

## **Title**

Mass Spectrometry on Mars: Looking Towards the Future

## **Abstract**

Mass spectrometry originally arrived on Mars over 30 years ago with the Viking lander. Since then numerous instruments have sent back data from Mars, with each gaining in capability as well as complexity. NASA's Curiosity rover, currently operating on Mars, contains a very capable (and complex) quadrupole filter based mass spectrometer as part of the Sample Analysis at Mars (SAM) instrument suite. NASA is also actively building a next generation linear ion trap based mass spectrometer for the Mars Organic Mass Analyzer (MOMA) instrument, which will travel to Mars on the European Space Agency's ExoMars rover set to launch in 2018.

The overarching goal of these instruments has been to investigate the potential for Mars to support life. A great deal of data has been obtained to begin to address this very difficult question. Over one year into its mission on Mars, SAM has provided data that points to the potential for Mars to have supported life at one time.

The goals of the MOMA instrument build on the capabilities of SAM in an effort to investigate the Martian environment with added breath and depth. The MOMA mass spectrometer consists of a custom linear ion trap mass spectrometer with two modes of operation: laser desorption ionization (LDI) at Mars ambient conditions (5-7 Torr of mainly CO<sub>2</sub>) and electron ionization (EI) of gas chromatograph effluent. The overall instrument design, function and performance are uniquely suited to the environment in which it will operate. This environment has also demanded many technological developments in order to enable the complex operational modes while still fitting within the operational constraints of a Mars lander mission. The design of MOMA is currently being finalized and the full capabilities of the instrument are being tested. These capabilities, when applied to the analysis of the surface and subsurface of Mars, have the potential to significantly enhance our understanding of what (if any) past or present life exists on one of our nearest neighbors.

## **Bio**

Ryan M. Danell is the President and founder of Danell Consulting, Inc. and specializes in mass spectrometer instrument simulation, design, and control. His research interests are focused on enabling high performance instrument operation through unique designs resulting in novel solutions to current and future analytical problems. His expertise is equally split between computer simulation, hardware design and software development. His clients include small start-up companies, large multinational instrument companies as well as research institutions, government labs and universities. Dr. Danell received his B.S. degree in Chemistry from Harvey Mudd College in Claremont, CA in 1997 and his Ph.D. in Analytical Chemistry in 2001 from the University of North Carolina at Chapel Hill.