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研究报告

微/纳米力学技术对金属空泡腐蚀表层力学性质的定量表征

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摘要： 采用微/纳米力学测试技术，在研究奥氏体不锈钢空泡腐蚀规律的基础上，对奥氏体不锈钢受到空化作用后其金属表层的纵向截面微米硬度和腐蚀表层的纳米力学性能进行定量表征，研究奥氏体不锈钢腐蚀表层力学性能参数及其空间分布，并初步探讨腐蚀表层力学性质劣化与金属空泡腐蚀间的关系。结果表明，奥氏体不锈钢在空泡腐蚀过程中，表层中由硬度较小的腐蚀表层、硬度较大的硬化层和机体层构成。在空化作用下，因空化与介质腐蚀交互作用引起奥氏体不锈钢空泡腐蚀表层力学性质劣化，使得奥氏体不锈钢发生严重腐蚀，并存在空泡腐蚀表层力学性质劣化的阈值。其中，奥氏体不锈钢的空泡腐蚀表层纳米硬度起主要作用。无量纲函数--空泡腐蚀表层纳米硬度与弹性模量之比, 可用于描述金属空泡腐蚀表层力学性质劣化程度，并可与金属空泡腐蚀评价深度相关联。

关键词： 微纳米力学测试技术 纳米硬度与弹性模量 空泡腐蚀 腐蚀表层 空化作用 力学性质劣化

QUANTITATIVE DETERMINATION OF MECHANICAL PROPERTIES FOR CAVITATION CORROSION SURFACE LAYER OF METAL BY MICRO/NANO MECHANICS MEASUREMENT TECHNOLOGY

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Abstract: The microhardness of the cross section of metal surface layer and the nano-mechanical properties of cavitation corrosion surface layer for austenitic stainless steel after cavitation corrosion test were quantitatively determined by micro/nano mechanics measurement technology on the base of researches on the cavitation corrosion of austenitic stainless steel. The nano-mechanical parameters of cavitation corrosion surface layer and their changes with displacement into surface including in the relation between the degradation of nano-mechanical properties of cavitation corrosion surface layer and cavitation corrosion were studied. It was found that the surface layer of austenitic stainless steel was composed of cavitation corrosion surface layer with smaller hardness, hardening layer with higher hardness and metal substrate under cavitation corrosion. The degradation of nano-mechanical properties for cavitation corrosion surface layer was induced by the interaction between cavitation and corrosion of media，resulting in serious cavitation corrosion of austenitic stainless steel. There was a critical value for the degradation of nano-mechanical properties of cavitation corrosion surface layer, below which austenitic stainless steel was seriously subjected to cavitation corrosion. And that nanohardness played a dominating role during cavitation corrosion of austenitic stainless steel. The ratio of nano-hardness to nano- elastic modulus (*H/E*) of cavitation corrosion surface layer is a dimensionless function, which can be used for comprehensively measuring degradation degree of cavitation corrosion surface layer of metal and for studying the relation between the degradation of nano-mechanical properties of cavitation corrosion surface layer and the mean depth of cavitation corrosion penetration of metals.

Keywords: micro/nano mechanics measurement technology nanohardness and elastic modulus cavitation corrosion corrosion surface layer mechanical property degradation

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