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Process-tolerant pressureless-sintered silicon carbide ceramics with alumina-yttria-calcia-strontia

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Abstract

Process-tolerant SiC ceramics were prepared by pressureless sintering at 1850-1950°C for 2 h in an argon atmosphere with a new quaternary additive (Al_2O_3-Y_2O_3-CaO-SrO). The SiC ceramics can be sintered to a >94% theoretical density at 1800-1950°C by pressureless sintering. Toughened microstructures consisting of relatively large platelet grains and small equiaxed grains were obtained when SiC ceramics were sintered at 1850-1950°C. The presently fabricated SiC ceramics showed little variability of the microstructure and mechanical properties with sintering within the temperature range of 1850-1950°C, demonstrating process-tolerant behavior. The thermal conductivity of the SiC ceramics increased with increasing sintering temperature from 1800°C to 1900°C due to decreases of the lattice oxygen content of the SiC grains and residual porosity. The flexural strength, fracture toughness, and thermal conductivity of the SiC ceramics sintered at 1850-1950°C were in the ranges of 444-457 MPa, 4.9-5.0 $MPa \cdot m^{1/2}$, and 76-82 $Wm^{-1}K^{-1}$, respectively.

Keywords: Silicon carbide; Mechanical properties; Thermal conductivity; Microstructure; Process-tolerant behavior

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1. Introduction

The market for advanced ceramics is continuously growing due to their excellent performance, multifunctional properties, and high energy efficiency [1]. However, the lower yields for ceramics than for those of other materials such as metals and polymers could be a