In recent years, conducting polymers have been used as protective coatings to avoid corrosion for metals such as mild steel (MS), stainless steel, iron, aluminum and copper. Many studies have demonstrated that the corrosion of MS, stainless steel and pure iron is effectively inhibited by the electrochemical synthesis of poly(N-methylaniline) (P7VMA) and polypyrrole (PPy) [1-4].

In this study, electrochemical synthesis of poly(N-methylaniline) (PNMA), polypyrrole-dodecylsulfate (PPy-DS) and their bilayer coatings (P7VMA/PPy-DS, PPy-DS/PAMA) on a mild steel electrode (MS) was performed with the potentiodynamic technique. The electropolymerization of NMA and Py monomers was carried out on the surfaces of the passivated MS electrodes. While the P7VMA was obtained via electrosynthesis between 0.3 V and 1.2 V at a 10 mVs⁻¹ scan rate, the PPy-DS was electrosynthesized between 0.3 V and 0.9 V at a 50 mVs⁻¹ scan rate after a 0.05 M sodium dodecylsulfate addition to the polymerization solution. The synthesis of bilayer coatings were performed in the conditions used for electrosynthesis of PNMA and PPy-DS homopolymers. The characterization of coatings was carried out by Fourier Transform Infrared (FTIR) spectroscopy and Field Emission Scanning Electron Microscopy (FESEM).

The corrosion protection performances of these polymer coatings were examined using Tafel analysis and EIS techniques in 0.5 M HCl solution. Tafel tests were carried out by anodic sweeping ± 0.200 V range of open circuit potential (E_{OCPP}) versus Ag/AgCl at a 1 mVs⁻¹ scan rate in 0.5 M HCl. Before Tafel experiments, the bare and polymer-coated MS electrodes were held in the test solution until reach a steady-state E_{OCPP} value. EIS was performed in the frequency range of 10⁵ to 0.1 Hz with amplitude of 5 mV at the E_{OCPP} of substrates for different immersion times in 0.5 M HCl. Equivalent circuit models were formed by ZView 3.2c software based on EIS measurements. It was found that their protection efficiencies determined by using Tafel extrapolation were compatible with those of EIS methods. It was observed that the PNMA, PPy-DS, PNMA/PPy-DS films were effectively inhibit the corrosion of MS.

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References