Poster Abstract

A High Density Micro-Ion Trap Array Miniature Mass Spectrometer

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We report on a novel approach to develop a high density μ-cylindrical ion trap (HD μ-CIT) array mass spectrometer (MS), with emphasis on reducing the device capacitance, optimizing trap geometry and sensitivity, and improving component alignment to extend the mass range and improve the mass resolution. Microelectromechanical system (MEMS) technologies are used to fabricate the ring and endplate electrodes with micron scale precision. A hexagonal orientation of CITs was adopted to pack more μ-CITs per unit silicon (Si) volume. μ-CIT geometries with a range of radii (r0) (250 - 350 μm) were investigated in SIMION to determine the optimum z0/r0 ratios. To reduce the device capacitance and increase breakdown voltage, a range of spacings between ringΩ and endplate electrodes (up to 60 μm) were also investigated through simulations. Designs for optimum geometries were incorporated in an optical mask for MEMS fabrication. Deep reactive ion etching (DRIE) and potassium hydroxide (KOH)-based etch methods were used to batch fabricate multiple μ-CIT arrays in a single Si wafer. Capacitance between the ring and endplate electrodes was reduced by selectively etching the sputtered metal layers. A package for easy assembly and connections of μ-CIT components was designed and fabricated in Ultem, a transparent plastic material compatible with high vacuum operation. Design of a vacuum system with provision for differential pumping and simultaneous ionization of analytes in all traps in a μ-CIT array is underway. A microchannel plate (MCP) coupled with a multi-anode plate will be used as the ion detector, allowing investigation of the performance of each μ-CIT separately. It is expected that the new design of HD μ-CIT array MSs will provide much higher sensitivity than previously realized. The results obtained from these experiments will help lay the design foundation for the next generation μ-MS systems, paving the way toward a low power handheld chemical analyzer.