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Microstructure and Mechanical Properties of SiC-Si₃N₄ Composites Containing β -Si₃N₄ Seeds

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The effect of β -Si₃N₄ seeds on microstructure and mechanical properties of the hot-pressed SiC-Si₃N₄ composites with an oxynitride glass as a sintering additive were investigated. A microstructure that consisted of uniformly distributed, elongated β -Si₃N₄ grains, equiaxed β -SiC grains and an amorphous grain-boundary phase was developed. The mechanical properties of SiC-Si₃N₄ composites increased with increasing the β -Si₃N₄ seeds content, owing to the reduced defect size and enhanced bridging and crack deflection by elongated β -Si₃N₄ grains. The flexural strength and fracture toughness of SiC-70 wt% Si₃N₄ composites were 770 MPa and 62 MPa·m^{1/2}, respectively.

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Flaw-Tolerance and R-Curve Behavior of SiC-30 wt% TiC Composites

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Flaw tolerance and R-curves for SiC-30 wt% TiC composites and monolithic SiC ceramics were characterized using indentation-strength method. Both materials exhibited rising R-curve behavior. However, SiC-30 wt% TiC composites with 62 MPa·m^{1/2} toughness exhibited better flaw tolerance and more sharply rising R-curve behavior than monolithic SiC ceramics with 5.3 MPa·m^{1/2} toughness. Total volume fractions of SiC key grain, which take part in toughening mechanisms such as crack bridging and crack deflection, were 0.607 for monolithic SiC ceramics and 0.614 for SiC-30 wt% TiC composites. Thus, superior performance of SiC-TiC composites was attributed to the additional contribution by TiC grains.