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Experimental and theoretical studies of the synergistic inhibition effects between the plant leaves extract (PLE) and zinc salt (ZS) in corrosion control of carbon steel in chloride solution

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Abstract: The synergistic inhibition effects between green corrosion inhibitors (GCI) extracted from Nettle leaves and zinc cations in corrosion control of carbon steel specimens in 3.5 wt.% NaCl solution were studied by electrochemical techniques, surface analyses, molecular dynamics simulations and electronic-structure approaches. The inhibition mechanism and efficiency of corrosion inhibitors were evaluated by electrochemical impedance spectroscopy (EIS) and polarization test. The morphology and composition of the film deposited on the surface of carbon steel specimens dipped in the chloride solution containing different inhibitors were analyzed by field-emission scanning electron microscopy (FE-SEM) and X-ray photoelectron spectroscopy (XPS). The results obtained from EIS analysis confirmed that combination of zinc salt (ZS, 200 ppm) and green corrosion inhibitor (200 ppm, GCI) effectively reduced the carbon steel corrosion in saline solution. Polarization test results demonstrated a mixed type inhibition effect between ZS and GCI inhibitors. Moreover, the results obtained from FE-SEM and XPS analysis showed that the organic compounds like hystamine, serotonin and quercetin could effectively form complexes with zinc cations and establish protective film over the steel surface.

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