National Aeronautics and Space Administration

NASA Technology Improves Identification and Analysis of Materials

New XRF device widely used by NASA, preferred instrument for museums

Photos courtesy of Bruker Corporation.

NASA's Marshall Space Flight Center and KeyMaster Technologies Inc. developed a vacuum attachment for a handheld X-ray fluorescence (XRF) analyzer that provides expanded capacity for determining the identity and amount of light-element alloys that are present in any material. The innovation has been used by NASA to detect and evaluate the composition of aluminum and other light elements that are prevalent in NASA flight hardware, and it expands the capacity for conducting research and tests that require identification of the precise elemental composition of materials. The technology was patented and licensed to KeyMaster—which has since been acquired by Bruker Corporation—and it has been used commercially throughout the world for conservation and authentication of artwork and artifacts, research, and in a variety of other applications.

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Benefits of Technology Transfer

- **Expanded capacity:** Detects aluminum and other light alloys with a handheld XRF device, not possible with other handheld XRF devices
- **Diverse uses:** Allows elemental analysis in many different applications, including research and testing and quality control of flight hardware, artifacts, and a variety of consumer products
- **Portable:** Provides additional sensitivity; yet maintains a lightweight, handheld design
- **Non-destructive:** Obtains precise readings without damaging the surface of the tested object

success

On the Record

"The assistance of Marshall's Technology Transfer Office was essential to the development of the vacuum technology for the XRF system, and NASA's participation added credibility when our small company began marketing this new product." — *Dr. Bruce Kaiser, Co-inventor, Former President of KeyMaster, and Current Chief Scientist for Bruker Elemental*

"When we began to develop the vacuum technology, there were no portable or handheld instruments available to identify aluminum, which is used extensively in flight hardware and welding rods. The technology helped to meet a NASA need and has also taken off in the museum market."— *Fred Schramm, Co-inventor, Marshall Space Flight Center Technology Transfer Office*

About Bruker Corporation

With more than 4,000 employees and 90 locations on all continents, Bruker Corporation is a leading provider of high-performance scientific instruments and solutions for molecular and materials research, as well as for industrial and applied analysis. Bruker purchased KeyMaster and the license and patents related to the Tracer family of portable XRF products in 2006. The Tracer XRF devices are part of the Bruker Elemental line of products, which includes handheld X-ray spectrometry and optical emission spectrometry.

Technology Origins

In 2001, NASA's Marshall Space Flight Center Technology Transfer Office identified KeyMaster as a partner to meet NASA's need for a specialized identification device for light elements in order to analyze space shuttle propulsion systems on the launch pad. Prior to this advancement, all handheld XRF scanners on the market were limited to the detection of heavier metals because air impeded the detection and processing of the weak return X-rays from metals lighter than titanium.

NASA and KeyMaster signed a Space Act Agreement to collaborate on improving and adding capabilities to the company's existing XRF analyzer. As part of the agreement, NASA provided the materials for a prototype as well as technical expertise to evaluate the new capability, and KeyMaster provided the product expertise and facilities needed to continue to develop the XRF. The technology was patented and the vacuum technology was licensed to KeyMaster in 2004. Now marketed as Bruker's Tracer III-SD and Tracer III-V, the devices have a wide variety of uses for NASA and the commercial marketplace.

About the Technology

The vacuum pump attaches in a snap-on fashion to a handheld XRF device, without creating limitations to portability. By greatly reducing the atmosphere between the sample and the detector, the new device with the vacuum pump is the first handheld XRF to detect aluminum alloys that are used frequently in flight hardware. The new technology allows quick and easy analysis of non-uniform materials and concentration analysis of uniform materials consisting of elements from magnesium to plutonium. The instrument's high sensitivity allows the user to identify the elements of a sample matrix with concentrations as low as parts-per-million. The sensitivity, power, lightweight-design, and non-destructive performance of Bruker's Tracer XRF analyzers places them on the cutting edge of handheld XRF technology.

Addressing a Need through Partnership and Technology Transfer

NASA has purchased Tracer units to conduct failure analysis of materials, analyze welding rods on external tanks, and evaluate flight hardware for contamination, corrosion, and material deviations. The technology can be used by NASA for research or tests that require the identity and amount of each element in a material to be determined, such as for quality control in the creation of simulated regolith in preparation for traveling to the moon.

In the commercial marketplace, Tracer's ability to identify the composition and concentration of elements in a non-destructive fashion has made it the instrument of choice for use with art and archeological artifacts in museums. Major museums throughout the world use the device to determine the origin of valuable objects or obtain elemental data for a geochemical survey, often a critical tool in supporting authentication. The device also helps museums with restoration work by identifying the composition of pigments and other materials in damaged paintings or other artifacts.

Tracer is also used widely for research and teaching, mining and exploration, material screening and identification, and for testing the composition of consumer products—such as medicine and vitamins—to ensure the products contain the desired concentration of elements and to identify harmful contaminants. As part of The Carpet and Rug Institute's (CRI) Seal of Approval Program, CRI and an independent laboratory have used the device to measure the effectiveness of vacuums and extractors by analyzing the precise amounts and types of soils removed from carpet samples. More than 500 museums and universities worldwide use Tracer XRF analyzers for their testing and research needs.

For More Information

If you would like more information about this technology (MFS-31898-1) or about other technologies available for license, please contact:

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Fuentek is a contractor to NASA's Innovative Partnerships Program, providing support for the access and transfer of technology.