

Electrodeposition of Brass Coating: Process Parameter & Surface Characteristics

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Structured Abstract

Background: Copper is well known for its antimicrobial properties, but pure copper coatings are expensive and prone to rapid oxidation. Brass, a copper-zinc alloy, offers a cost-effective alternative with comparable antimicrobial properties and improved durability. Despite growing interest in brass-coated surfaces for touch applications, there is limited information on how electrodeposition parameters control alloy composition and coating performance on stainless steel substrates. This study addresses that gap by optimizing key variables (applied potential and deposition time) to achieve a target (60:40) Cu:Zn ratio.

Methods: Stainless steel coupons (304 grade, 20 × 20 × 1 mm) were polished, ultrasonically cleaned, and coated via electrodeposition in a 0.1 M copper-zinc sulfate electrolyte containing 0.06 M CuSO₄ and 0.04 M ZnSO₄ at pH 1. A three-electrode cell was used with Ag/AgCl as the reference, platinum as the counter, and stainless steel as the working electrode. Applied potentials of -0.5 V, -1.0 V, and -1.5 V were tested for 15 min and -1.0 V was further examined for 30 and 60 minutes. Coatings were characterized by Scanning Electron Microscopy (SEM) for morphology, Energy-Dispersive X-ray Spectroscopy (EDX) for elemental composition, and a tape test for adhesion.

Results: This study shows that all brass coatings were successfully produced. At -1.0 V for 30 minutes, coatings exhibited the most uniform, nodular morphology with minimal defects. EDX confirmed a Cu:Zn ratio of approximately 96:1 by weight, with an oxygen content below 5 wt.%. Adhesion tests showed strong coating-substrate bonding with less coating removal. Coatings deposited at -0.5 V show incomplete coverage, while those at -1.5 V show signs of hydrogen evolution reaction. An extended deposition time (60 minutes) offered no additional benefit compared with the 30-minute sample.

Conclusion: The findings of this study indicated that -1.0 V and 30 minutes were the optimal electrodeposition parameters for producing durable, well-adhered brass coatings on stainless steel. Although zinc incorporation remained below the 60:40 target, the process delivers cost-effective, uniform layers suitable for healthcare-touch surfaces. Future work will explore adjustments to electrolyte composition and the use of additives to further enhance Zn incorporation.

Keywords: Electrodeposition, brass coatings, stainless steel, process parameters, cu-zn ratio

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