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PII: S0955-2219(18)30384-4
DOI: https://doi.org/10.1016/j.jeurceramsoc.2018.06.022
Reference: JECS 11943

To appear in: *Journal of the European Ceramic Society*

Received date: 13-12-2017
Revised date: 2-6-2018
Accepted date: 9-6-2018

Please cite this article as: Zhu W, Fu H, Xu Z, Liu R, Jiang P, Shao X, Shi Y, Yan C, Fabrication and characterization of carbon fiber reinforced SiC ceramic matrix composites based on 3D printing technology, *Journal of the European Ceramic Society* (2018), https://doi.org/10.1016/j.jeurceramsoc.2018.06.022

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/cm^3, 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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