

A Miniature MALDI-TOF Mass Spectrometer Using Electric Fields that are Non-homogeneous in Space and Time

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We are developing a miniature MALDI time-of-flight mass spectrometer that uses a novel electrode geometry and a time-dependent pulsing method to generate an accelerating field that is non-homogeneous in space and dynamic in time. The combination of these technologies has the potential to fundamentally improve space and energy focusing and, consequently, improve the mass resolving power in time-of-flight mass spectrometry. This is potentially useful in a wide variety of applications, including field-portable applications involving the analysis of high-mass ions, for which the resolving power is relatively low due to the small size of the analyzer. It is also important for aerosol particulate analyses, where the starting conditions for individual particles may vary.

Our current instrument platform has an open, gridless design that generates a non-homogeneous electric field with a non-linear field gradient. The instrument has a 2.9 inch diameter and a flight path length that can be varied from 1.5–4 inches in order to alter the electric field distribution. Experimental results indicate that configurations having a 2–3 inch flight path length provide the best performance when the non-homogeneous field is applied using time-lag focusing. The instrument exhibits the unusual property of performing adequately over a wide range of time delays between ionization and application of the electric field. The arrival time at the detector for ions of a given m/z is nearly independent of the delay time for certain instrumental configurations, indicating that the non-homogeneous field exhibits nearly perfect space-focusing properties.

Currently, our efforts are directed at implementing the time-dependent dynamic field to compensate for the initial energy distribution. The combination of the spatially non-homogeneous and time-dependent features should provide complete compensation for the initial spatial and energetic distribution problem. This presentation will show our experimental results achieved thus far and the performance we theoretically expect to achieve when the design is completed.