Electron-donating Effect of Hydantoin Derivative Inhibitor on the Enhanced Anticorrosion Capacity for Mild Steel in Hydrochloric Acid Medium

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Hydantoin (HDT) and its derivative (allantoin, ALT) were evaluated as corrosion inhibitors for 20# steel in 1 M HCl solution at 303 K through gravimetric test, potentiodynamic polarization, electrochemical impedance spectroscopy and surface analysis. Especially, the electron-donating effect of extra acid diamide group (ALT) on improving the anticorrosion efficiency was observed: the inhibition efficiency of ALT-inhibited specimen (maximum of 96.12%) was higher than the counterpart protected by HDT at the same dosage. Electrochemical results showed that the corrosion current density was largely suppressed along with the elevated interfacial charge transfer resistance for steel in HCl solution with ALT. Due to the effective adsorption, both HDT- and ALT-inhibited specimens emerged the inferior surface wettability as compared to that of blank control; surface morphology also evidenced the better protection of ALT than that of HDT. Theoretical modelling indicated that acid diamide group on ALT intensified the negative potential of hydantoin ring, which played a pivotal role in chemisorption and the ensuing corrosion inhibition mechanism for 20# steel in HCl solution.

Keywords: hydantoin; corrosion inhibitor; electrochemical evaluation; density functional theory; molecular dynamics simulation

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