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研究报告

用开尔文探针研究Al-Mg-Si合金在$MgCl_2$液滴下的腐蚀行为

蔡超1,杨建锋1,李劲风2,曾锋利2,谭星2

1. 西安交通大学 金属材料强度国家重点实验室 西安 710049
2. 中南大学材料科学与工程学院 长沙 410083

摘要： 采用开尔文探针研究了相对湿度（RH）为75% 和33%时，Al-0.63 Mg-0.28 Si合金在原始 浓度0.05 ~0.3 mol/L、体积6μL的$MgCl_2$液 滴作用下的腐蚀行为。由于液滴水分蒸发，在合金表面 形成直径约2.9~3.2 mm的$MgCl_2$薄液膜。当开路 电位基线在基本维持稳定（-0.3~-0.5 V_{vs} \ SCE）的 基础上重复出现电位突降而后立即回复的电位噪声时，对应 于亚稳孔蚀的不断形成与钝化，合金表面生成直径小于3 μm的亚稳孔蚀。当开路电位缓慢下降 至-0.7~ -0.8 V 左右并维持稳定时，对应 于合金表面丝状腐蚀的形成与生长。在RH=33%气 氛中，合金表面只发生亚稳孔蚀。在RH=75%气氛 中，当初始浓度0.3 mol/L和0.2 mol/L时，24 h内合 金主要发生亚稳孔蚀；当浓度下降至0.1 mol/L时，合 金表面发生稳定腐蚀（丝状腐蚀），且丝状腐蚀发生 在液滴边缘并向外扩展；当浓度进一步下降至0.05 mol/L 时，发生稳定腐蚀的几率下降，24 h内主要发生亚稳 孔蚀。气氛湿度降低，单位时间内亚稳孔蚀数目降 低；而相同气氛湿度条件下，随原始$MgCl_2$液滴 浓度降低，单位时间内亚稳孔蚀数目增加。

关键词： Al-Mg-Si合金 开尔文探针 $MgCl_2$液滴

CORROSION OF AN Al-Mg-Si ALLOY UNDER $MgCl_2$ SOLUTION DROPS THROUGH KELVIN PROBE

CAI Chao[1], YANG Jianfeng[1], LI Jinfeng[2], ZENG Fengli[2], TAN Xing[2]

1. State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an 710049
2. School of Materials Science and Engineering, Central South University, Changsha 410083

Abstract: The corrosion behavior of Al-0.63Mg-0.28Si alloy under $MgCl_2$ solution drops with initial concentration of 0.05 mol/L~0.3 mol/L and volume of 6 μL in the environment of relative humidity (RH) 75% and RH 33% were studied by using Kelvin Probe. In these two environments, because the water in the drop is evaporated, a thin $MgCl_2$ solution layer with a diameter of about 2.9~3.2 μm forms on the alloy surface. As the open circuit potential (OCP) baseline keeps stable at -0.3~-0.5 V_{vs} \ SHE, there exists potential noise that the OCP repeatedly exhibits a sudden decrease and then immediate recovery, which is associated with initiation and re-passivation of metastable pits with diameter less than 3 μm. When the OCP baseline decreases slowly to -0.7~0.8 V and keeps stable low, stable filiform-like corrosion occurs and develops. In the environment of RH 33%, only metastable pitting corrosion occurs within 24 h. In the environment of RH 75%, as the initial $MgCl_2$concentration is 0.3 mol/L and 0.2 mol/L, the main corrosion form is metastable pitting corrosion. As the initial concentration is reduced to 0.1 mol/L, stable filiform-like corrosion always occurs on the drop edge and grows outward. As the initial concentration is further decreased to 0.05 mol/L, the likelihood of stable corrosion is lowered, and the main corrosion form is metastable pitting corrosion within 24 h. The number of metastable pits every unit time is increased with RH of the environment. Meanwhile, in environment of the same RH, it is increased with the decrease in initial concentration.

Keywords: Al-Mg-Si alloy Kelvin probe (KP) $MgCl_2$ solution drop

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通讯作者: 李劲风

作者简介: 蔡超，男，1978年生，博士，副教授，研究方向为铝合金材料及其腐蚀与防护

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通讯作者E-mail: lijinfeng@csu.edu.cn

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