Miniaturized Planar Electrode Linear Ion Trap (LIT) Mass Analyzer

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Our group is developing a miniaturized planar linear ion trap with good portability and performance by using two ceramic plates with lithographically patterned electrodes. The plate spacing of the trap (r_0 = 0.95 mm) has been decreased to 43% of its original value (r_0 = 2.19 mm), resulting in a significantly smaller trapping region and maintained resolution. It provided the first experimental data of LIT with trapping dimension r_0 less than 1 mm. The resolution of the LIT with plate spacing of r_0 = 0.95 mm is comparable to that of the LIT with r_0 = 2.19 mm.

The smaller plate LIT (r_0 = 362 μm) is a further step for the LIT miniaturization. A new mass analysis method, digital waveform analysis, is applied on the smaller LIT with plate spacing of r_0 = 362 μm. Positive and negative voltages are used in this digital ion trap (DIT) to form trapping and excitation waveforms by rapidly switching between discrete voltages, which causes frequency sweep with improved mass resolution and extended mass range. The experiments on the current device are underway.

Prior to the fabrication, the higher-order field effects were simulated using SIMION 8.0 to provide a model for electrode configuration. Each electrode was designed at different sizes and positions, and the electric field in this condition was determined via SIMION simulation. Higher-order field effects were studied to theoretically determine the ion trap performance. The electrode configuration with optimal quadrupole and higher-order fields was designed for microfabrication and subsequent use in the mass analysis experiment.