

Low-Pressure ICP-MS for Planetary Trace Elemental Analysis

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Inductively coupled plasma mass spectrometry (ICP-MS) is the gold standard for elemental analysis. However, due to rigorous size, power, and gas consumption constraints, ICP-MS techniques have not been employed for planetary exploration. Currently, the standard for elemental analysis during planetary exploration is laser desorption mass spectrometry (LDMS; e.g., MOMA onboard the ExoMars rover) or laser-induced breakdown spectroscopy (LIBS; e.g., ChemCam on the Curiosity rover). However, these techniques do not offer the detection limits required for accurate quantitation of trace elements at ppmw levels and below.

We are developing a mission enabling miniaturized ICP-MS system with an advanced quadrupole mass spectrometer based on the heritage design of SAM QMS space flight instrument. The ICP-MS system under development employs a reduced-pressure plasma that requires only a fraction of the power (<20W) and gas supply (<200 SCCM) of the conventional system. Our current and ongoing efforts will be presented that includes preliminary studies regarding reduced-pressure argon and helium plasmas, Langmuir probe studies, ion extraction with a two-lens system as the interface, and preliminary mass spectrometric measurements with a custom QMS system.