无机材料学报 2006 21 (5): 1179-1184 ISSN: 1000-324X CN: 31-1363/TQ

C/SiC复合材料等温化学气相浸渗过程的数值模拟研究

魏玺, 成来飞, 张立同, 徐永东

西北工业大学超高温结构复合材料国防科技重点实验室, 西安 710072

收稿日期 2005-9-2 修回日期 2005-11-10 网络版发布日期 接受日期

摘要 根据C/SiC复合材料的结构以及等温化学气相浸渗法的工艺特点, 建立了ICVI过程中C纤维预制体结构变化的多尺度孔隙模型和C/SiC复合材料ICVI致密化过程的数学模型. 利用该模型对ICVI法制备C/SiC复合材料进行了数值计算和分析. 模拟结果与实验结果呈现出相同的规律并且两者之间误差较小, 表明本文所建立的模型可以很好地描述C/SiC复合材料的ICVI致密化过程. 利用该模型计算出C/SiC复合材料孔隙率的分布情况以及总体孔隙率在浸渗过程中的演化规律, 对ICVI工艺的优化具有一定的指导意义.

关键词 C/SiC复合材料 等温化学气相浸渗 数值模拟 多尺度孔隙模型

分类号 TB323

Numerical Simulation of Isothermal Chemical Vapor Infiltration Process for Fabrication of C/SiC Composites

WEI Xi, CHENG Lai-Fei, ZHANG Li-Tong, XU Yong-Dong

National Key Laboratory of Thermostructural Composite Materials, Northwestern Polytechnical University, Xi'an 710072, China

Abstract The multi-scale porosity model depicting infiltration induced changes of carbon fiber preform and the mathematical model depicting ICVI process for fabrication of C/SiC composites were developed. The integrated model was proposed to simulate densification behavior of C/SiC composites. The correspondences of calculation results and the experimental data indicate that the model is reasonable and feasible to characterize ICVI process of C/SiC composites. The calculated results, such as distribution of local porosity, uniformity of densification and evolution of global porosity during infiltration process, lay foundation of further research and optimization of ICVI process for fabrication of C/SiC composites.

Key words C/SiC composites isothermal chemical vapor infiltration numerical simulation multi-scale porosity modelend

DOI:

通讯作者 魏玺 libra_wei@163.com