

Corrosion Behaviour of Copper and Copper-Coated Stainless Steel in Simulated Hand Sweat Solution

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Structured Abstract

Background: Copper is widely used as an antimicrobial material on frequently touched surfaces due to its ability to kill bacteria and viruses by releasing copper ions. However, its long-term use is limited by corrosion caused by human sweat, which contains chloride ions, acids, and organic compounds. These substances accelerate copper degradation, cause surface discoloration, and reduce the antimicrobial effectiveness of copper-based surfaces. Therefore, selecting a copper-based surface with high corrosion resistance is essential for ensuring long-term performance in real environments. This study investigates the corrosion behaviour of copper and copper coated stainless steel in simulated hand sweat solution to determine their durability and stability in touch surface applications.

Methods: Four samples, consisting of 100% copper and three types of copper coated stainless steel (Coating A, B, and C), were tested. The simulated sweat solution contained 0.5% sodium chloride, 0.1% lactic acid, and 0.1% urea, adjusted to pH 6.5 based on the EN 1811 standard. Electrochemical behaviour was measured using linear polarization resistance (LPR) and Tafel extrapolation methods. Surface morphology was examined before and after immersion using Field Emission Scanning Electron Microscopy (FE-SEM). A 30-day immersion test was also conducted to observe visual surface degradation and solution colour changes throughout the exposure period.

Results: Coating A showed the best corrosion resistance with the lowest corrosion rate (0.658 mm/year) and maintained a stable surface condition throughout testing. Pure copper experienced moderate corrosion and continuous ion leaching, indicated by blue-green solution colour. Coating B exhibited localized pitting due to surface microdefects, while Coating C showed the highest corrosion rate (6.227 mm/year), with severe surface damage including cracking and delamination. FE-SEM analysis confirmed significant surface degradation in the more corroded samples.

Conclusion: The findings highlight that coating quality, immersion time, and surface morphology are key factors in determining corrosion resistance under sweat exposure. Coating A demonstrated the most promising performance for durable antimicrobial applications in healthcare settings.

Keywords: Copper, Corrosion, Copper Coated Stainless Steel, Hand Sweat, Electrochemical Behaviour

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