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论文

# 不锈钢双极板电弧离子镀$Cr_{1-x}N_x$薄膜改性研究

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摘要:

用电弧离子镀方法在质子交换膜燃料电池(PEMFC)不锈钢双极板表面沉积一系列 $Cr_{1-x}N_x$($x$=0.28-0.50)改性薄膜, 对薄膜的成分、相组成以及改性双极板的导电、耐蚀等性能进行了分析测试. 结果表明, 双极板的导电与耐蚀性能因沉积$Cr_{1-x}N_x$薄膜而显著提高, 并且与薄膜的成分和相组成密切相关: 当$x$值从0.28增加到0.50, 薄膜由Cr+Cr2N转变为$Cr_2N$, 再转变为$Cr_2N$+CrN, 最终变为CrN; 当薄膜由单相组成时, 双极板既导电又耐蚀、综合性能最好, 与原始不锈钢相比, 导电性能提高2个数量级以上, 而耐蚀性能提高近3个数量级.

关键词: 质子交换膜燃料电池 Cr-N膜 不锈钢双极板 电弧离子镀 接触电阻 耐蚀性能

# RESEARCH OF MODIFICATION OF STAINLESS STEEL BIPOLAR PLATES WITH $Cr_{1-x}N_x$ FILMS DEPOSITED BY ARC ION PLATING

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Abstract:

In the proton exchange membrane fuel cell (PEMFC) with widely applicated future, the bipolar plate plays an important role in supporting the cell stack, collecting current, separating the oxidants from fuels and channeling the oxidants and fuels. The ideal bipolar plate should be of good electric conductivity, high corrosion resistance, high mechanical strength, low gas permeability, low cost and easy processing. Although the stainless steels can be used as bipolar plate materials, their corrosion resistance in fuel cell environment is not satisfied, and the cations induced by metal corrosion would poison the proton exchange membrane. A series of $Cr_{1-x}N_x$ ($x$=0.28-0.50) films were deposited on the surface of stainless steel by arc ion plating (AIP), the composition and phases of $Cr_{1-x}N_x$ films and the electric conductivity and corrosion resistance of the modified bipolar plates were tested. The results show that as the value of $x$ varying from 0.28 to 0.50, the phases in the films change from Cr+$Cr_2N$ to $Cr_2N$, then to $Cr_2N$+CrN and finally to CrN. The bipolar plates coated with the $Cr_{1-x}N_x$ film with single phase structure show good electric conductivity and high corrosion resistance. Comparing with the original stainless steel, the electric conductivity and corrosion resistance of bipolar plates are enhanced by more two orders of magnitude and almost three orders of magnitude, respectively.

Keywords: proton exchange membrane fuel cell (PEMFC) Cr-N film stainless steel bipolar plate arc ion plating contact resistance corrosion resistance

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