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论文

室温下铝合金表面Ce-Mn转化膜的制备及性能

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摘要:

以薄膜厚度和耐点滴腐蚀时间作为衡量Ce-Mn转化膜性能的指标, 采用正交实验研究了室温下pH值为2.0时铝合金表面Ce-Mn转化处理液配方及成膜时间对转化膜性能的影响. 分别获得两种较佳工艺, 配方和成膜时间分别为: 10 g/L $Ce(NO_3)_3$ +2 g/L $KMnO_4$ +0.06 g/L NaF,12 min; 7 g/L $Ce(NO_3)_3$ +1 g/L $KMnO_4$ +0.06 g/L NaF, 9 min. 采用点滴腐蚀法、极化曲线和交流阻抗研究铝合金表面Ce-Mn转化膜的耐腐蚀性能; 采用硬度计、SEM和EDS研究转化膜的表面硬度、形貌及组成. 结果表明处理液中添加成膜促进剂NaF后, 使转化膜的成膜速率和耐腐蚀性能(耐点滴腐蚀时间)提高, 制备Ce-Mn转化膜后, 铝合金表面的显微硬度从纯Al时的HV72最大增大至HV532.

关键词: 铝合金 Ce-Mn转化膜 正交实验 促进剂

PREPARATION AND PERFORMANCE OF Ce–Mn CONVERSION COATING ON Al ALLOY SURFACE AT ROOM TEMPERATURE

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Abstract:

NaF was used as the accelerant to accelerate the conversion coating formation on 6063 Al alloy in Ce $(NO_3)_3$ and KMnO4 solution. Orthogonal experiments were conducted to find out the optimal process for prepare Ce–Mn conversion coating on Al alloy surface. Coating thickness and anti–corrosion time were taken as the indexes of performance assessment. Two better solution components and coating formation times at room temperature and pH=2.0 were selected to be 10 g/L $Ce(NO_3)_3$ +2 g/L $KMnO_4$ +0.06 g/L NaF, 12 min and 7 g/L $Ce(NO_3)_3$ +1 g/L $KMnO_4$ +0.06 g/L NaF, 9 min. The anti–corrosion ability of coating was evaluated by dropping test, polarization curve and electrochemical impedance spectroscopy. The increase of ΔE (the different between pinhole corrosion and corrosion potentials) and the decrease of corrosion demonstrate that the anti–corrosion ability of 6063 Al alloy with Ce–Mn conversion coating is greatly enhanced since the cathodic current (ic) and anodic corrosion current (i_a) decrease. Ce–Mn conversion coating serves as an effective barrier to prevent corrosion attack. Generally, lower C (Capacitance) points out relatively higher degree of surface homogeneity which yields an almost closed capacitive arc. The addition of NaF make C become less, conversion coating resistance (R_c) and charge transfer resistance (R_{ct}) become higher. A thicker and denser coating was formed on the surace of l alloy, which presents a barrier to O_2 or CO_2 or Cl^- permeation, bring better protection to Al 6063 alloy. The surface hardness was determined by micro–hardness test, the micro–morphology, and compositions of coatings were analysed by SEM and EDS. With NaF added, the surface hardness becomes stronger. Formation time was also an important factor to prepare a high–quality coating, corrosion resistance of Ce–Mn conversion coating was more effective when formation time is 9 min than when it is 15 min. The results of orthogonal experiments show that the optimal coating processing is 7 g/L $Ce(NO_3)_3$ + 1 g/L $KMnO_4$ +0.06 g/L NaF, 9 min. The additioof NF can accelerate the coatig formation, increase the Ce and Mn content in coating and thus improve the coatig anti–corrosion performance. It is found that the surface icro–hardness increases from HV72 of pure Al surface to HV532 of Al alloy surface with Ce–Mn conversion coating.

Keywords: Al based alloy Ce–Mn conversion coating orthogonal experiment accelerant

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