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FH550级海洋平台用钢冲击断裂行为实验研究

周砚磊, 徐洋, 陈俊, 刘振宇

东北大学轧制技术及连轧自动化国家重点实验室, 沈阳 110819

摘要: 通过热模拟、拉伸和低温冲击实验, 采用SEM, TEM, EDS和EBSD等手段研究了FH550海洋平台用钢的低温断裂行为。结果表明, 轧态实验钢为下贝氏体和粒状贝氏体的混合组织, 回火后为回火贝氏体组织; 冲击断口多为韧窝断口, 部分等轴韧窝底部有含Ca和Al的氧化物夹杂, 个别试样呈现准解理断裂, 存在尺寸大于10 μm 的含Fe, Mn的碳化物夹杂, 恶化韧性, 导致冲击吸收功波动; 断裂过程中裂纹扩展的主要方式为微孔聚合长大并与裂纹颈缩连结生长, 同时存在的剪切扩展裂纹易受到由于塑性变形而聚集成团的富C硬相的阻碍, 从而增加了裂纹扩展功。79.3%的大角度晶界比例以及7.61 μm 的细小晶粒尺寸是获得优良低温冲击韧性的关键因素。

关键词: FH550海洋平台用钢 冲击韧性 大角度晶界 裂纹扩展 M-A岛

EXPERIMENTAL STUDY OF THE IMPACT FRACTURE BEHAVIOR OF FH550 OFFSHORE PLATFORM STEEL

ZHOU Yanlei, XU Yang, CHEN Jun, LIU Zhenyu

State Key Laboratory of Rolling and Automation, Northeastern University, Shenyang 110819

Abstract: The impact fracture behavior of FH550 offshore platform steel was investigated by use of SEM, TEM and EDS. The experimental results show that the microstructure of as-rolled test steel is consist of low bainite and granular bainite, and tempered bainite is the main structure of this steel after tempering. The dimple fracture was observed on most of fracture surfaces of samples, and some inclusions, such as CaO and Al_2O_3 , appear at the bottom of isometric dimples. Carbides inclusions more than 10 μm were found on the cleavage fracture surface of a few of samples which could aggravate the impact toughness, and result in the fluctuation of the impact energy as brittle particles. Micropore accumulating and growing and crack necking are the main way for propagation of cracks, however, shear crack propagation may be obstructed by the particle clusters generated during plastic deformation, increasing the crack propagation work. It is also found that the fraction of high angle grain boundaries is 79.3%, and the average grain size is 7.61 μm . High percentage of large angle grain boundaries and fine grain size are the key factors to obtain excellent impact toughness.

Keywords: FH550 offshore platform steel impact toughness high angle grain boundary crack propagation M-A island

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通讯作者: 周砚磊

作者简介: 周砚磊, 男, 1984年生, 博士生

通讯作者E-mail: zhouyanlei84@163.com

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