A184 Spark - Induced Breakdown Spectroscopy (SIBS) Analysis of Bioaerosols and Biological Warfare Agents

Morgan Steele, MS, 2895 Cherry Way, Parker, CO 80138*

After attending this presentation, attendees will be introduced to a new device and method for air sampling and analyzing harmful biological aerosols. After attending this presentation, participants will understand the principles of Spark-Induced Breakdown Spectroscopy (SIBS), the equipment and techniques used, and how SIBS compares to Laser- Induced Breakdown Spectroscopy (LIBS). The aim of this work was to investigate further use of SIBS for bioaerosols as an alternative to the more expensive and well-known LIBS.

This presentation will impact the forensic community by introducing a unique method for rapidly screening and analyzing biological warfare agents as airborne pathogens. SIBS has the ability to distinguish between atomic spectra of airborne biological particles. These spectra can then be used to differentiate between harmful and harmless biological species, such as Bacillus anthracis (Anthrax) vs. Bacillus thuringiensis (Bt). Therefore, SIBS can be used as a real-time trigger sensor for biological warfare agents.

SIBS was initially developed as a real-time sensor for toxic heavy metals in aerosols at detection limits of 1 to 10 mg/m^3. SIBS uses a high- energy electrical spark between two electrodes to ionize, vaporize and excite the elements of the sample of interest. The aerosol sample passes through the spark gap containing rod-shaped electrodes, which ablates the sample creating plasma. Within this plasma, the ablated material dissociates into ionic and atomic species. After plasma cooling, atomic and molecular emission lines of the sample can be observed. The SIBS apparatus is coupled with a Czerny-Turner Spectrometer and an Andor iCCD detector. The more familiar technique LIBS, on the other hand, is very similar, except that it uses a focused laser pulse as the excitation source. When the highly energetic laser is discharged, it ablates a small amount of the sample and creates plasma.

In this experiment, biological warfare simulants Bt, Ragweed Pollen, and Johnson Grass Smut aerosols were studied in the spectral regions around 380nm. These samples were made into an aqueous suspension and sprayed through a nozzle to create an aerosol standard. Aerosolized DI water and electrode material alone were also studied. The electrodes were originally placed so that the focus of the optics covered the energized side of the gap. The gap was then translated to allow optical probing of the center of the plasma. Finally, the gap was moved further until the emission at the ground side of the gap was in view of the collection optics. In this presentation, we will present data acquired in each of the three locations at a variety of delay times. This presentation will also include unique molecular features found in this spectral region.

The results of this and other studies demonstrate that SIBS can spectrally distinguish between biological and non-biological samples, as well as distinguish between biological samples within the same species. The low detection limit, sensitivity, and discrimination potential of SIBS indicates this system as an alternative to the costly LIBS system. In the future, SIBS could also be useful in other areas of forensics such as trace and drug analysis.

SIBS, Bioaerosols, Air Sampling

 ** Presenting Author*