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T91钢热浸镀铝及其在水蒸汽中的循环氧化行为

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摘要: 研究SA213T91钢热浸镀铝后并退火后样品在90% Ar+10% H₂O气氛中于600, 650和700 °C下的循环氧化行为。研究表明: T91钢热浸镀铝并退火后样品在表面形成Fe₂Al₅金属间化合物层, 该层中有贯穿Fe₂Al₅层的裂纹; Fe₂Al₅层下为扩散层; 镀层表现良好的抗氧化性能; 在600 °C氧化速率缓慢, 样品表面仅生成极薄的Al₂O₃膜, 其生长方式主要由Al向外扩散为主, 而在650 °C和700 °C时氧化质量增量增大; 在循环氧化过程中, 由于基体和镀层的热膨胀系数不匹配, 镀层在降温和升温过程中将受到循环应力作用, 镀层中裂纹增加, 并导致镀层剥落。

关键字: T91钢; 热浸镀铝; 水蒸汽; 循环氧化

Cyclic oxidation behavior in water-vapour atmosphere of ferritic-martensitic steel T91 coated by hot dip aluminizing

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Abstract: An aluminide coating was prepared on SA213T91 steel by hot dip aluminizing then annealing. The cyclic oxidation behaviors of coated samples were studied in 10% H₂O+90% Ar at 600, 650 and 700 °C for various time. The results show that Fe₂Al₅ intermetallic layer with penetrated micro-cracks forms on the sample surface after hot dip aluminizing and annealing. A diffusion layer containing Al is observed beneath the outer coating layer. The coated samples exhibit much better, oxidation resistance than that of bare sample oxidized under the same conditions. When the samples is oxidized at 600 °C, the oxidation rate is very slow and only thin Al₂O₃ film forms on the sample surface. AFM observation reveals that the growth of oxide is dominated by Al diffusion outward. However, the oxidation rate is accelerated at 600 °C and 700 °C. Because of the mismatch of linear expansion coefficient of coating and substrate, the stress was generated in the coating during the cyclic oxidation, which leads to more micro-cracks formation in the coating and parts of coating spallation.

Key words:T91 steel; hot dip aluminizing; water vapor; cyclic oxidation

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