Development of a Compact, Isobaric Chamber for High Pressure Mass Spectrometry of Ambient Organics

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Considerable effort has been directed towards development of compact mass spectrometry systems over the past decades. This work has resulted in many transportable instruments that retain most of the functionality and performance of their benchtop counterparts. Realization of a mass spectrometer with a handheld form factor has remained elusive, despite all of these efforts. Eliminating the turbomolecular pumps required by nearly all these instruments allows a significant reduction in system size, weight, and power (SWAP). High pressure mass spectrometry (HPMS) conducted at pressures > 1 torr will allow the use of small, rugged mechanical pumps and has been the focus of our lab for the past several years. We have previously developed and demonstrated HPMS with the use of microscale quadrupole ion traps.

Towards the development of a hand held mass spectrometer we have developed an extremely compact and light weight vacuum chamber to house the ion source, mass analyzer, and detector. These components are all contained in a chamber with dimensions less than 1” × 1” × 2” and pumped with a single mechanical pump. Ambient air is introduced at low flow rates and used as sample introduction and for the ion trap buffer gas. Direct current glow discharge is used as a low power electron source for in-trap electron impact ionization. The formed ions are then mass analyzed in sub-millimeter ion traps and detected using a Faraday cup and charge sensitive amplifier detector. Mass spectra will be shown of several organic analytes sampled from ambient atmosphere, and the instrument performance metrics will be compared at varying buffer gas pressures up to 1 torr.