

using bar codes and matrix codes to be much more secure. Finally, it is expected to find its way into the courtroom, having the unique insight as to which object is genuine and which is not. Authentication using XRF DEDS may well be the next-generation expert witness in product liability cases.

*This work was done by Harry F. Schramm of Marshall Space Flight Center and Bruce Kaiser of Keymaster Technologies, Inc. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov.*

*In accordance with Public Law 96-517, the contractor has elected to retain title to this in-*

*vention. Inquiries concerning rights for its commercial use should be addressed to:*

*Keymaster Technologies, Inc.  
415 N. Quay Street, Suite 1  
Kennewick, WA 99336*

*Refer to MFS-31886, volume and number of this NASA Tech Briefs issue, and the page number.*

## Identifying Objects via Encased X-Ray-Fluorescent Materials — the Bar Code Inside

**XRF spectra would be used as labels, similarly to bar codes, inside a product.**

*Marshall Space Flight Center, Alabama*

Systems for identifying objects by means of x-ray fluorescence (XRF) of encased labeling elements have been developed. The XRF spectra of objects so labeled would be analogous to the external bar code labels now used to track objects in everyday commerce. In conjunction with computer-based tracking systems, databases, and labeling conventions, the XRF labels could be used in essentially the same manner as that of bar codes to track inventories and to record and process commercial transactions. In addition, as summarized briefly below, embedded XRF labels could be used to verify the authenticity of products, thereby helping to deter counterfeiting and fraud.

A system, as described above, is called an “encased core product identification and authentication system” (ECPIAS).

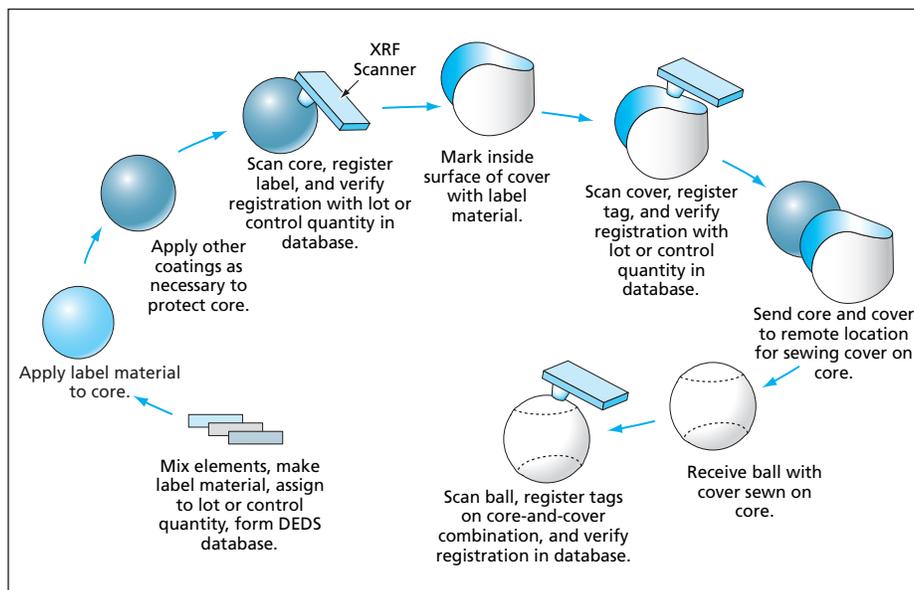
The ECPIAS concept is a modified version of that of a related recently initiated commercial development of handheld XRF spectral scanners that would identify alloys or detect labeling elements deposited on the surfaces of objects. In contrast, an ECPIAS would utilize labeling elements encased within the objects of interest.

The basic ECPIAS concept is best illustrated by means of an example of one of several potential applications: labeling of cultured pearls by labeling the seed particles implanted in oysters to grow the pearls. Each pearl farmer would be assigned a unique mixture of labeling elements that could be distinguished from the corresponding mixtures of other farmers. The mixture would be either incorporated into or applied to the surfaces of the seed prior to implantation in

the oyster. If necessary, the labeled seed would be further coated to make it non-toxic to the oyster. After implantation, the growth of layers of mother of pearl on the seed would encase the XRF labels, making these labels integral, permanent parts of the pearls that could not be removed without destroying the pearls themselves. The XRF labels would be read by use of XRF scanners, the spectral data outputs of which would be converted to alphanumeric data in a digital equivalent data system (DEDS), which is the subject of the previous article. These alphanumeric data would be used to track the pearls through all stages of commerce, from the farmer to the retail customer.

In another potential application (see figure), an ECPIAS would be used to track softballs. Softball cores and covers are typically manufactured in the United States and shipped offshore where the covers are sewn on. At present, in order to verify the origin of a shipment of assembled softballs returning to the United States, it is necessary to take some balls as samples, cut their covers off, and examine their cores. In contrast, the ECPIAS would make it possible to verify the origin of the balls quickly and nondestructively. The ECPIAS concept could also be applied to other products in which XRF labels could be permanently encased. Examples include balls used in high-profile sports, tires, printed-circuit components, layered clothing items (e.g., shoes), and critical aircraft components.

The ECPIAS is a “next logical step” technology that gives an OEM a new safeguard for product liability. With the bar code inside the part or even mixed with the material of the



**Softball Cores and Covers Would Be Labeled** by mixtures of elements having unique XRF spectra. The balls would be tracked through the stages of manufacture and transport by using the spectra to verify their identities.

part, authentication can be attained with a simple scan. For those who have ever tried to put a barcode inside a pearl, ECPIAS may sound like a good alternative.

