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CAPILLARY INFILTRATION BEHAVIOR OF C/C-PREFORMS FOR PRODUCTION OF C/C-SIC COMPOSITES VIA LSI

Abstract

Liquid silicon infiltration (LSI) processing has been widely applied for the manufacture of carbon/carbon-silicon carbide (C/C-SiC) composites due to its advantages as an efficient, as well as low-cost process. Silicon infiltration based on capillary force in porous carbon/carbon (C/C) preforms is the key to fabricate liquid silicon infiltration based C/C-SiC composites. However, the infiltration process in C/C-preforms is very difficult to observe because of high melting temperature (>1693K) of silicon in vacuum conditions. This study investigated capillary infiltration behavior of C/C-preforms by water and subsequently validated using liquid silicon infiltration. The depth of the C/C plate in water was about 5mm. The mass change of C/C-preforms was determined every certain time for a duration of 3600s. At the same time, capillary infiltration height was observed by applying thermal camera. These C/C-preforms were further infiltrated by liquid silicon at 1873K under vacuum and to form C/C-SiC composites. Within an initial stage, capillary infiltration mass of C/C preforms for water increases rapidly, followed by a slow stage, whereas thermal imaging indicates that water has reached the entire C/C preforms at initial stage. A model was proposed to explain these results. Infiltration mass varies linearly with capillary height rise at the initial stage. This topic is further studied in combination with LSI results to understand the capillary infiltration behavior. It indicates that the study of the capillary behavior of C/C performs using wetting solvent instead of liquid silicon is a feasible approach.