复合材料学报 2010, 27(1) 167-172 DOI: ISSN: 1000-3851 CN: 11-1801/TB

论文

含界面相的单向纤维增强复合材料三维应力场的二重双尺度方法

(哈尔滨工业大学 复合材料与结构研究所, 哈尔滨 150080)

摘要：

提出了计算含界面相的单向纤维增强复合材料三维应力的二重双尺度方法。在性能预报方面，首先对界面相和纤维进行均匀化得到均匀化夹杂，然后对均匀化夹杂和基体进行均匀化得到宏观均匀材料；在应力场描述方面，从宏观均匀场出发，利用双尺度渐近展开技术经过两次应力场传递，依次得到单胞和应力集中区域的应力场。与有限元方法相结合，计算了宏观轴向均匀拉伸载荷条件下含界面相的单向纤维增强复合材料的三维应力场分布。数值结果表明在此载荷条件下最大应力发生在每根纤维的中截面内，靠近纤维与界面相的交界处。讨论了界面相性能对应力场分布的影响，结果显示纤维、界面相与基体力学性能的等差过渡有利于缓解纤维在界面附近的应力集中。

关键词： 二重双尺度方法 三维应力场 界面相 单向纤维增强复合材料 宏观性能 有限元方法

Dual two-scale method for 3D stress computation of unidirectional-fibre reinforced composites considering interphase

(Centre for Composite Materials and Structures, Harbin Institute of Technology, Harbin 150080, China)

Abstract:

A dual two-scale method was presented for computing 3D st ress fields of unidirectional-fibre reinforced composites considering the interphase. In the prediction of properties, the homogenized inclusion was obtained by homogenizing the fibre and the interphase, and the macroscopic homogenized material was obtained by homogenizing the homogenized inclusion and the matrix. In the characterization of 3D stress fields, by twice stress transmissions, the stress fields of the unit cell and the stress concent ration area were obtained in turn by the two-scale asymptotic technique. Combining with the finite element method, the 3D stress fields of the proposed composites, which are under the macroscopic axial uniform tensile load, were computed by the dual two-cale method. The numerical results show that the maximum stress occurs within the region which is in the middle section of each fibre and close to the border between fibre and interphase. The influence of different interphases on the distributions of stress fields was also discussed. The results show that arithmetical transition of the properties of fibre, interphase and matrix is beneficial to releasing stress concent ration.

Keywords: dual two-scale method 3D stress fields interphase unidirectional-fibre reinforced composites macroscopic properties finite element method (FEM)

收稿日期 2008-12-19 修回日期 2009-04-01 网络版发布日期

DOI:

基金项目:

通讯作者: 梁 军，教授，博士生导师，研究方向: 三维编织复合材料性能预报与失效分析，防热复合材料性能表征与评价

作者简介:

作者Email: liangj@hit. edu. cn

参考文献：

本刊中的类似文章

1. 陈富利, 蒋持平.含非均匀界面相纤维增强复合材料热传导性能预测的递推公式[J]. 复合材料学报, 2009,26(4): 151-155
2. 罗吉祥,唐春,郭然.纤维增强复合材料界面脱层和基体裂纹的模拟分析[J]. 复合材料学报, 2009,26(6): 201-209

3．郭素娟, 康国政, 阚前华.颗粒形状对复合材料单轴棘轮行为及其细观塑性变形特征的影响[J]. 复合材料学报, 2008,25(1): 153-160

文章评论

反馈人		邮箱地址	
反馈标题		验证码	5564
反馈内			