THE GROWING NEED FOR THE VERIFICATION OF PRECISE JEWELRY COMPOSITION

By Jonathan Margalit, PhD

In the most recent article of this series (October 2015 issue), we discussed some of the common methods used to test jewelry and to verify the gold content in jewelry, including the scratch/acid test, electronic testers, and the fire assay method. In this article, we will cover a powerful and convenient method which, though slightly lesser-known than the aforementioned techniques, is used by a growing number of jewelry professionals.

More jewelers are turning to x-ray fluorescence (XRF) technology to perform a quick, non-destructive, and accurate analysis of jewelry, coins, and other items containing precious metals. The technology is typically housed in either a portable, handheld instrument or the more stationary table-top version. Compared to the methods discussed previously, which can detect or measure a limited number of elements (1-3), portable XRF analyzers can measure a wide range of elements. XRF technology allows for the analysis of elements above magnesium (Mg) in the periodic table, all the way to uranium (U), which means that, in theory, the technology can identify a total of 81 elements. However, in practice, portable XRF manufacturers typically limit the number of elements for precious metals and jewelry applications to anywhere between half a dozen to two dozen elements, depending on the manufacturer and the intended application.

Portable XRF technology comes at a higher price point than other methods – generally between $8,000-25,000 – which reflects a wide variety of optional features, multiple capabilities and higher analytical performance levels. However, when compared to other, less accurate methods that can either damage the piece of jewelry, or harm the user's skin (acid test), or, if there is a significant amount of gold being bought and sold, the premium can be well worth it.

How does portable XRF work?

XRF analyzers emit low radiation x-rays that are directed onto the sample, such as a piece of jewelry. These x-rays interact with the atoms in the sample and induce them to emit secondary, or fluorescence, x-rays. The energy and wave lengths of these secondary x-rays are characteristic and unique for each and every element on the periodic table and therefore serve as a "fingerprint" for the element. The XRF analyzer reads the different "fingerprints" in a sample and can then identify and quantify the elements of interest.

XRF is a non-destructive method, and when used for jewelry analysis, in that it can analyze all the precious metals and the alloying elements used in jewelry making, such as copper, nickel, zinc, as well as elements commonly used in jewelry counterfeiting, such as chromium, titanium, and tungsten. Most XRF analyzers have a user-friendly screen, which displays the sample's chemical composition upon analysis. In the case of gold, they will display the karat value of a sample – easily identifying non-standard, under-karated, and even sophisticated counterfeit jewelry that other methods may be incapable of differentiating. XRF analyzers' measurement times are typically within a few seconds and the accuracy levels are comparable to those of the fire assay method. One particular XRF analyzer on the market today, equipped with a patented gold-plating detection technology, performs a series of primary and secondary tests to flag gold-plated items, and works regardless of the composition of the substrate or the plating layer.

One of the most appealing features of portable XRF analyzers lies in the fact that they provide an entirely new store experience for the customer. When selling or buying precious metals, a customer is able to maintain visual contact with the tested jewelry item during the entire testing period; ensure the integrity of the piece; and achieve a near-lab-quality result within seconds. That process offers tremendous value and can boost the trust between the customer and the jeweler. While portable XRF involves a high level of technical integration between hardware and software components, it is designed for non-technical users and often requires no more than a simple button push to obtain near lab results.

With the higher price of portable XRF analyzers, compared to some of the traditional methods used to evaluate precious metals in jewelry, the decision to purchase the equipment should take into account the volume of gold traded. Depending on the volume and type of jewelry being traded, the payback period may be less than a year for some users. A simple payback analysis calculation demonstrates that when buying the equivalent of 1.5 troy oz. of gold per day, a standard portable XRF instrument could pay for itself in less than one year.

Author's Note: In the next issue we will take a deeper look into the exciting world of numismatics – the study of coins - and review some of the special situations and needs encountered by numismatics professionals.

By Jonathan Margalit, PhD

Jonathan Margalit is the business development manager for Thermo Scientific Portable Analytical Instruments, a business unit within Thermo Fisher Scientific. In his role, Margalit manages the development of new field portable instruments for applications in the precious metals, mining, and regulatory (consumer goods, lead paint and environmental) markets. He received his PhD from the RWTH Aachen, Germany, in the field of high-temperature aircraft ceramics.