

PROJECT SUMMARY

Purpose of the Research

In situ resource utilization (ISRU) is essential for several of NASA's future flagship missions. Currently envisioned ISRU plants include production of oxygen from hydrogen reduction of lunar regolith and extraction of water from Martian regolith or asteroid material. NASA's Regolith & Environmental Science and Oxygen & Lunar Volatile Extraction (RESOLVE) mission's objectives are to analyze the distribution of volatile compounds in the lunar surface and to demonstrate ISRU operation on the moon. To support ISRU activities, NASA requires the development of a compact, lightweight gas chromatograph/mass spectrometer (GC/MS) instrument that can quantify volatile gases with masses below atomic number 70 released by sample heating. The instrument must also be designed to withstand exposure to the release of HF, HCl, or Hg that may result from heating regolith samples to high temperatures. Creare proposes to design, build, and test a compact, lightweight GC/MS system capable of detecting, identifying, and quantifying 100 ppm to 100%-level concentrations of relevant compounds having mass less than 70 amu.

Brief Description of the Research Carried Out

Creare built a prototype GC/MS system based on commercial off-the shelf analytical instruments. These instruments were complemented with a sample delivery system and heated plumbing lines. The gas flow was controlled with high-temperature solenoid valves, and a software system was devised to control these valves and to collect data from the instrument.

Research Findings or Results

The testing of the system showed that we were able to quantify all relevant compounds to a limit of detection less than 100 ppm, much better than the 1% concentration requirement. In particular, we demonstrated that samples of water varying in concentration from 400 ppm to 100% could be injected into the system and quantified accurately without any detectable water carry-over.

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