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考虑孔隙的针刺C/SiC复合材料弹性参数计算

Calculation of needled C/SiC composite elastic parameters in consideration of the porosity

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作者	单位
李龙	南京航空航天大学能源与动力学院机械结构力学及控制国家重点实验室, 南京 210016
高希光	南京航空航天大学能源与动力学院机械结构力学及控制国家重点实验室, 南京 210016
史剑	南京航空航天大学能源与动力学院机械结构力学及控制国家重点实验室, 南京 210016
宋迎东	南京航空航天大学能源与动力学院机械结构力学及控制国家重点实验室, 南京 210016

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中文摘要:

基于针刺陶瓷基复合材料试件(CMCs)光学显微照片的微观型貌,并选择恰当的代表体积单元(RVE),建立了针刺陶瓷基复合材料弹性性能预测的单胞模型.考虑了孔隙率对基体和纤维束弹性性能的影响,采用混合率计算出纤维束的弹性常数,然后将纤维束和基体的弹性参数代入到单胞模型中,通过有限元法计算得到复合材料的整体弹性常数.开展了材料拉伸试验和孔隙率测定试验,测得材料的开孔孔隙率为7.33%,闭孔孔隙率为10.67%,弹性性能的计算结果与试验吻合较好,误差为3.1%.

英文摘要:

Based upon the microphotographs of the needled ceramic matrix composites(CMCs),appropriate representative volume elements(RVE) were selected to establish a single-cell model for predicting the elastic properties of needled ceramic matrix composites.The effect of porosities on the elastic properties of matrix and fiber bundles was considered,and the elastic constants of fiber bundles were calculated by mixed rate,then elastic constants of fiber bundles and matrix were taken into the single-cell model.The elastic properties of needled ceramic matrix composites were calculated by the finite element method(FEM) at last.At the same time,the tests for tensile strength and determination of porosities were carried.Through the experiment,the materials' open porosity of 7.33% and closed-cell porosity of 10.67% were acquired.Numerical results of the elastic properties obtained by the proposed method agree well with the experimental results,and the error is 3.1%.

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