Development of a Miniature Rectilinear Ion Trap Array with Independently Controlled Channels

[1]P. HENDRICKS, [2]J.D. MAAS, [2]W.J. CHAPPELL, [1]R.J. NOLL, [3]Z. OUYANG, [1]R.G. COOKS

[1]Purdue University, Department of Chemistry, West Lafayette, IN
[2]Purdue University, Department of Electrical Engineering, West Lafayette, IN
[3]Purdue University, Department of Biomedical Engineering, West Lafayette, IN

An eight-channel array of miniaturized rectilinear ion traps (RIT) with electrically isolated electrodes has been constructed using stereolithography (SLA) technology. The trapping dimensions for each channel measure 1.66 x 1.33 x 16.66 mm, X0, Y0, and Z respectively, and are arranged in a circular pattern around a single central detector. The array is metal plated through uniform electroless Cu deposition, and then subject to metal ablation using a high aspect ratio laser for electrical isolation of each electrode. Using bias tee networks and dedicated operational amplifiers individual ion trap control can be used to improve the overall spectral quality of the device by compensating for dimensional variation of between ion trap channels. The device is operated using a discontinuous atmospheric pressure interface (DAPI) for direct sampling of externally generated ions therefore operated at pressures of ~10-1 to ~10-2 Torr during sample introduction and at the start of mass analysis. Single channel performance for mass spectral resolution is approximately 1 to 2 Th FWHM across the mass spectrum and detection of chemical species in excess of m/z 1000 is demonstrated. Due to the miniaturized size, low amplitude voltages can be utilized for the RF. Detection of the entire charge state envelope (+14 to +26) for intact proteins such as myoglobin 17 kDa) was completed at RF amplitudes of less than 1500 Vp-p (950 kHz drive RF). Additionally, improved sensitivity and dynamic range of 0.1 ug/ml to 10 ug/ml propranolol is demonstrated through parallel operation of multiple ion traps and tandem MS.