Joining of CVD β-SiC and SiC_f/SiC ceramics to themselves using in-situ formed SiC-ZrC interlayer

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ABSTRACT

In this work, CVD β-SiC and SiC_f/SiC ceramics were joined to themselves with in-situ formed SiC-ZrC ceramic composite interlayer and the mechanical properties of the joints were investigated. The $ZrSi_2$ alloy and $ZrSi_2$-C powders mixture were applied as an interlayer on the joining surfaces of the materials in the form of a slurry. Afterward, the pressure-assisted joining was performed via field-assisted sintering technology at different temperatures (1400 – 1650°C). The joints with pure $ZrSi_2$ alloy showed a non-homologous interlayer, consisting of both ZrC and remaining $ZrSi_2$. In addition, a significant reaction with SiC substrate was observed, leading to the dissolution of SiC and infiltration of the filler into the base materials. When $ZrSi_2$-C interlayer was used, the uniform SiC-ZrC composite interlayer was formed by in-situ reactions between $ZrSi_2$, C, and SiC-based ceramics. The strength of the CVD β-SiC joints was investigated using 4-point flexural test, while the mechanical performance of SiC_f/SiC joints was determined using shear strength measurements. The strength of the joints was significantly improved with the increasing joining temperature and reached the initial strength of the reference, un-joined CVD β-SiC and/or SiC_f/SiC materials.

Keywords: Joining, SiCf/SiC, ceramic matrix composites, CVD-SiC, high-temperature ceramics