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(U*) (POS-50) Laser-Induced Breakdown Spectroscopy Emission Enhancement from Bacteria on a Silver Thin Film

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Laser induced breakdown spectroscopy (LIBS) is a technique whereby time-resolved optical emission spectroscopy is performed on high-temperature laser-induced plasmas to determine the elemental composition of the target. This lab uses LIBS to identify and classify bacterial pathogens based on differences in the concentrations of inorganic elements in the membrane of bacterial cells. This rapid classification will be used for diagnosing pathogenic bacteria in clinical specimens. Preliminary work using silver microparticles deposited on a nitrocellulose filter underneath the bacterial cells showed promising enhancement of the bacteria's LIBS emission spectra. This motivated work to increase the uniformity of deposited silver for an improved ablation surface and to prevent the silver deposition from being disrupted by the laser shots. A 60 mJ 1064 nm pulsed laser focused onto a rotating silver foil target in a 10 mTorr evacuated environment sputtered a highly uniform silver thin film onto a nitrocellulose filter. Experiments were performed to locate the filter in a position to sputter the most uniform film across the 9 mm filter diameter. Sputtering times from 1 minute to 20 minutes were investigated. Uniformity was determined with LIBS and scanning electron microscopy.
The silver filters were removed from the vacuum sputtering chamber and ablated in an atmospheric pressure argon environment to acquire LIBS spectra. Analysis of the LIBS spectra exhibited decreased shot-to-shot variation in the silver LIBS intensity between subsequent laser pulses when compared to previous experiments on microparticle covered filters. Bacteria specimens were deposited on a silver filter using a centrifugation concentration device. Analysis of the LIBS spectra from bacteria deposited on filters created with a sputtering time of greater then 15 minutes showed a 50-100% increase in the magnesium and calcium ion emission intensity, while neutral element emission intensity decreased, indicating an increase in plasma temperature. While overall LIBS emission enhancement was observed for a *S. aureus* sample deposited on a silver filter compared to an empty filter, no statistically significant increase in the signal to noise ratio was found. Work is ongoing to investigate other silver deposition methods including pulsed laser deposition in a non-vacuum environment to create nanoparticles.

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