

Graphene Oxide/Polyaniline Composite Coating for Corrosion Protection of Mild Steel in 0.5M Sodium Chloride (NaCl) Solution

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Structured Abstract

Background: Polyaniline (PANI) is a well-known conductive polymer that is light in weight, non-toxic, inexpensive and has strong electrochemical and reversible redox properties. According to Chang et al. (2012), adding well-dispersed graphene oxide to PANI enhances the pathways for reactive gas diffusion in polymer coatings. In comparison to pristine PANI polymer coatings, this results in a notable improvement in the corrosion protection of metallic substrates. Additionally, the steel surface is successfully preserved by GO's impermeability to oxygen and water.

Methods: In this study, PANI and PANI modified with graphene oxide (GO-PANI) were synthesized by the chemical polymerization method and were identified by using Fourier transform infrared (FTIR) and Field Emission Scanning Electron Microscopy (FESEM) measurements. The weight loss method was used to determine the corrosion rate (CR) and the percentage corrosion inhibition efficiency (%IE) of PANI and GO-PANI coatings.

Results: The FTIR findings revealed that for PANI coating, a strong broad absorption band at 3402 cm^{-1} indicates the secondary amines (N-H) while a small and sharp absorption peak was observed in the spectra at 1654 cm^{-1} assigned to the stretching vibration of the C=C. Meanwhile, for GO-PANI composite coating, a strong broad at 3364 cm^{-1} was due to the O-H bond while a medium band at 1652 cm^{-1} indicates the C=C stretching. On the other hand, FESEM micrographs showed the surface morphologies of the PANI polymerized coatings exhibit a cauliflower structure while GO-PANI composite coatings displayed the flaky structure of GO. The corrosion study using the weight loss method indicates that the GO-PANI composite coating provides a higher percentage inhibition efficiency (87.78%) and lower corrosion rate (3.60 mm/yr) compared to PANI (12.50 mm/yr).

Conclusion: The modification of the PANI polymer with graphene oxide enhances the barrier properties and improves the corrosion efficiency of the PANI coating as well as reduced the corrosion rate of the mild steel substrates.

Keywords: Graphene oxide, polyaniline, coating, corrosion, mild steel

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