Y-12

OAK RIDGE Y-12 PLANT

LOCKHEED MARTIN

Project Accomplishment Summary
for
DOE Technology Transfer Initiative
Project 95-Y12P-002-XX

RAPID SCANNING MASS SPECTROMETER

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PROJECT ACCOMPLISHMENT SUMMARY

Title: Rapid Scanning Mass Spectrometer
DOE TTI No.: 95-Y12P-002-XX
CRADA No.: Y1295-0394
Partner: Vacuum Technology, Inc.

BACKGROUND

Mass spectrometers and residual gas analyzers (RGA) are used in a variety of applications for analysis of volatile and semi-volatile materials. Analysis is performed by detecting fragments of gas molecules, based on their mass to charge ratio, which are generated in the mass spectrometer. The analysis results are typically in the form of qualitative identification, gas phase composition, or flow rate. When used as a detector for a gas chromatograph, they function as a means to quantitatively identify isolated volatile species which have been separated from other species via the gas chromatograph.

Vacuum Technology, Inc. (VTI) produces a magnetic sector mass spectrometer/RGA which is used in many industrial and laboratory environments. In order to increase the utility of this instrument, it is desirable to increase the mass scanning speed, thereby increasing the number of applications for which it is suited. This will allow VTI to package their mass spectrometer/RGA with gas chromatographs as well as enter other gas analysis markets.

DESCRIPTION

This project was used to modify VTI's computer/mass spectrometer interface to allow the mass spectrometer to acquire rapid scans. The computer interface sends signals from the PC to the mass spectrometer, controlling its filament, giving scan instructions, and selecting the proper electrometer range, and detector. It then receives the detector output in the form of amplified digital signals from the electrometer. A block diagram of this process is shown in Figure 1. This project performed the following three upgrades on the computer interface. 1. A new electrometer was designed and built to process the signal from the detector. This new electrometer is more sensitive, over 10 times faster, and over 100 times more stable than the electrometer it will replace. A picture of the prototype of this electrometer is shown in Figure 2. 2. The controller EPROM was reprogrammed with new firmware. This firmware acts as an operating system for the interface and is used to shuttle communications between the PC and the AEROVAC mass spectrometer. The new firmware allows digital signals to be transmitted considerably faster to and from the mass spectrometer than the old firmware. Figure 3 shows the location of the EPROMS where this firmware resides. 3. The voltage regulator which causes the ion selector voltage to ramp to allow ions of selected mass to be sequentially detected was redesigned and prototyped. The redesign allowed obsolete electronics in the regulator circuitry to be replaced with more efficient circuitry. The redesigned voltage regulator can be ramped up or down more than 100 times faster than the existing regulator. Figure 4 shows a picture of the prototype voltage regulator circuit.

These changes were incorporated into a prototype unit and preliminary performance testing conducted. Results indicated that scanning speed was significantly increased over the unmodified version.

Essentially all work on this project was performed at the VTI factory using VTI equipment and materials. Larry Mooney, Lockheed Martin Energy Systems, and Ziad Burbar (VTI) worked jointly on the computer programming. William Andrews, Lockheed Martin Energy Research, and Ziad Burbar designed the electrometer and voltage regular which were tested by Ziad Burbar. Mark Boeckmann (VTI) was responsible for the overall system construction and testing, while John Leckey (LMES) was responsible for program administration.

ECONOMIC IMPACT

The product of this CRADA was a significantly upgraded mass spectrometer/RGA prototype capable of rapidly acquiring mass spectral data. VTI will be marketing this improved system in mid-1997 and has an annual sales goal of 40 to 60 units of this type.

BENEFITS TO DOE

A potential customer for this rapid scanning mass spectrometer is the DOE nuclear weapons surveillance program, where the mass spectrometer could be used on-site at surveillance disassembly facilities at Y-12, Pantex, and Los Alamos National Laboratory.

PROJECT STATUS

The CRADA was completed in November 1996.

PROJECT EXAMPLES

A sketch of the mass spectrometer/RGA system and some photographs of the improved system are attached.

COMPANY SIZE

Vacuum Technology, Inc., has 30 full time-equivalent employees and annual sales of \$4 million.

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RELEASE OF INFORMATION

Information about this CRADA may be released to the public.

VTI MASS SPEC SCHEMATIC

Figure 2. New electrometer prototype.

Figure 3. EPROM exhibit.

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