The Antimicrobial Effect of an Ag-Doped TiO_2-PDMS Coating on *A. baumannii*

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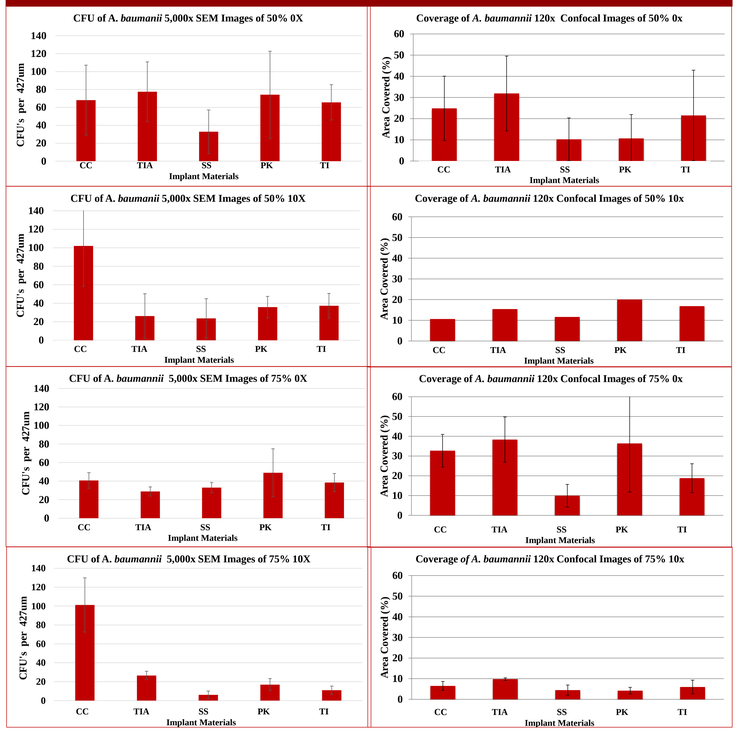
Abstract

Infections are one of the most prevalent complications associated with orthopedic implant surgeries. The rise of multidrug resistant bacteria intensifies the risk of serious complications resulting from infection, as these bacteria cannot be fought with traditional noninvasive treatments.[1] *A. baumannii* is a nosocomial, multidrug bacteria originating in military field hospitals and has since spread to civilian hospitals, where it threatens immunocompromised patients.[2] The objective of this study is to assess the adherence and proliferation of multidrug-resistant *A. baumanii* with varying concentrations of antimicrobial, silver-doped titanium dioxide-PDMS.

Methodology

Spinal implant materials – cobalt chromium, titanium alloy, stainless steel, polyether ether ketone, and titanium – were cut in half lengthwise to form a 2.5mm semicircular rod and dip coated in a Ag-doped TiO_2-PDMS solution overnight to dry. The implants were then inoculated with 2.5 mL of $1x10^7$ CFU/mL of *A. baummannii* in tryptic soy broth and incubated at 4 hours at 37°C to allow adherence, rinsed with PBS, and incubated for another 20 hours to allow proliferation. The *A. baummannii* was then fixed on the implants and prepared for visualization. For confocal scanning laser microscopy, the implants were tagged with an anti-LPS 1° Ab that was then conjugated with a FITC 2° Ab for imaging at 120X. For scanning electron microscopy, samples were dehydrated, dried, sputter coated with gold, and imaged. Images were analyzed via ImageJ. For SEM images, CFU per area were counted. For confocal images, area coverage of *A. baumannii* was calculated.

