

Effect of Boron Nitride Nanotube Addition on ZrB₂-SiC Composites Fabricated by Spark Plasma Sintering-Reaction Synthesis

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This study presents a novel approach for fabricating boron nitride nanotube (BNNT)-reinforced ZrB₂-SiC composites with enhanced fracture toughness using spark plasma sintering-reaction synthesis (SPS-RS). Unlike conventional methods employing commercially synthesized SiC powder, we utilized ZrB₂, Si, and C powders to induce in-situ SiC formation during sintering. This approach enables densification at significantly lower temperatures, thereby preserving the structural integrity of thermally vulnerable BNNTs. The study elucidates the effects of BNNT addition on the microstructure and mechanical properties, particularly the correlation between BNNT structural survival and toughness enhancement. By lowering the processing temperature through reaction synthesis, matrix densification was achieved while maintaining BNNT integrity. Flexural strength reached its maximum at 3 wt% BNNT, showing a 35.7% improvement over BNNT-free specimens due to efficient load transfer. Fracture toughness increased with BNNT content, reaching 7.87 MPa·m^{0.5} at 5 wt%, a 92.4% improvement attributed to energy absorption along crack paths. The SPS-RS process effectively enables composite densification while minimizing BNNT thermal damage. The addition of 3–5 wt% BNNTs compensates for the inherent brittleness, enabling simultaneous strength and toughness improvements, thus suggesting promising applicability for aerospace and ultra-high temperature components.

Professional Status of the Speaker

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