

**MS Biotechnology Thesis Defense: Mr. Joshua J. Bazata**

**Thesis Title: SYNTHESIS AND CHARACTERIZATION OF ANTIMICROBIAL  
NON-COLOR FORMING SILVER-SILICA NANOCOMPOSITE**

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**ABSTRACT**

Silver has been utilized for its antimicrobial properties for thousands of years in a variety of fields, extending the shelf life of food and water, rendering eating utensils sanitary, and more recently in biomedical applications such as silver based antiseptic creams. While effective as an antimicrobial agent at very low concentrations ( $\mu\text{g/mL}$ ), silver imparts a strong color to objects it is incorporated into, due to its high plasmonic efficiency. The goal of this study was to determine if incorporating silver nanoparticles into a silica matrix could reduce or eliminate the plasmonic signal, while retaining the antimicrobial effects of the silver nanoparticles. Silver nanoparticles (AgNP) were synthesized and incorporated into silica nanoparticles. To test the antimicrobial efficacy of these synthesized silica coated silver nanoparticles (SiAgNP), minimum inhibitory concentration testing at three time points, 1, 4, and 8 hours, was carried out against *E. coli* and *S. aureus* using broth microdilution and Alamar Blue as an indicator of microbial growth. Efficacy was judged against uncoated AgNP and aqueous silver nitrate ( $\text{AgNO}_3$ ) solutions at equivalent Ag concentrations. Silica nanoparticles (SiNP) were utilized as a negative control. Further antimicrobial characterization using a bacterial viability assay revealed a time dependent killing trend in the SiAgNP, suggesting a controlled release of  $\text{Ag}^+$  from within the silica matrix. Efficacy of the SiAgNP was determined to fall between the most effective antimicrobial form of silver tested,  $\text{AgNO}_3$ , and least effective, AgNP. However, the SiAgNP material exhibited no visible plasmon peak when UV-Visible spectrophotometric readings were taken, as well as remaining colorless when coated onto a ceramic substrate. Zeta potential revealed a high degree of colloidal stability of the SiAgNP. TEM imaging studies were carried out, verifying the presence of Ag within and on the silica nanoparticles, as well as the crystalline structure of the uncoated AgNP. It was determined that coating AgNP synthesized through borohydride reduction with silica through a Stöber synthesis mechanism yields a material with enhanced antimicrobial effects compared to AgNP, but with no detectable plasmon signal, effectively producing a non-color forming silver based antimicrobial.

Keywords: Silver, Silica, Antimicrobial, Surface Coating, Plasmonic

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*Approved for distribution by Dr. (Swadeshmukul Santra), Committee Chair, on 6-29-2015*

***The public is welcome to attend.***