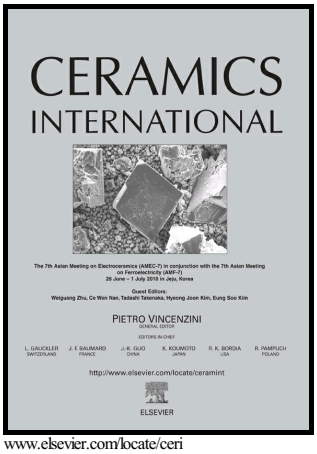

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SPARK PLASMA SINTERING OF GRAPHENE REINFORCED SILICON CARBIDE CERAMICS

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Abstract

Silicon carbide (SiC) ceramics have superior properties in terms of wear, corrosion, oxidation, thermal shock resistance and high temperature mechanical behavior, as well. However, they can be sintered with difficulties and have poor fracture toughness, which hinder their widespread industrial applications. In this work, SiC-based ceramics mixed with 1 wt% and 3 wt% multilayer graphene (MLG), respectively, were fabricated by solid-state spark plasma sintering (SPS) at different temperatures. We report the processing of MLG/SiC composites, study their microstructure and mechanical properties and demonstrate the influence of MLG loading on the microstructure of sintered bodies. It was found that MLG improved the mechanical properties of SiC-based composites due to formation of special microstructure. Some toughening mechanism due to MLG pull-out and crack bridging of particles was also observed. Addition of 3 wt% MLG to SiC matrix increased the Vickers hardness and Young's modulus of composite, even at a sintering temperature of 1700°C. Furthermore, the fracture toughness increased by 20% for the 1 wt% MLG-containing composite as compared to the monolithic SiC selected for reference material. We demonstrated that the evolved 4H-SiC grains, as well as the strong interactions among the grains in the porous free matrices played an important role in the mechanical properties of sintered composite ceramics.

Keywords: spark plasma sintering (SPS), SiC, multilayer graphene (MLG), mechanical properties