

题目： 新型边界元法分析层状和梯度材料中的裂纹问题

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摘要： 在过去 20 多年里，我们发展了层状材料基本解的新型边界元方法来分析层状和梯度材料的断裂力学问题。采用位移边界元法分析裂纹时，引入面力奇异单元捕获裂纹尖端应力的奇异性。采用对偶边界元法时，引入不连续单元捕获裂纹尖端的奇异性。解决了各类奇异积分的精确计算问题。采用沿材料梯度方向分层的方法逼近梯度材料力学参数的变化。采用建议方法分析了层状和梯度材料中不同类型三维裂纹。获得层状和梯度材料力学和几何参数对裂纹应力强度因子和裂纹扩展的影响。计算结果有助于深入了解层状和梯度材料断裂力学特性。

New Boundary Element Methods for Analyzing the Fracture Mechanics of Layered and Graded Materials

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Abstract: In the past more than twenty years, we developed the new boundary element methods (BEM) using the fundamental solutions of layered materials. In applying the displacement BEMs, the traction singular element was applied to capture the behavior around the crack tip. In applying the dual BEMs, the discontinuous elements are used to capture the behavior of the crack tip. In the BEM formulations, various singular integrals were successfully calculated. The discretized method along depth was applied to approximate the variations of the parameters of graded materials. The proposed methods were used to analyze the three dimensional crack problems in layered and graded materials. The influence of the mechanical and geometric parameters on the stress intensity factors and crack growth was obtained. These results are much useful for understanding the fracture properties of layered and graded materials.