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论文

泵阀用2Cr13马氏体不锈钢等离子体基低能氮离子注入研究

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摘要： 采用等离子体基低能氮离子注入技术, 在450 ℃, 4 h改性处理核电站泵阀零部件用2Cr13马氏体不锈钢, 获得了深度为10-12 μm的改性层,超高氮过饱和浓度为35%-40%(原子分数), 由hcp结构的ε-$Fe_{2-3}N$相组成.改性层的硬度最大值为15.7 GPa, 球--盘式摩擦学实验测定的改性层摩擦系数由原始不锈钢的1.0减至0.85, 耐磨性显著提高. 在3.5%NaCl溶液中,改性层的阳极极化曲线由原始不锈钢的活化溶解转化为自钝化-孔蚀击穿特征,自腐蚀电位增加至-185 mV(vs SCE), 维钝电流密度为10^{-1} μA/cm^2,孔蚀击穿电位为-134 mV(vs SCE), 抗孔蚀性能明显改善. 表面改性2Cr13马氏体不锈钢满足泵阀零部件耐磨损抗腐蚀的需求.

关键词： 等离子体基低能氮离子注入 2Cr13马氏体不锈钢 耐磨性 抗蚀性

PLASMA – BASED LOW – ENERGY NITROGEN ION IMPLANTATION OF 2Cr13 MARTENSITIC STAINLESS STEEL USED IN PUMPS AND VALVES

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Abstract: The 2Cr13 martensitic stainless steel used in pumps and valves has been modified by plasma – based low – energy nitrogen ion implantation at a processing temperature of 450℃ for a treatment time of 4 h. The modified layer on the 2Cr13 stainless steel has a thickness range of 10—12 μm. The modified layer consists of monophase and has a high supersaturated nitrogen concentration up to 35%—40% (atomic fraction). The microhardness of the ε–$Fe_{2-3}N$ phase layer was measured to be 15.7 GPa, and the increased wear resistance of the modified layer was obtained on a ball on disctribometer with a decreased friction coefficient from 1.0 of the original stainless steel to 0.85. A typical course from self – passivation to pitting corrosion of the modified layer in 3.5%NaCl solution was observed with a corrosion potential of −185 mV(vs SCE), a passive current density of 10^{-1} μA/cm^2, and a pitting potential of −134 mV(vs SCE). The pitting corrosion resistance of the modified layer was improved in comparison with that of the original stainless steel with non anodic passivation. It was found that the plasma – based low – energy nitrogen ion implantation of 2Cr13 martensitic stainless steel provided an opportunity of combined improvement in wear and corrosion resistance for use in pumps and valves.

Keywords: plasma – based low – energy nitrogen ion implantation 2Cr13 martensitic stainless steel wear resistance corrosion resistance

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