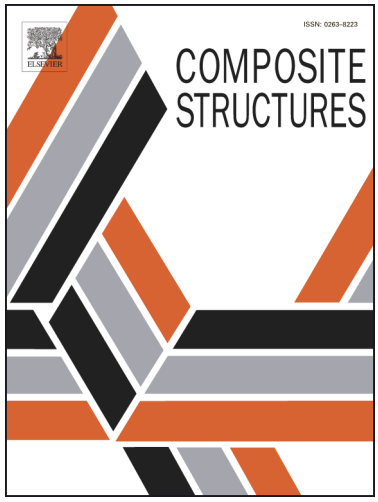

Numerical and experimental studies on scattered mechanical properties for 3D needled C/C-SiC composites

Junbo Xie, Guodong Fang, Zhen Chen, Jun Liang

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Numerical and experimental studies on scattered mechanical properties for 3D needled C/C-SiC composites

Junbo XIE[a,b] , Guodong FANG[b,*] , Zhen CHEN[b], Jun LIANG[c,*]

[a] Key Laboratory of Advanced Textile Composite Materials of Ministry of Education, Institute of Composite Materials, Tianjin Polytechnic University, Tianjin 300387, China

[b] Science and Technology on Advanced Composites in Special Environments Key Laboratory, Harbin Institute of Technology, Harbin 150080, China

[c] Institute of Advanced Structure Technology, Beijing Institute of Technology, Beijing 100081, China

Abstract: 3D needled C/C-SiC composites show scattered mechanical properties in the experimental tests due to the random needling region distributions in the composites and the variability of microstructures at the needling regions. A specified methodology is developed to predict the scattered mechanical properties of the composites. Meso-scale models of the test specimens are established, in which the random distribution of needling regions and the uncertain properties of needling regions are considered. The predicted coefficients of variation for initial modulus, strength and failure strains of the composite agree well with the experimental results. Size effect of the test specimens on the experimental results is well analyzed by the proposed method. The influence of needling density, depth and distribution on the uncertainty of composite properties are also obtained. The methodology introduced by this work would guide the design of the proper specimen size and manufacturing needled materials with lower scattered mechanical properties.

Keywords： Needled composites; Scattered mechanical properties; Meso-scale model; Finite element method

1. Introduction

Three dimensional needle-punching (or 3D needling) technology [1-6] has been used to produce 3D fiber reinforcements, in which the in-plane fibers of the fabric plies can be transferred to the thickness direction by needling process to enhance the delamination resistance. 3D needling technology is attracting growing interest due to its simple process and low cost. Compared with the traditional 3D preform forming

* corresponding email: fanggd@hit.edu.cn (GD Fang), liangjun@bit.edu.cn (J Liang)