

镀锌钢表面复合超疏水转化膜的制备与耐蚀性研究

李冲冲^{1)✉} 曹晓明²⁾ 范永哲²⁾

(1.北华航天工业学院材料工程学院, 廊坊 065000;

2.河北工业大学材料科学与工程学院, 天津 300401)

摘 要: 近年来, 通过在金属基体上制备超疏水涂层用于金属的腐蚀防护越来越受到研究人员的关注。因此, 在镀锌钢表面构建一种多功能超疏水膜层不仅可用于腐蚀防护, 同时赋予镀锌钢自清洁、防污、防覆冰等特性。本文通过将清洁的镀锌钢基体浸入含有硅烷、辅助离子和长链脂肪酸的混合溶液中, 通过一步自发沉积工艺在镀锌钢基体上制备出具有多级粗糙度的花瓣状和树枝状的复合超疏水膜层。结果表明: 所制备的复合超疏水膜层的接触角为 $161 \pm 2^\circ$, 滚动角约为 4° ; 与裸镀锌钢相比, 其腐蚀电流密度降低了近 3 个数量级, 表现出优异的耐腐蚀特性。采用该一步法工艺在镀锌钢表面制备超疏水转化膜是一种新的尝试, 且该工艺简单、环保、无需进一步采用低表面能物质改性, 有望发展成为一种潜在的新型金属表面处理工艺。

关键词: 超疏水; 腐蚀防护; 镀锌钢; 自清洁;

分类号: TG174.4

Preparation and Corrosion Resistance of Composite Superhydrophobic Conversion Film on Galvanized Steel

Li Chongchong^{1)✉}, Cao Xiaoming²⁾ Fan Yongzhe²⁾

(1.School of Materials Engineering, North China Institute of Aerospace Engineering, Langfang 065000;

2.School of Materials Science and Engineering, Hebei University of Technology, Tianjin 300130)

ABSTRACT: Recently, the preparation of superhydrophobic coatings on metal substrates for corrosion protection of metals has received increasing attention from researchers. Therefore, constructing a multi-functional super-hydrophobic film on the surface of galvanized steel can not only be used for corrosion protection, but also imparts self-cleaning, anti-fouling and anti-icing properties to galvanized steel. In this paper, a composite superhydrophobic film with petal-like and dendritic-like structures is prepared on galvanized steel by a one-step spontaneous deposition process. The superhydrophobic coating is prepared by immersing the substrate in a mixed solution containing silane, auxiliary ions and long-chain fatty acids for several minutes. The results show that the prepared super-hydrophobic film layer has a contact angle of $161 \pm 2^\circ$ and a rolling angle of about 4° , which shows excellent water-repellent properties. The electrochemical test results show that compared with bare galvanized steel, the corrosion current density is reduced by nearly three orders of magnitude and exhibits excellent corrosion resistance. Moreover, the fabrication process is simple, environmentally friendly, and no further modification of low surface energy substances is required. It is a new trial for the protection of galvanised steel against corrosion, and it is expected to develop into a new type of metal surface treatment technology.

KEY WORDS: Superhydrophobic; corrosion protection; galvanized steel; self-cleaning;

通信作者: 李冲冲 (1989-); E-mail:hdglichong@163.com; 研究方向: 金属材料腐蚀防护及热浸镀