

论文

Ti处理改善船体钢焊接粗晶区的低温韧性研究

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摘要:

采用Gleeble 1500D热模拟试验机对Ti和Al处理船体钢进行不同热输入焊接热模拟实验, 并利用OM和SEM研究了母材和热模拟粗晶区氧化物夹杂及显微组织. 结果表明: Ti处理钢中弥散分布的Ti氧化物具有良好的高温稳定性, 75 kJ/cm的焊接热输入对其形貌、成分及尺寸无影响, 能有效促进晶内针状铁素体(AF)形核长大. Al处理钢中以Al<sub>2</sub>O<sub>3</sub>为核心的复合夹杂高温易分解, 不能促进晶内AF形核. 线能量大于50 kJ/cm的大热输入条件下, Ti处理钢模拟粗晶区的低温韧性明显高于Al处理钢.  $t_{8/5} > 40$  s时, Ti处理钢中较多的晶内AF组织抑制了M-A岛形成, 细化了基体铁素体组织, Al处理钢中的TiN和Nb(C, N)第二相粒子粗化, 粗晶区晶粒异常长大, 大于Ti处理钢中的奥氏体晶粒尺寸.

关键词: Ti处理钢 低温韧性 粗晶区 针状铁素体 Ti氧化物

STUDY ON LOW TEMPERATURE TOUGHNESS IMPROVEMENT OF WELDING COARSE GRAIN ZONE OF HULL STEELS BY Ti TREATMENT

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Abstract:

The welding thermal simulation experiments were carried out on Ti/Al treated steels with different heat inputs by using Gleeble 1500D. The oxide inclusions and microstructures in the two base metals and simulated coarse grain heat affected zones (CGHAZ) were studied by using OM, SEM and EDS. At a higher heat input of 50 kJ/cm the low temperature Charpy impact energy in the CGHAZ of Ti treated steel (TTS) is higher than that of Al treated steel (ATS), and the impact energy of TTS reaches 60 J when the welding heat input was 75 kJ/cm. The dispersed Ti oxide inclusion with good high temperature stability in TTS can promote the nucleation of intragranular ferrite, and the welding heat input of 75 kJ/cm has only little effect on the morphology, composite and size of the inclusion. Whereas the Ti-rich nitride precipitated at the core of Al<sub>2</sub>O<sub>3</sub> dissolved at high temperature, which can't promote acicular ferrite nucleation. The higher low temperature toughness of TTS is related to the formation of intragranular acicular ferrite in the CGHAZ. When  $t_{8/5}$  ranged from 40 s to 100 s, the volume fraction of M-A islands in TTS can be reduced and the ferrite matrix microstructure can be refined by formation of fine intragranular acicular ferrite nucleated at Ti oxide inclusion, and the hardness in the simulated CGHAZ in TTS is lower than that of ATS at the same  $t_{8/5}$  value. Simultaneously, the austenite grain growth became abnormal and the second phase particles, TiN and Nb(C,N), were coarsened in ATS, resulting in bigger austenite grain size than that in TTS.

Keywords: Ti treated steel low temperature toughness coarse grain zone acicular ferrite Ti oxide

收稿日期 2009-06-29 修回日期 2009-10-02 网络版发布日期 2009-12-17

DOI:

基金项目:

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