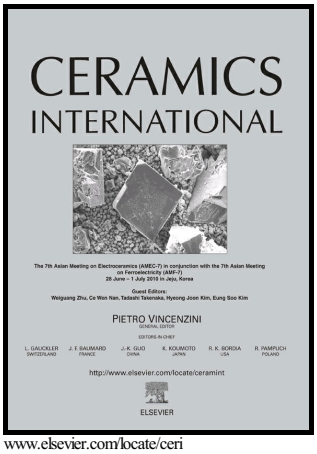

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Yufei Zu, Jianjun Sha, Jian Li, Zhaofu Zhang, Shouhao Wang, Zhaozhao Lv, Jixiang Dai

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Yufei Zu, Jianjun Sha*, Jian Li, Zhaofu Zhang, Shouhao Wang, Zhaozhao Lv, Jixiang Dai

State Key Lab. of Structural Analyses for Industrial Equipment, Dalian University of Technology, 116024 Dalian, China.

*Corresponding author: Tel./Fax: +86 411 8470 9004. jjsha@dlut.edu.cn

Abstract

Multi-walled carbon nanotubes (MWCNTs) were used to optimize the microstructure and improve the fracture properties of hot-pressed carbon fiber-reinforced ZrB_2-based ultra-high temperature ceramic composites. Microstructure analysis indicated that the introduction of MWCNTs effectively reduced the carbon fiber degradation and prevented fiber-matrix interfacial reaction during processing. Due to the presence of MWCNTs, the matrix contained fine ZrB_2 grains and in-situ formed nano-sized SiC/ZrC grains. The fracture properties were evaluated using the single edge-notched beam (SENB) test. The fracture toughness and work of fracture of the C_f/ZrB_2-based composite with MWCNTs were 7.0±0.4 MPa·$m^{1/2}$ and 379±34 J/m^2, respectively, representing increases of 59 % and 87% compared to those without MWCNTs. The excellent fracture properties are attributed to the moderate interfacial bonding between the fibers and matrix, which favour the toughening mechanisms, such as fiber bridging, fiber pull-out and crack deflection at interfaces.

Keywords: UHTCs; ZrB_2-based composite; fiber-reinforced composite; carbon nanotubes; fracture properties; toughening mechanism