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Fabrication and characterization of carbon fiber reinforced SiC ceramic matrix composites based on 3D printing technology

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Abstract

A novel method has been developed to fabricate carbon fiber reinforced SiC (C_f/SiC) composites by combining 3D printing and liquid silicon infiltration. Green parts are firstly fabricated through 3D printing from a starting phenolic resin coated carbon fiber composite powder; then the green parts are subjected to vacuum resin infiltration and pyrolysis successively to generate C_f/C preforms; finally, the C_f/C preforms are then infiltrated with liquid silicon to obtain C_f/SiC composites. The 3D printing processing parameters show significant effects on the physical properties of green parts and also resultant C_f/C preforms, consequently greatly affecting the microstructures and mechanical performances of the final C_f/SiC composites. The overall linear shrinkage of the C_f/SiC composites is less than 3%, and the maximum density, flexural strength and fracture toughness are 2.83±0.03 g/cm³, 249±17.0 MPa and 3.48±0.24 MPa m^{1/2}, respectively. It demonstrates the capability of making near net-shape C_f/SiC composite parts with complex structures.

Keywords: Ceramic-matrix composites (CMCs); Mechanical properties;

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