

THE EFFECT OF SURFACE PROPERTIES ON ANTIBACTERIAL BEHAVIOR OF TITANIUM 6AL-4V COLD SPRAYED COATINGS

Josh Dixon, Fardad Azarmi and Annie X.W. Tangpong
North Dakota State University Biomedical Engineering
Fargo, North Dakota, United States

Corresponding Author: Annie Tangpong
Email: Annie.Tangpong@ndsu.edu
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ABSTRACT

Antibacterial coatings are used to prevent bacterial biofilm formation on high-touch surfaces in public spaces (door handles, water fountains, etc.) Biofilms are resistant to traditional disinfectants due to their self-protective structure. High-touch surfaces are commonly made from materials that do not possess innate antibacterial properties, such as stainless steel. Antibacterial coatings, commonly made from copper and silver, disrupt biofilm formation through contact killing and ion release. Further research must be conducted on antibacterial coatings to improve their long-term usefulness. Titanium 6Al-4V (Ti-64) is a commonly used material in biomedical implants, and it has shown promise in antibacterial coatings for high-touch surfaces. Factors such as protective oxide layers (TiO_2), wettability, and surface roughness properties can affect bacterial adhesion on the surface of Ti-64 materials. Previous research on antibacterial coatings has shown that increasing surface roughness can increase bacterial adhesion. A rougher surface provides the bacteria with more opportunities to adhere and form biofilms. Further understanding this relationship will help improve the efficacy of antibacterial coatings. This research investigated the antibacterial properties of stainless steel, Ti-64 bar, and Ti-64 coated materials produced via cold spray against *Staphylococcus aureus.* The surface roughness and contact angle of each material were measured, and colony forming units (CFU) were investigated after 24 hours of culturing. The oxide layer of each sample was also examined. The results revealed that the Ti-64-coated samples had increased antibacterial properties when compared to stainless steel. The discovery in this work will contribute to future research on antibacterial coatings on high-touch surfaces.

Keywords: Ti-64, antibacterial coating, high-touch surface, biofilm

INTRODUCTION

Reducing the spread of disease-causing species of bacteria continues to be a challenging process. Many disease-causing bacteria are able to survive on dry contact surfaces for months before coming in contact with a potential host. *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* are all common species of bacteria that have shown the ability to survive for months to even more than a year on plastic or metal surfaces. High-touch surfaces in public spaces such as countertops and railings act as a reservoir for bacteria to survive on [1]. In healthcare settings, surfaces of bed rails, surgical tools, light switches, and tables are frequently contaminated with disease-causing bacteria. Contaminating bacteria are able to easily transfer from surfaces to gloves or hands of patients or healthcare workers upon contact [2]. Bacteria biofilm formation on high-touch surfaces presents an additional challenge to reducing the spread of disease-causing bacteria. Biofilms are groups of bacteria encapsulated in a protective extracellular matrix (ECM) that is composed of proteins, polysaccharides, and DNA. Biofilms provide physical protection from antibiotics and disinfecting agents. Bacteria within a biofilm can also communicate with each other due to their close proximity; genetic exchanges can occur quickly to spread antibiotic-resistant genes across the bacteria in a biofilm. **Figure 1** shows the stages of biofilm formation