

综述评论

金属材料疲劳损伤的宏微观理论

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摘要 工程结构的疲劳损伤发展过程经历了由初始缺陷的形成、裂纹的稳态扩展直到最后失效的不同发展阶段, 通常疲劳损伤的演化可以概括为以下几个阶段: (1) 亚结构和微观结构的变化引起永久损伤的形成, 产生微观裂纹; (2) 微观缺陷的长大会合形成主裂纹; (3) 主裂纹稳态扩展; (4) 结构失稳或完全失效. 首先论述了疲劳裂纹扩展的物理机制, 并从细观和宏观两个方面总结了处理疲劳裂纹问题的最新研究成果, 对位错力学在处理短裂纹扩展问题中的应用, 以及无位错区 (DFZ) 在疲劳裂纹扩展中的作用进行了较详细讨论.

关键词 [损伤](#) [疲劳裂纹](#) [裂纹扩展](#) [疲劳寿命](#) [短裂纹](#)

分类号

MICROSCOPIC AND MACROSCOPIC THEORY OF THE FATIGUE DAMAGE OF METAL

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Abstract

There are different stages of the fatigue damage in an engineering component where defects may nucleate in an initially undamaged section and propagate in a stable manner until catastrophic fracture ensues. For this most general situation, the progression of the fatigue damage can be broadly classified into the following stages: (1) substructural and microstructural changes which cause the nucleation of permanent damage, and the creation of microscopic cracks; (2) the growth and coalescence of microscopic flaws to form 'dominant' cracks; (3) stable propagation of the dominant macrocrack; (4) structural instability or complete fracture. A review of the microscopic and macroscopic theory of the fatigue damage of metal is given in the present paper. The mechanism of the evolution of the fatigue damage is discussed firstly, and the recent advances of the research of the fatigue damage are then presented. Emphasis is given on the application of dislocation mechanics to evaluating the propagation of the fatigue cracks, and the role of dislocation-free zone in the process of the fatigue crack propagation.

Key words [damage](#) [fatigue crack](#) [crack propagation](#) [fatigue life](#) [short crack](#)

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