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Experimental evaluation of micro-ion trap mass spectrometer geometries

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Miniaturization of mass spectrometers opens up a wide range of new applications that require portability during chemical measurements. Mass production of micro-sized mass spectrometers ultimately reduces production costs, allowing miniaturized spectrometers to be used as point-of-care medical diagnostics instruments. A new fabrication method, simulations, and experimental results for micromachined cylindrical ion trap (μ -CIT) arrays for use in miniaturized mass spectrometers are therefore presented. Simulations were performed in SIMION 7.0 to determine the optimum range of μ -CIT z_0/r_0 to be fabricated and tested. Micromachined μ -CIT arrays were fabricated in a silicon-on-insulator substrate. A series of z_0/r_0 were chosen in incremental steps of 3% for each array by changing r_0 from 308 to 392 μm , while keeping z_0 fixed at 355 μm , resulting in a range of z_0/r_0 from 1.16 to 0.92 (nine geometries in total). This resulted in fast, iterative measurements of the differences in the mass spectra from μ -CITs with different ratios of half-axial to half-radial dimensions (z_0/r_0). A deep reactive ion etching technique was used to create the cylindrical structures. Surface metallization created the ion trap electrodes. Symmetrical arrays of half-CITs were fabricated, diced, and bonded back-to-back to obtain complete μ -CIT array chips. Mass spectra were obtained experimentally from each trap geometry and μ -CIT performance was found to follow the trend with respect to z_0/r_0 observed in the simulations. Axial modulation on one endplate electrode resulted in mass spectra with full-width-at-half-maximum peaks of 0.4 amu.

Biography

Friso H W van Amerom holds a PhD in Physical Chemistry from the University of Amsterdam and University Leiden (Netherlands). He is a Research Scientist at SRI International and Managing Director of Mini-Mass Consulting, Inc., delivering services and expertise to clients in the field of mass spectrometry. He reviews scientific instrumentation for customers and works with NASA, focusing on building and testing mass spectrometers for planetary sciences.

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