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EFFECT OF ELECTROSPUN POLYVINYL ALCOHOL (PVA) COATING ON THE ELECTROCHEMICAL CORROSION OF Cu Al ELECTRODES

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ABSTRACT

EFFECT OF ELECTROSPUN POLYVINYL ALCOHOL (PVA) COATING ON THE ELECTROCHEMICAL CORROSION OF Cu Al ELECTRODES

Corrosion of metals such as copper (Cu) and aluminium (Al) in chloride-rich environments remains a significant concern, particularly in electrochemical applications that involve saline electrolytes. One such example is the saltwater lamp-based energy device, where saltwater is used to generate low-voltage electricity through electrochemical reactions between dissimilar metal electrodes. Although these systems offer a simple, low-cost, and sustainable alternative for small-scale energy generation, their performance is often hindered by the rapid corrosion of metal electrodes in the presence of aggressive chloride ions. To improve the durability of such systems, surface protection strategies are essential. Among various protection methods, electrospun polymer coatings have emerged as a promising solution due to their high surface area, porosity, and ability to form uniform protective barriers. Polyvinyl alcohol (PVA), a biodegradable and water-soluble polymer, has shown potential as a corrosion inhibitor, yet its application on Cu and Al electrodes under varying salinity conditions remains underexplored. In this study, PVA nanofibers were deposited onto metal substrates via electrospinning using a 10 wt% PVA solution with feed rate of 0.3 ml/h, an applied voltage of 10 kV, and a tip-to-collector distance of 15 cm. The morphology and chemical composition of the fibers were characterized using optical microscopy, scanning electron microscopy (SEM), and Fourier-transform infrared spectroscopy (FTIR). Corrosion performance was evaluated through weight loss analysis, corrosion rate measurements, and inhibition efficiency calculations after immersion in 0.5 M, 0.88 M, and 1.25 M NaCl solutions, as well as in 0.88 M seawater. It was observed that the PVA-coated electrodes showed lower corrosion rates in all solutions tested. In 0.88 M NaCl, a solution that closely simulate seawater salinity concentration, the inhibition efficiencies were 82.47% for copper and 74.63% for aluminium, which is notably higher than in natural seawater, where the efficiencies were 64.82% for copper and 55.62% for aluminium, respectively. FTIR analysis confirmed reduced hydroxide formation in coated samples, while SEM-EDX revealed lower accumulation of corrosion products. Thus, this show that the coating performed better in controlled chloride conditions compare to natural seawater.

TABLE OF CONTENTS