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*Refer to MFS-31890, volume and number of this NASA Tech Briefs issue, and the page number.*

## Vacuum Attachment for XRF Scanner

**A greater range of elements could be analyzed.**

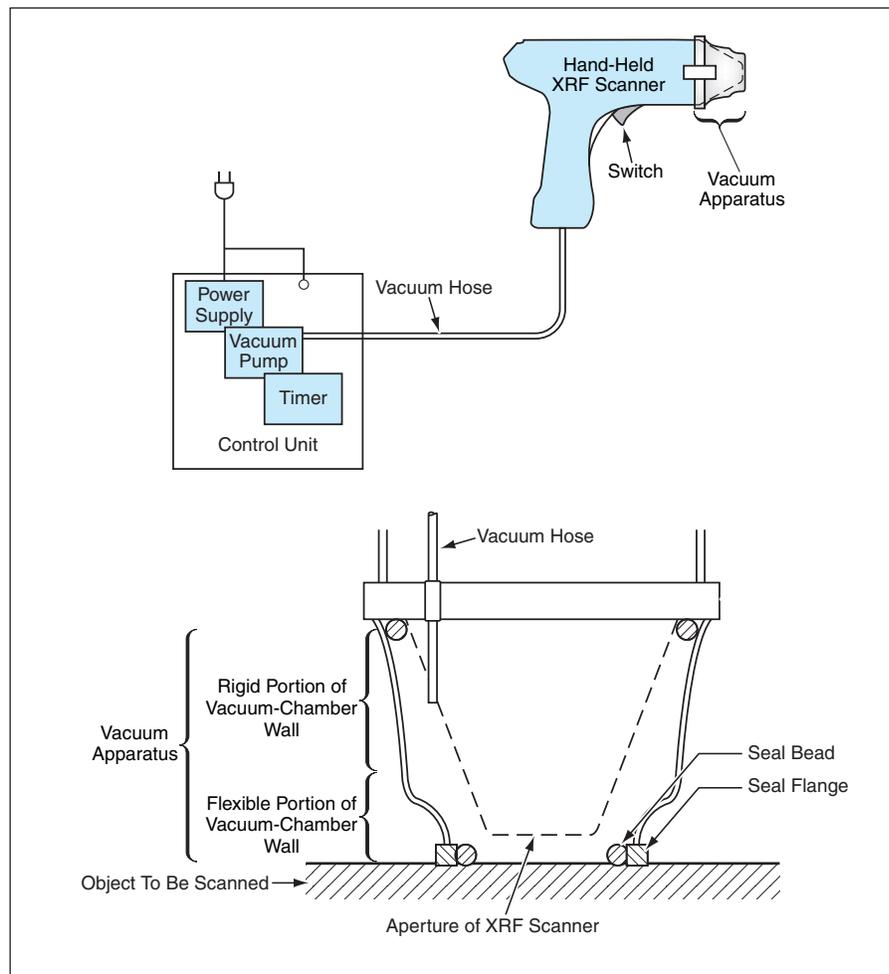
*Marshall Space Flight Center, Alabama*

Vacuum apparatuses have been developed for increasing the range of elements that can be identified by use of x-ray fluorescent (XRF) scanners of the type mentioned in the two immediately preceding articles. As a consequence of the underlying physical principles, in the presence of air, such an XRF scanner is limited to analysis of chlorine and elements of greater atomic number. When the XRF scanner is operated in a vacuum, it extends the range of analysis to lower atomic numbers — even as far as aluminum and sodium. Hence, more elements will be available for use in XRF labeling of objects as discussed in the two preceding articles.

The added benefits of the extended capabilities also have other uses for NASA. Detection of elements of low atomic number is of high interest to the aerospace community. High-strength aluminum alloys will be easily analyzed for composition. Silicon, a major contaminant in certain processes, will be detectable before the process is begun, possibly eliminating weld or adhesion problems. Exotic alloys will be evaluated for composition prior to being placed in service where lives depend on them. And in the less glamorous applications, such as bolts and fasteners, substandard products and counterfeit items will be evaluated at the receiving function and never allowed to enter the operation.

Both hand-held and tabletop XRF portable scanners have been developed. The vacuum apparatus is compact and lightweight and does not detract from the portability of either XRF scanner. It is attached to and detached from the aperture end of either XRF scanner.

The upper part of the figure schematically depicts the hand-held XRF scanner. The XRF scanner and vacuum apparatus would be connected to a portable (belt-mounted) control unit that would contain



A Compact Vacuum Apparatus attached to the aperture end of a hand-held XRF scanner would enable vacuum XRF analysis without the need to mount the entire XRF scanner in a vacuum chamber.

a power supply and a vacuum pump. The lower part of the figure is a simplified, enlarged cross-sectional view of a vacuum apparatus attached to the aperture end of the XRF scanner. The side wall of the vacuum apparatus would include a flexible portion that would support a seal flange and seal bead, which would be pressed against an object to be scanned to form an airtight seal. While holding the seal and

pressing the object of the XRF scanner against the aperture of the XRF scanner, the operator would press a switch, thereby starting the process. The switch would turn on the pump and keep it on for as long as needed to maintain the vacuum needed for the XRF scan.

The vacuum enhanced version of the hand-held XRF, already in use in the shuttle program, takes the chemistry lab