The effects of electrochemically deposited polypyrrole coatings on the corrosion protection properties of copper and copper alloys

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In recent yeas the use of conducting polymers for corrosion protection of metal substrates has been studied [1]. One area of focus has been the application of conducting polymers, such as polypyrrole, for the corrosion protection of iron and aluminum-based alloys[1-3]. However, to the best of our knowledge, there have been no reports on the corrosion protection properties of polypyrrole films deposited on copper or copper-based alloys. Deposition of conducting polymers can be achieved at metal surfaces by spin coating chemically synthesized polymers onto the substrate or by an *in-situ* electro-polymerization process. The later offers several advantages; the main one being the ability of the polymer to form at irregular shaped objects. The electro-polymerization process has one major obstacle to overcome, and that is dissolution of the metal substrate at the potentials necessary for monomer oxidation, which is essential for polymer formation. In the case of electro-polymerization on iron this problem is overcome by using oxalic acid as the electro-polymerization media. This allows deposition of an oxalate layer over the metal substrate protecting the metal and allowing electro-polymerization of pyrrole onto the surface.

In this paper the *in–situ* electro-polymerization of polypyrrole at pure copper and copper based alloys is examined. The polypyrrole layers are polymerized from near neutral oxalate solution, using constant potential techniques. Growth of films at the copper interface was facilitated by the initial oxidation of the copper electrode in the oxalate solution to generate a copper oxalate pseudo-passive layer. The initial stages of polymer growth were followed using an electrochemical quartz crystal microbalance technique and the bulk polymer film characterized using FTIR and SEM/EDX analysis. SEM micrographs show that the resultant polypyrrole layers are smooth, homogenous and adherent. The corrosion protection properties of these coatings were assessed using polarization data, electrochemical impedance and open-circuit potential measurements as a function of time in aggressive chloride-containing solutions. Preliminary results show that the conducting polymer layer has good corrosion protection properties. Evidence of this can be seen in Figure 1, which shows that both thick and thin polymer layers provide good corrosion protection to pure copper in an acidic environment.

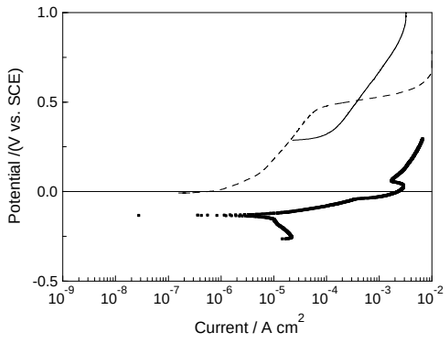

Figure 1. Anodic polarization plots recorded in a pH 3.5, 0.1 M dm^{-3} NaCl solution for · · · · uncoated Cu - - - - thin polypyrrole layer and — thick polypyrrole layer.

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