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Development of electrochemical coatings based on polypyrrole doped with bulky anions and evaluation of their anticorrosive protection of 1020 steel

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Mild steels are widely used in structural applications. However, they are susceptible to chemical attack and therefore deteriorate when exposed to corrosive environments. Traditionally, chromate based coatings have been employed to inhibit steel corrosion, but these compounds are highly toxic and environmentally dangerous1. Intrinsic conducting polymers (PCIs)2 have emerged as an alternative to chromates as corrosion inhibitors or protective films3. Among them, polypyrrole (PPy) has attractive properties as the ease of synthesis, chemical stability, low toxicity, biocompatibility and high electrical conductivity4,5. In this work, three different anions, sodium polystyrene sulfonate (PSS), sodium bis (2-ethylhexyl) sulfosuccinate (BEHSS) and sodium polyphosphate (PF), were used as dopants in the electrosynthesis of PPy polymers. Potentiodynamic, potentiostatic and galvanostatic electropolymerization methods were compared. The performance of these polymers as protective films of 1020 carbon steel was evaluated by Tafel polarization curves, open circuit potential (OCP) and electrochemical impedance spectroscopy (EIS). Polyphosphate-doped polypyrrole obtained by potentiostatic method, showed the highest adhesion to the metal surface as well as the best protection against corrosion.