NASA Phase I Project Summary

Firm: Creare Incorporated
Contract Number: NNX10CF13P
Project Title: Compact Vacuum Pump for Titan Lander Missions

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)

NASA has a need to develop small, robust, low-power and lightweight vacuum systems for various planetary and terrestrial scientific instruments, notably mass spectrometers (MS) and electron microscopes (EM). Planetary atmospheric and solid sample analysis using MS and EM include planned missions to Mars, Jupiter's moons, and the major moons of Saturn, notably Titan, and will require vacuum pump capabilities exceeding current technology. Terrestrial applications within NASA include atmospheric sampling instruments in support of several space-based remote atmospheric sensing systems. Another NASA application that would benefit from such a vacuum system would be an air sampling instrument for the International Space Station. Commercial applications include portable MS systems used for air sampling, radioactive material identification, homeland security applications, etc. One of the biggest factors preventing the development of truly low-cost, rugged, and portable mass spectrometers, is the size and cost of the high vacuum systems required for their operation.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)

To achieve our overall project goal, our Phase I research focused on the design, fabrication, and testing of key components of a regenerative pump capable of compressing exhaust gas from our turbo molecular pump and exhausting directly to an Earth or Titan atmosphere. We also developed a preliminary design for the complete pump to be built during Phase II.

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)

During this project, we achieved or exceeded all of our Phase I technical goals. We demonstrated that our innovative regenerative pump meets the pumping requirements to be able to exhaust to 1.5 atm (150 kPa) while generating an inlet pressure of less than 10 torr (1.33 kPa) and consuming less than 25 watt. We further demonstrated that this pumping performance can be achieved in a lightweight package of less than 200 gram. Finally, we confirmed our model predictions that we further used to make predictions about the performance of a full-up CVP.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)

Portable and battery-powered vacuum pumps are an enabling technology for next-generation spacecraft. By greatly reducing the size, mass, and power of vacuum support equipment without compromising key performance measures, the extremely miniaturized high vacuum system will enable deployment of scientific instruments on spacecraft and on Earth atmospheric instruments.

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)

The compact vacuum system technology developed in this project will find a number of applications in portable gas analysis equipment. Portable gas analysis systems are a powerful tool for pollution monitoring, process control, and trace element determination. We especially anticipate the development of handheld residual gas analyzers and helium leak detectors that could find a very large commercial market. The military also has a great interest in highly portable gas analysis equipment for the detection of chemical and biological weapons.

Name and Address of Principal Investigator: (Name, Organization, Street, City, State, Zip)

Paul H. Sorensen, Creare Inc., 16 Great Hollow Rd, Hanover, NH 03755

Name and Address of Offeror: (Firm, Street, City, State, Zip)

Creare Inc., 16 Great Hollow Rd, Hanover, NH 03748