Iran Polym J (2012) 21:747–754
DOI 10.1007/s13726-012-0080-8

ORIGINAL PAPER

Investigation of corrosion performance of epoxy coating containing polyaniline nanoparticles

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Received: 12 January 2012 / Accepted: 7 August 2012 / Published online: 11 September 2012

Abstract An emulsion polymerization of aniline was performed in a solution of dodecylbenzenesulfonic acid emulsifier, benzoyl peroxide oxidant and tartaric acid as dopant. The polyaniline-containing coating was applied over carbon steel panels and the polyaniline content in the coating was 1 %. The influence of reactants concentration on the morphological and anti-corrosive properties of polyaniline was investigated to determine the optimum conditions for the synthesis of polyaniline nanoparticles. The average size of particles determined by X-ray diffraction measurement was 70–104 nm, which is found to be in agreement with the scanning electron microscopy results. Corrosion resistance of coatings was obtained using electrochemical techniques (electrochemical impedance spectroscopy and open circuit potential measurements) in 3.5 % sodium chloride solution. Nyquist diagrams showed two capacitance loops, one at high frequency range followed by a larger one at low frequencies due to coating and charge transfer resistance. The corrosion resistance values were found to decrease due to the corrosion of carbon steel in pinholes of the coating. For longer immersion times, the coating resistance values were found to increase due to the passivation effect of polyaniline. The results showed that epoxy coating with doped polyaniline nanoparticles is able to offer protection in sodium chloride solution.

Keywords Corrosion performance · Impedance · Polyaniline nanoparticles · Scanning electron microscopy

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Introduction

Polyaniline has emerged as one of the more promising conductive polymers for commercial applications. It is electrically conductive with good thermal and environmental stability. Its conductivity can be modified by the oxidation state of the main chain and degree of protonation. Polyaniline can be exploited in various applications such as microporous electrically conducting materials, anti-corrosion protection of metals, supporting material for catalysts, etc. [1–3]. There have been many reports on the preparation of polyaniline microparticles via emulsion method focused on the contribution of micelles to the formation of the stable dispersions, morphology and the anti-corrosive properties [4, 5], but the effect of polyaniline nanoparticles on coating anti-corrosive properties has not been studied by many research groups. Wessling et al. [6] studied the anti-corrosive performance of nanostructure polyaniline product of Ormecom GmbH in an epoxy primer in combination with some other systems. Bagherzadeh et al. [7, 8] have reported using commercial conductive nanopolyaniline dispersion as an additive to make anti-corrosive water-based epoxy coating.

In recent years, corrosion protection of steel by conductive polymer pigmented coatings has been reported [9, 10]. The advantage of protection by conductive polymer coatings is that the coatings have more tolerance to pin holes due to their passivation ability. Nevertheless,