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Corrosion Protection Ability of Chitosan/ZnO Nanoparticles on Mild Steel in Sodium Chloride Solution

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Structured Abstract

Background: Chloride ions in saltwater have a small ionic radius, allowing them to spread across metal surfaces and cause erosion quickly. Zinc oxide nanoparticles (ZnO NPs) incorporated with chitosan as a hybrid organic-inorganic inhibitor was used to improve corrosion protection of mild steel in sodium chloride solution.

Methods: In this study, the synthesis process involves adding chitosan solution to zinc nitrate hexahydrate and NaOH, resulting in a color change from colorless to milky white. The solution was then microwaved, forming a supersaturated aqueous solution. After filtration, the precipitates were collected, washed, dried, ground to a fine powder, and finally calcined at 350 °C for 4 hours, resulting in white powder of CS-ZnO NPs. Attenuated Total Reflectance-Fourier Transform Infrared (ATR-FTIR) and UV-Visible (UV-Vis) spectroscopies were used to characterize CS/ZnO NPS. CS/ZnO NPs' effectiveness as a corrosion inhibitor was assessed using weight loss method, Potentiodynamic Polarization (PDP) and Scanning Electron Microscope (SEM).

Results: The study successfully synthesized CS/ZnO NPs as a corrosion inhibitor for mild steel in a sodium chloride solution. FTIR analysis showed a strong interaction between chitosan and ZnO at 3467 cm^{-1}, while UV-Vis characterization revealed a characteristic peak at 381 nm for CS/ZnO NPs. The weight loss method indicates that higher inhibitor concentrations increased inhibition efficiency and reduced the corrosion rate. However, this effect decreased after a specific period and showed 1.0×10^{-5} M as the optimum CS/ZnO NPs concentration. The PDP measurement shows CS/ZnO NPs could be an anodic-type inhibitor since the potential change of CS/ZnO NPs inhibitor moves more positively than the blank

Conclusion: Employing CS/ZnO NPs as a corrosion inhibitor appears to be a favorable alternative for corrosion prevention in this circumstance, given its ease of application, cost-effectiveness, and environmental friendliness.

Keywords: Hybrid corrosion inhibitor, chitosan, zinc oxide, mild steel

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