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Graphene Oxide Based Palm Kernel Shell as a Potential Corrosion Inhibitor for Mild Steel in 1.0 M Hydrochloric Acid Solution

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Structured Abstract

Background: Corrosion on mild steel (MS) has been the main issue because MS is one of the most employed materials in today's industries. However, the corrosion process can be controlled using a corrosion inhibitor. The palm oil mill's waste product, palm kernel shell (PKS), can be synthesized into graphene oxide (GO) and can be a potential corrosion inhibitor.

Methods: This study synthesized graphene oxide (GO) based PKS using pyrolysis, chemical vapour deposition (CVD) and modified Hummer's methods. The collected GO was characterized by Attenuated Total Reflectance-Fourier Transform Infrared (ATR-FTIR) and Ultraviolet-Visible (UV-Vis) spectroscopies to determine GO functional groups. The corrosion protection performance of GO tested on MS substrate using weight loss and potentiodynamic polarization (PDP) techniques, and the working area of corrosion on the MS substrate was limited to 1 cm2. The corrosion measurement was carried out on MS substrate in the absence and presence of different concentrations of GO in 1.0 M HCl solutions for up to seven days of exposure.

Results: ATR-FTIR results show GO has functional groups of carboxylic acids and alcohols. From UV-Vis results, plasmon excitation of π–π^* transition corresponds to the C=C bond. Moreover, it was found that GO can control corrosion for MS substrate under 1.0 M HCl solution. The weight loss method and PDP results show that inhibition efficiency increased with increasing concentrations of GO, with the highest inhibitory effectiveness being 71% at 0.01 M. The corrosion rate was lowered from 2.199 mm/year in the absence of a corrosion inhibitor to 0.626 mm/year with the addition of 0.01 M GO in 1.0 M hydrochloric acid solution.

Conclusion: GO based PKS was synthesized using pyrolysis, CVD, and modified Hummer's methods. GO was classified as an anodic inhibitor, with the inhibition mechanism suggested to be the adsorption of the molecules to form a thin organic protective layer on the MS substrate's surface. GO allows protective film formation on the MS substrate's surface by adsorption that can prevent corrosion.

Keywords: Palm Kernel Shell (PKS), Graphene Oxide (GO), Corrosion Inhibitor, mild steel

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