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金属疲劳裂纹初期扩展的特征及其影响因素

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STUDY ON CHARACTERISTICS OF FATIGUE CRACK PROPAGATION AT NEARTHRESHOLD RANGE AND ITS AFFECTING FACTORS

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摘要 本文回顾了各种金属及合金在门坎区附近的疲劳裂纹扩展的机制和特征。 根据一系列试样和结构的微观断口金相分析的结果表明,在近门坎区产生的占主导的断口形态是小平面或河流花样。对于不同金属与合金小平面的方位与晶体点阵结构的相互关系,用滑移型和层错能进行描述。 本文对于板状及缺口试样的疲劳极限和门坎值的相互关系以及短裂纹的疲劳裂纹扩展机制也一起进行了评述,短裂纹的裂纹扩展行为可以一般地表达为: $\Delta K_{th}=f(a)\Delta\sigma_{th}(na)^{1/2}$式中,f（a）为裂纹长度与试样几何形状的函数。 文中回顾了应力比、显微组织、环境对在门坎区附近疲劳裂纹扩展行为的影响,曾提出产生裂纹闭合效应的“氧化物诱发”及“粗糙度诱发”的概念,可以用来解释结构材料中上述因素对在近门坎区疲劳裂纹扩展行为的影响。

关键词：

Abstract： This paper presents a review of the characteristics and mechanisms of fatigue crack propagation（FCP）at near-threshold range in various metals and alloys.Experimental results from a series of microfractographic analysis of specimens and structures indicated that a type of crystallographic fracture,facets or river patterns,occurs predominantly at near-threshold range.A correlation of the orientation of facets for different metals and alloys with lattice structures,SFS and modes of slip was described.In this paper,the relation between the fatigue limits of plain-and notched-specimens and fatigue thresholds together with the mechanism of FCP behaviors in short cracks was evaluated.The crack propagation behaviors in short cracks can be generally expressed as,where f（a）is a function of the crack length and specimen geometry.The influence of stress ratio,microstructure and environment on fatigue crack propagation behaviors at near-threshold range was also reviewed.It is suggested that the concept of "oxide-induced" and "roughness-induced" crack closure may be useful for explaining the effect of the above mentioned factors on FCP behaviors at near-threshold level in structural materials.

Keywords：

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