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Corrosion Resistance of Graphene-reinforced Waterborne Epoxy Coatings

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Graphene (G) was dispersed uniformly in water and used as an inhibitor in waterborne epoxy coatings. The effect of dispersed G on anticorrosion performance of epoxy coatings was evaluated. The composite coatings displayed outstanding barrier properties against H_2O molecule compared to the neat epoxy coating. Open circuit potential (OCP), Tafel and electrochemical impedance spectroscopy (EIS) analysis confirmed that the corrosion rate exhibited by composite coatings with 0.5 wt% G was an order of magnitude lower than that of neat epoxy coating. Salt spray test results revealed superior corrosion resistance offered by the composite coating.

Key words: Waterborne epoxy coating; Graphene; Corrosion resistance; Electrochemical impedance spectroscopy (EIS)

1. Introduction

Waterborne coating has gained increasing attention for metal protection due to the strict regulations in the use of volatile organic compound (VOC). However, its anticorrosion performance is farther inferior to solvent coating because the hydrophilic groups were retained in the coating during the film formation process, decreasing the shielding ability of vapor diffusion and moisture-resistant ability[1–3]. Thus, the addition of corrosion inhibitors or fillers is necessary to improve the corrosion resistance of the waterborne coating[4,5].

In the past decade, graphene (G), a novel two-dimensional material with single layer having a thickness around 0.335 nm and a diameter ranging from several microns to several hundred microns, has attracted increasing attention from academic and industrial fields due to their unique nanostructure, excellent physical properties, large specific surface areas, super hydrophobic property and good compatibility with polymer matrix[6–8]. It has been reported that G exhibited extraordinary corrosion resistance and self-lubricant characteristics due to its unique flexible graphitic layers, super-hydrophobic characteristics, extremely high strength, and easy shear capability on its densely packed and atomically smooth surface[9,10]. Sun et al.[11] fabricated G coating as a solid-phase microextraction fiber bonded onto stainless steel wire, and found that this fiber exhibited high thermal and chemical stability. Shen et al.[12] proved that the wear resistance and tribological performance of epoxy coating was remarkably strengthened by adding only a small amount of G. Wang et al.[13] provided a “green” strategy for fabricating the G-reinforced polyurethane coatings by sol-gel method, and found that a 86%