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添加稀土Er于熔剂中对铸态AZ91 镁合金组织与性能的影响

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摘要:研究了熔炼时在熔剂(42%MnCl₂+53%LiCl+5%CaF₂, 质量分数, %)中添加稀土Er对铸态AZ91镁合金显微组织、力学性能、断口形貌以及腐蚀行为的影响。结果表明:在熔剂中添加稀土Er能够去除镁合金熔炼过程中产生的熔剂夹杂,净化镁合金熔体,提高铸态AZ91镁合金的拉伸性能和耐腐蚀性能;当熔剂中添加10%的稀土Er时,镁合金的抗拉强度 σ_b 和伸长率 δ 分别从156 MPa和1.8%上升到最大值220 MPa和4.1%;同时,镁合金在5%NaCl水溶液中的腐蚀速率从1.20 mg/(cm²·d)下降到最小值0.15 mg/(cm²·d);然而,随着稀土Er在熔剂中添加量的进一步提高,合金中开始有 ϕ -(Al₇ErMn₅)和 τ -(Al_{66.7}Mg_{23.3}Er₁₀)等含有稀土Er的相生成,消耗了合金中的Al和Mn元素,改变了 β -(Mg₁₇Al₁₂)相的形态;而且沿枝晶界附近分布的粗大 ϕ -(Al₇ErMn₅)相降低了枝晶之间的结合力,使得合金的 σ_b 和 δ 下降;同时,部分网状的 β -(Mg₁₇Al₁₂)相断裂,呈离散的块状,导致合金的腐蚀速率增加;熔剂中添加稀土Er不改变镁合金的断裂机理,断裂机制仍为准解理断裂。

关键字: AZ91镁合金; 稀土Er; 熔剂; 力学性能

Effects of Er addition in flux on microstructure and properties of casting AZ91 magnesium alloy

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Abstract: The effects of Er addition in the flux(42%MnCl₂+53%LiCl+5%CaF₂, mass fraction, %) on the microstructure, tensile properties, fractography, and corrosion behaviour of casting AZ91 Mg alloy were investigated. The results show that

Er addition in the flux can eliminate the inclusions formed during smelting, purify the melt and improve the tensile properties and corrosion resistance. Using the flux mixed with 10% Er, σ_b and δ of the casting AZ91 magnesium alloy can be improved by purification from 156 MPa and 1.8% to the maximum value of 220 MPa and 4.1%, respectively. Meanwhile, the corrosion rate decreases from 1.20 mg/(cm²·d) to the minimum value of 0.15 mg/(cm²·d) in 5%NaCl solution. However, further increasing Er content in flux, φ -(Al7ErMn5) and τ -(Al66.7Mg23.3Er10) phase form, which can consume Al and Mn element in the alloy, and modify the morphology of β -(Mg17Al12) phase. The coarse φ -(Al7ErMn5) phase along dendrite boundaries can decrease the cohesion force between dendrites, which leads the tensile properties to decrease. In addition, some net-like β -(Mg17Al12) phases become dispersive and nubble-like, resulting in the increase of corrosion rate. The Er addition in flux cannot change the fracture mechanism of quasi-cleavage of AZ91 Mg alloy.

Key words: AZ91 magnesium alloy; rare earth of Er; flux; mechanical properties

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