

A Newsletter for the Advancement of Field-Deployed Mass Spectrometers

Exploring Mars

This edition of the HEMS newsletter focuses on the recent successful landing of the Mars lander/rover Curiosity. Over the years, several probes have been designed and launched by numerous agencies (NASA, Soviets/Russians, British, ESA, etc.) with only a handful achieving the mission goals. Of these probes, many of the have included mass spectrometers (MS). Below is a quick list of all probes to successfully land.

In 1971, the first successful probe to land on Mars was the Soviet Union's Mars-3, which included a mass spectrometer. Unfortunately the probe only communicated for a few seconds and no MS data was returned. In 1976, the United States successfully landed two probes on Mars (Viking I and II), both of which included gas chromatograph-mass spectrometers. The next three probes to successfully land on Mars, Mars Pathfinder (landed 4-Jul-1997), Mars Exploration Rovers Spirit (MER-A) (landed 4-Jan-2004), and Opportunity (MER-B) (landed 25-Jan-2004), did not have a MS. Landing on 25-May-2008, Phoenix carried the Thermal and Evolved Gas Analyzer (TEGA) a high-temperature furnace with mass spectrometer, which measured water, carbon dioxide, methane and other organics.

Sincerely, C Richard Arkin (Arkin.HEMS@gmail.com)

Sample Analysis at Mars

A mass spectrometer has landed on Mars! Oh yes, and it was accompanied by the Curiosity rover, which successfully touched down in Gale Crater on August 5, 2012. Along with the nine other science investigations on Curiosity, the Sample Analysis at Mars (SAM) Suite, developed by NASA's Goddard Space Flight Center (Principal Investigator: Dr. Paul R. Mahaffy) and its partners, will robotically explore the habitability of Mars over the next two Earth years. Gale shows evidence of ancient deposition of water-borne minerals and may preserve chemical, organic, and isotopic signs that Mars could have supported life in the distant past. SAM (upper panel) is actually three instruments: a quadrupole mass spectrometer (QMS), a gas chromatograph (GC), and a tunable laser spectrometer (TLS). They analyze the composition of the Martian atmosphere as well as solid samples collected by the rover's arm-based drill and delivered through solid sample inlet tubes (SSIT) to one of SAM's 74 pyrolysis cells. The QMS (middle panel) is a 2-535 Da

instrument with electron impact ionization, both unit and fractional scanning, and a dynamic range of 10^6 . All three instruments are supported by an extensive chemical processing and separation lab including 54 microvalves and two wide-range turbomolecular pumps that exhaust directly to Mars ambient pressures (~5-6 Torr). The SAM Suite is approximately the size of a microwave oven and was designed with great care to withstand the rigors of the mission. After roving a while, Curiosity will begin explore the amazing layered terrain of Mt. Sharp at the center of Gale (lower panel). SAM is operating extremely well and has already conducted its first atmospheric analysis, which is excitedly being poured over by team scientists.

Go Curiosity!

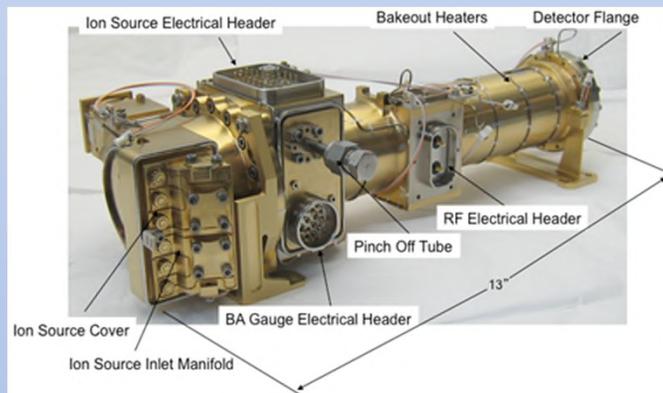
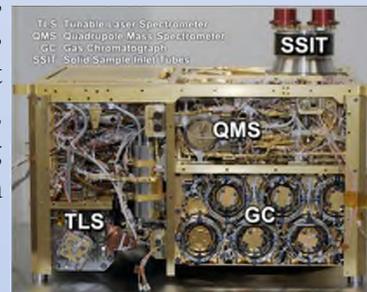


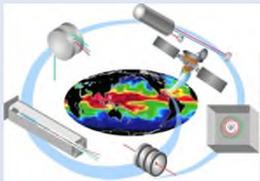
Image Credit: NASA/JPL-Caltech/MSSS

See also:

<http://mars.jpl.nasa.gov/msl>

<http://ssed.gsfc.nasa.gov/sam/index.html>

Submitted by: Will Brinckerhoff, GSFC, NASA.



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Martian Turbo Pump

When asked to submit an article to the HEMS newsletter, the Mars Science Laboratory, Curiosity rover was less than a week from touchdown on Mars, and the discussion in the media was about whether it would land safely, or crash and burn. As you no doubt know, Curiosity is already motoring along in Gale Crater.

However, for us at Creare the real nail-biter came two weeks after touchdown, when the SAM (Sample Analysis at Mars) instrument commissioning took place and they spun up our vacuum pumps for the first time. The SAM instrument, built by Paul Mahaffy's group at NASA Goddard includes a six column gas chromatograph (GC), a quadrupole mass spectrometer (QMS) and a tunable laser spectrometer (TLS) as well as a complicated gas processing system and two miniature turbomolecular/molecular drag (TMP/MDP) vacuum pumps designed and built by Creare. The pumps provide 10^{-7} – 10^{-8} Torr vacuum level for the QMS and TLS and exhaust directly to a 5-6 Torr Martian atmosphere of mainly CO₂. The two pumps provide all the SAM gas flow and have to operate over a large temperature range (-40C - +60C) as well as being able to start and stop hundreds of times.



It was a great relief that the pumps spun up to their prescribed 100,000 rpm without problems and proved that they had safely survived rocket launch from Cape Canaveral, a nine month journey through the cold of outer space and the “seven minutes of terror” during landing. The pumps will now provide the vacuum levels necessary for the SAM

instrument to pursue the answer to the main science question of MSL: “Was Mars ever inhabited?”

Submitted by: P. Sorensen & R. Kline-Schoder, Creare Inc.

Upcoming Conferences

SciX - SCientific eXchange (formerly known as FACSS)
30 September – 5 October, Kansas City, MO

Asilomar Mass Spectrometry in Food Safety and Quality
5 – 9 October 2012, Pacific Grove, CA

AVS 59th International Symposium and Exhibition
28 Oct – 2 Nov 2012, Tampa, FL

Sanibel Conference – Top Down Mass Spectrometry
24-27 January 2013, St. Pete Beach, FL

Mass Spectrometry Applications to the Clinical Laboratory
09-13 February 2013, San Diego, CA

Pittcon Conference and Expo
17 – 21 March 2013, Philadelphia, PA

61st ASMS Conference on Mass Spectrometry
9 – 13 June 2013, Minneapolis, MN

9th Workshop on Harsh Environment Mass Spectrometry
15-18 September 2013, St. Pete Beach, FL

Announcements

- The 9th Workshop on Harsh Environment Mass Spectrometry (HEMS) will be held at the Don CeSar Resort, St. Pete Beach, FL from 15-18 September 2013. Visit www.HEMS-workshop.org for additional details.
- There is a HEMS Workshop Group on LinkedIn as a forum for people to discuss real-time issues/solutions, job postings, and the like.

Call for Articles

Tell us about your lab, research, project, instrument, or just an opinion. Please submit articles to Richard Arkin (Arkin.HEMS@gmail.com).