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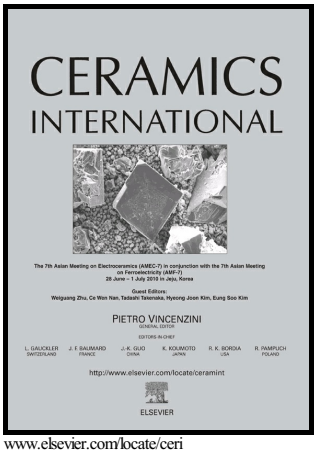

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The effect of TiO_2 additive on sinterability and properties of SiC-Al_2O_3-Y_2O_3 composite system

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Abstract

In the current research, the effects of TiO_2 additive on mechanical and physical properties of SiC bodies, sintered by liquid phase methods were investigated. Al_2O_3 and Y_2O_3 were used as sintering-aids (10 wt. % in total) with an Al_2O_3/Y_2O_3 ratio of 43/57 to provide liquid phase during Sintering. TiO_2 was also used as the oxide additive with an amount ranging from 0 to 10 wt. %. After scaling and mixing the starting materials by a planetary mill, the obtained slurry was dried at 100 ℃ for four hours. The derived powders were finally pressed under a pressure of 90 MPa. The samples were then pyrolyzed and sintered at 600 ℃ and 1900 ℃, respectively under argon atmosphere for 1.5 hours. Phase analysis showed no trace of TiO_2 after the sintering process, demonstrating the complete TiO_2 to TiC transformation. The results showed that an increase in TiO_2 content up to 5 wt. %, led an improvement in all the measured properties including the relative density, hardness, Young's modulus, bending strength, indentation fracture resistance and the brittleness factor, reaching to 96.2%, 24.4 GPa, 395.8 GPa, 521 MPa, 5.8 $MPa.m^{1/2}$ and 286.5 $\times 10^{-6}$ m^{-1}, respectively. However more than 5 wt. % additive resulted in a decrease in all the above-mentioned properties. Microstructural studies demonstrated that crack deflection and crack bridging were the major mechanisms responsible for an increase in the indentation fracture resistance.

Keywords: SiC-TiC composite; TiO_2 additive; Bending strength; Indentation fracture resistance; Hardness.

I. Introduction

Silicon carbide (SiC) is an important structural material. This material has found a wide range of applications including wear-resistant parts, refractories, electronic equipment, high-