基于有限元法的平纹编织C/SiC复合材料等效导热系数预测方法

Prediction method on equivalent thermal conductivity coefficient of plain braided C/SiC composites material based on finite element method

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中文摘要：
　　提出了一种采用有限元法计算平纹编织C/SiC复合材料等效导热系数的方法. 首先研究了材料的细观结构，根据材料显微照片建立了带基体碳纤维束复合材料的单胞模型，采用基体中孔隙分布随机生成的单胞模型，计算了孔隙率对基体等效导热系数的影响，通过施加3组边界条件计算出带基体碳纤维束和复合材料的等效导热系数.最后应用提出的方法计算分析了碳纤维体积分数和孔隙率对复合材料等效导热系数的影响规律.结果显示：复合材料等效导热系数随碳纤维体积分数增大而线性下降，碳纤维体积分数从54%增加到78%的过程中，复合材料y轴方向的等效导热系数下降了12.8%，x与z轴方向的等效导热系数同时下降了8.6%；复合材料等效导热系数随孔隙率增大呈加速下降趋势，孔隙率从0增加到30%的过程中，材料的x与z轴方向的等效导热系数下降了22.91%，y轴方向的等效导热系数下降了34.66%.

英文摘要：
A computing method on equivalent thermal conductivity of plain braided C/SiC composites material was proposed based on finite element method. Mesoscopic structure of materials was studied firstly, including microscopic model of carbon fiber bundles with matrix and single-cell model. Effects of porosity on the matrix equivalent thermal conductivity coefficient were calculated using random-pore single-cell model. The equivalent thermal conductivity coefficient of carbon fiber bundles with matrix and composites material was calculated under the condition of three sets of boundary conditions. Finally with the proposed method, the relationship between equivalent thermal conductivity coefficient and fiber volume fraction/porosity was studied in detail. The results indicate that the equivalent thermal conductivity coefficient of the composites material decreases linearly with the increase of fiber volume fraction. While fiber volume fraction increases from 54% to 78%, the equivalent thermal conductivity coefficient in y axis direction declines by 12.8% and that in x and z axis directions by 8.6%. The equivalent thermal conductivity coefficient of the composites material presents an accelerating downward trend during the porosity's rising process. While the porosity increases from 0% to 30%, the equivalent thermal conductivity coefficient declines by 22.91% in x and z axis directions and 34.66% in y axis direction.

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