Inhibition Effect of Phthalocyaninatocopper(II) and 4-Tetranitro(phthalocyaninato)copper(II) Inhibitors for Protection of Aluminium in Acidic Media

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The inhibition effect of phthalocyaninatocopper(II) (CuPc) and 4-tetranitro(phthalocyaninato)copper(II) (TNCuPc) on aluminium in 1 mol/L HCl was investigated by electrochemical techniques. The CuPc and TNCuPc inhibitors were synthesized and confirmed by using X-ray diffraction (XRD), Fourier transform infrared (FTIR), simultaneous thermal analysis (STA, thermogravimetric analysis (TGA)/differential scanning calorimetry (DSC)) and ultraviolet-visible spectroscopy (UV-vis). The XRD, UV-vis and FTIR analyses showed successful formation of CuPc and TNCuPc inhibitors. The thermal stability of CuPc increased upon the introduction of NO₂ group in the peripheral position as indicative of the formation of TNCuPc. The potentiodynamic polarization (PDP) curves of aluminium in the corrosive environment of HCl in the presence and absence of CuPc and TNCuPc compounds demonstrated that both cathodic and anodic processes of Al corrosion were suppressed. The Nyquist plots of electrochemical impedance spectroscopy (EIS) expressed mainly as a capacitive loop with different concentrations of CuPc and TNCuPc. The inhibition efficiency of these inhibitors increased with increase in inhibitor concentration, and their inhibition efficiencies in the same concentration decreased in the order of CuPc > TNCuPc according to PDP and EIS results due to a steric hindrance.

Keywords: Phthalocyaninatocopper(II); 4-tetranitro(phthalocyaninato)copper(II); corrosion inhibitor; aluminium; electrochemical measurements

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