

Advanced Miniature Linear Ion Trap Mass Spectrometer for Space Applications

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Planetary Environments Lab at NASA-GSFC is developing the next generation miniature linear ion trap mass spectrometer (LITMS) by building upon the significant heritage of a Mars Organic Molecule Analyzer (MOMA) mass spectrometer (MS) destined for Mars onboard the ExoMars 2018 rover. The LITMS instrument enables analysis of i) volatile/semi-volatile organic compounds via electron impact (EI) ionization and ii) non-volatile/refractory organic and inorganic content in samples under Mars-ambient conditions via laser desorption ionization (LDI). It combines the dual source ion trap MS with a compact high temperature pyrolysis oven and precision core handling & subsampling system, which together allow pyrolysis/evolved gas analysis (EGA) of sampled fines from drill core samples and direct probing of cores via LDI for detailed chemical and mineralogical analysis of sub-mm-scale layers in drilled cores.

LITMS retains advanced analytical capabilities of its MOMA predecessor, such as unit mass resolution up to 500 Da, MS/MS mode of operation for molecular structure analysis, and Stored Waveform Inverse Fourier Transform (SWIFT) filtering for select ion(s) enrichment. Additionally, LITMS implements significant enhancements such as the expanded low and high mass cut-off for a full mass range of 20-2000 Da, dual-polarity ion detection, and a high temperature pyrolysis oven (1300°C). Here, we focus on recent progress toward demonstrating positive/negative (dual polarity) ion detection capability and present results of LDMS analyses on cored samples and EGA of synthetic mineral mixtures.