论文

具有细观结构新材料跨尺度分析的细观元法

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摘要：

建议一种适用于具有细观结构新材料宏细观间跨尺度分析的细观元方法.细观元法 在结构的常规有限元内部设置密集细观单元以反映材料细观构造, 又通过协调条件 将各细观元结点自由度转换为同一常规有限元自由度, 再上机计算. 此方法可实现 材料细观结构到构件宏观响应的直接过渡分析,而计算单元与自由度又等同一般常 规有限元,为解决具有细观结构新材料与构件跨尺度分析提供一种新的有力工具.研究了直接从制备时给定的材料组分分布及网状细观结构图形出发计算功能梯度板件宏观响应,给出了不同边界条件功能梯度板件的力学量三维分布形态以及细观结构局部突变引起宏观等应力线图的畸变.

关键词： 细观结构, 跨尺度分析, 细观元法, 组分, 网状结构

MICROELEMENT METHOD FOR SCALE-SPAN ANALYSES OF MATERIALS WITH MICROSTRUCTURE

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Abstract:

A microelement method for the scale-span analyses of new materials with microstructure was suggested. In order to reflect micro-constitution of materials, the microelement method set up the dense microelements in the normal finite element of structure, and translated the degrees of freedom of every microelement node into ones of the same normal finite element by the compatibility conditions, which will be calculated by computer. This microelement method can fully realize the transition from material microstructure to macro-response of structure, and its computational elements and degrees of freedom are same as the normal finite element method. Therefore, this method is an effective means for the scale-span analyses of materials and structures with microstructure. The macro-responses of functionally graded plates can be immediately
calculated by the material component distribution determined in the process of material production or the net-shaped microstructure figure. The 3-D distributions of mechanical quantities of functionally graded plates under different boundary conditions and the macro-response distribution distortions due to local variations of microstructure are given in the paper.

Keywords: material with microstructure, scale-span analysis, microelement method, component, net-shaped structure

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