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论文

# 镍基固溶体增韧$Cr_{13}Ni_5Si_2$合金在含$Cl^-$溶液中的腐蚀行为

袁蕾, 王华明

北京航空航天大学材料科学与工程学院激光材料制备与成形实验室, 北京 100191

摘要:

采用极化曲线、Tafel图和电化学阻抗谱(EIS)技术, 研究了镍基固溶体增韧$Cr_{13}Ni_5Si_2$金属硅化物合金在不同$Cl^-$浓度$Na_2SO_4$+NaCl溶液中的电化学腐蚀行为, 并对其表面钝化膜进行了X射线光电子能谱(XPS)分析. 结果表明: 由于超高的Cr含量易于在表面形成以$Cr_2O_3$为主的稳定钝化膜以及组成相$Cr_{13}Ni_5Si_2$和$Cr_3Ni_5Si_2$高的化学稳定性, 合金在不同$Cl^-$浓度溶液中均具有良好的耐蚀性; 合金的开路电位、破裂电位和腐蚀电流密度等几乎不随$Cl^-$浓度的增加而改变, 即合金对$Cl^-$浓度不敏感, 在中性含$Cl^-$介质中耐蚀性优异.

关键词: 金属硅化物 腐蚀 极化曲线 $Cl^-$浓度 电化学阻抗谱(EIS)

# CORROSION BEHAVIORS OF Ni BASE SOLID SOLUTION-TOUGHENED $Cr_{13}Ni_5Si_2$ ALLOY IN $Cl^-$ CONTAINING SOLUTIONS

YUAN Lei, WANG Huaming

Laboratory of Laser Materials Processing and Manufacturing, School of Materials Science and Engineering, Beihang University, Beijing 100191

Abstract:

From the application point of view, corrosion resistance of materials in corrosive environments, especially in $Cl^-$ containing medium, has great significance when used as mechanical components serving in marine and other aggressive environments. The corrosion behavior of a material is largely controlled by the presence or absence of protective surface film, which may act as a protective barrier against corrosion attacks. Therefore, the corrosion resistance of an alloy is closely related to the particular composition of the passive film and the synergistic interaction between the cations of alloy components in the passive film. In the present study, a $\gamma$-toughened $Cr_{13}Ni_5Si_2$ metal silicide alloy, consisting of $Cr_{13}Ni_5Si_2$, Ni base solid solution $\gamma$ and $Cr_3Ni_5Si_2$ was designed and fabricated by the introduction melting and die-casting prosess. Corrosion behaviors of the alloy in a series of $Na_2SO_4$+NaCl solutions were investigated by anodic polarization, Tafel plot and electrochemical impedance spectroscopy (EIS) experiments. Chemical composition of the passive film and the surface of polarized samples were examined by X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM), respectively. A commercial solution treated single phase austenitic stainless steel 1Cr18Ni9Ti was selected as the reference material for all the electrochemical tests. Results showed that the metal silicide alloy exhibited high corrosion resistance in all testing solutions due to the formation of a compact and protective passive film composed mainly of $Cr_2O_3$, as well as the high chemical stability of $Cr_{13}Ni_5Si_2$ and $Cr_3Ni_5Si_2$ phases. No evidence of localized corrosion occurred even after anodic polarization in 0.1 mol/L $Na_2SO_4$+1 mol/L NaCl solution. Moreover, the corrosion potential, breakdown potential and anodic current density are almost invariant with increasing $Cl^-$ concentration, which means the alloy has excellent corrosion resistance in neutral $Cl^-$ containing solutions.

Keywords: metal silicide corrosion polarization curve $Cl^-$ concentration elecrtochemical impedance spectroscopy (EIS)

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通讯作者: 王华明

作者简介: 袁蕾, 女, 1983年生, 博士生

作者Email: wanghm@buaa.edu.cn

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