MEMS Assembled Ion Optical Devices: Current Technology and a Look at Advantages and Disadvantages

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Miniature analytical devices have recently become a growing area to produce handheld, field-portable instrumentation. Because of the difficulty to micromachine optical components and features with small aberrations, it is necessary to incorporate new doped silicon micro-electro-mechanical system (MEMS) methods. This technique allows for precise manufacturing of small electrical and mechanical device assemblies.

I will introduce some of the devices currently being developed in my lab as well as an introduction to this new and growing field. My group have created and tested ten new MEMS based ion optical assemblies. This list includes the Bradbury-Nielsen Gate, cylindrical ion trap, time-lag focusing TOF, reflectron optics, einzel lens, electron beam collimator, periodic focusing, and ion mobility. Data will be presented showing the resolution, attenuation, and performance of each of these devices. With the ability to utilize multiple substrates such as Pyrex, sapphire, and aluminum nitride, we can make ion lenses that can withstand an applied potential >2kV before breakdown.

I will also discuss some of the advantages and disadvantages of this technology. The smaller the devices, the more "space-charge" effects and aberrations play dominate roles. I will introduce these concepts, and look at ways of overcoming these potential problems.