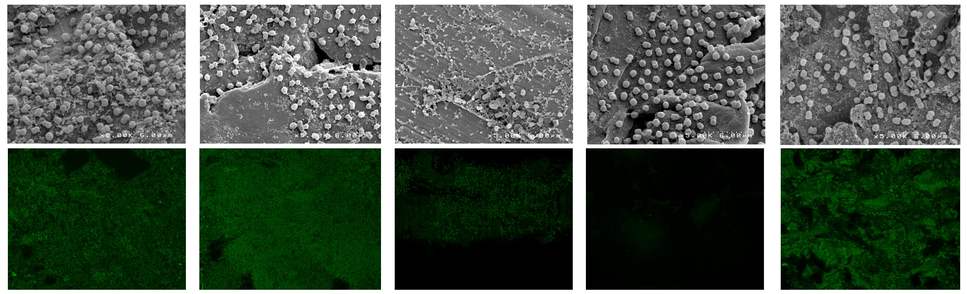
Results



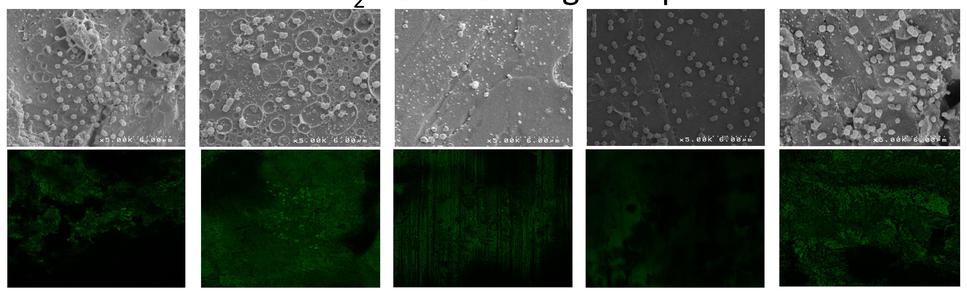
Results

Cobalt Chromium (CC)	Titanium Alloy (TiA)	Stainless Steel (SS)	PEEK (PK)	Titanium (Ti)

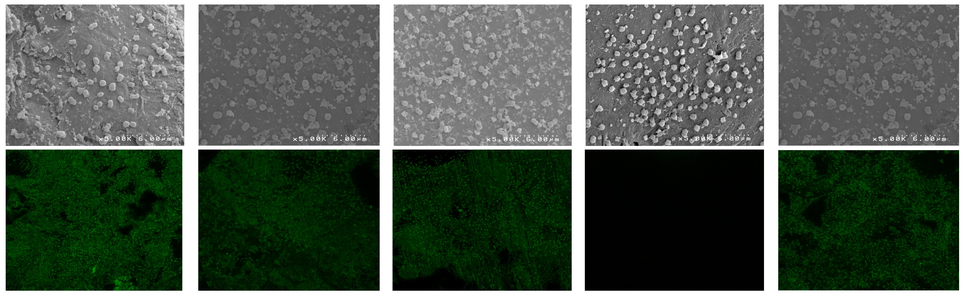
50:50 TiO_2:PDMS 0X Ag Samples



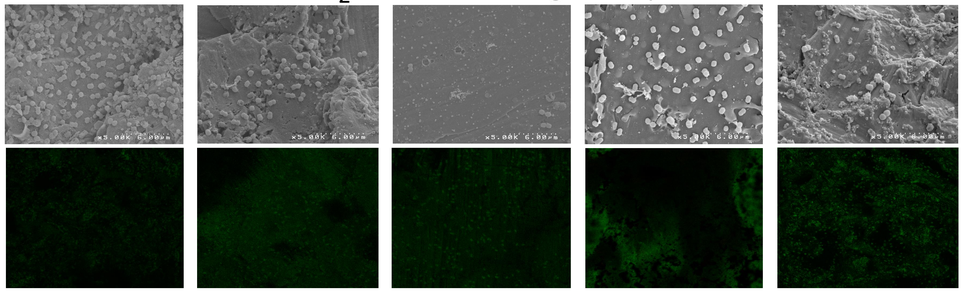
50:50 TiO_2:PDMS 10X Ag Samples



75:25 TiO_2:PDMS 0X Ag Samples



75:25 TiO_2:PDMS 10X Ag Samples



Conclusions

Of the implant materials, *A. baumannii* was least prevalent on SS for nearly every condition. The 75% TiO_2 10x Ag coating was most effective against *A. baumannii* adherence and proliferation. Coatings that were doped with silver were more effective at inhibiting bacteria growth than coatings that were not. Between the doped 50% and 75% TiO_2, the 75% TiO_2 prevented adherence and proliferation of *A. baumannii* to a greater extent, leading to the postulation that the matrix formed by the 75% TiO_2 and 25% PDMS was able to hold and elute more quantities of silver, which endows this coating with stronger antimicrobial properties.

Future Direction

- Test the efficacy of a higher concentration 95% TiO_2 coating against *A. baumannii*.
- Establish controls by testing *A. baumannii* growth on 100% Ag coated and uncoated samples.
- Test the coating on other nosocomial and multi drug resistant bacteria like vancomycin-resistant *E. faecalis.*

References

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2. McQueary, C., Kirkup, B., Si, Y., Barlow, M., Actis, L., Craft, D., & Zurawski, D. (2012). Extracellular stress and lipopolysaccharide modulate Acinetobacter baumannii surface-associated motility. *Journal of Microbiology*, *50*(3), 434–443.

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