Biological Applications on a Miniaturized Delayed Extraction Time-of-Flight Mass Spectrometer

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We have designed and built a miniaturized linear time-of-flight mass spectrometer with delayed extraction for improved mass resolution. Applications of interest for this instrument include distinction of biomarker signatures from different species of bacterial spores (biological weapons detection) and rapid mass spectral reading of oligonucleotides that differ by one base (studies of single nucleotide polymorphisms or SNPs).

Instrument dimensions were selected so that the space-focus of the ions occurs at the detector. The 3-inch flight tube is floated at the same voltage (~-2kV) as the detector to minimize fringe-field effects. A gridless Hamamatsu detector (8 degrees bias angle, 4 micro meter channel diameter and 0.5 ns response time) is used. The XY stage currently holds a 1" X 1" sample plate. Samples are ionized at 337 nm with a nitrogen laser.

Replicate measurements on the 12,000 dalton peak of Cytochrome C shows a linewidth of approximately 6 ns (FWHM). This translates to a resolution t/2(delta t) of 564 (standard deviation of 37) for replicates of 3 measurements at the same lasing spot and constant laser power and of 614 (standard deviation of 83) for 11 replicate measurements at constant laser power, but rastering the laser over the sample spot. We have also been able to detect a standard mix of oligonucleotides in positive ion mode, with mass range of 5,000 to 10,000 dalton.