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Analysis of precious metals

identifying counterfeit in coins and bullion – with SIGMASCOPE® GOLD

SIGMASCOPE® GOLD for analyzing coins, ingots and bullion

In recent years the price of gold and other precious metals has skyrocketed, making the purity of these valuable components the most important attribute of any precious metal product. Adulterated or fraudulent alloys of high-value coins or bullion can lead to considerable financial losses. The only way to rule out such risks is to test the items using trusted analytical methods.

For this purpose, many traditional methods are unacceptable since they cause damage to both the material and its value: only non-destructive methods should be used for material testing valuables made of precious metals. But beyond being reliable and reproducible, these methods must:

- Identify the alloy and the precious metal content
- Detect ignoble inclusions and forgeries

Fischer offers two complementary product lines of non-destructive testing methods, SIGMASCOPE® GOLD and FISCHERSCOPE® X-RAY XAN®.

Precious metal alloys and fine gold all differ in their electrical conductivity, making this physical dimension ideal for material analysis of bullion and coins. In just a few seconds the SIGMASCOPE GOLD can determine the conductivity of a sample with heretofore unmatched precision.

While the conductivity value is an ideal characteristic for detecting fraudulent inclusions, it cannot determine all the elements. The exact composition of jewelry, coins and ingots can be determined quickly and precisely by the FISCHERSCOPE X-RAY XAN product line.

The electrical conductivity is known for gold bullion and all common coins. Counterfeits have inclusions on the inside, made of e.g. tungsten, which significantly change the electrical conductivity. Thus, using a comparative measurement of the electrical conductivity allows for reliable, quick and non-destructive identification of counterfeits.

Conductivity measurement using Fischer instruments

With the SIGMASCOPE GOLD product line, Fischer offers instruments that are ideally suited for determining the conductivity of samples ranging from precious metal coins up to large gold bars. The instruments work non-destructively and utilize the eddy current method according to ASTM E 1004. The phase sensitive measurement signal evaluation allows for contact-free determination of the electrical conductivity even under non-conducting top layers such as plastic packaging. The penetration depth of the eddy currents can be selected to correspond to the thickness of the specimen.

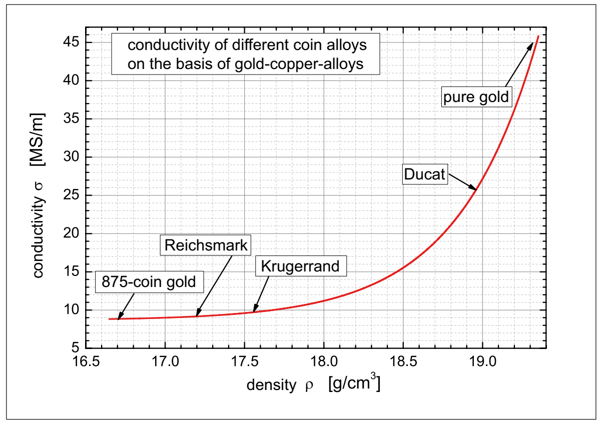
SIGMASCOPE GOLD C for testing coins and thin ingots (up to approx. 100 g)

The SIGMASCOPE GOLD C offers four unique measurement ranges, technically optimized for authenticity testing of a huge variety of coins and thin ingots. Thus, it reliably detects adulterated alloys and forgeries.

Electrical conductivity measurement on coins – fast and reliable even through plastic covers

Conductivity values of specific coins

The SIGMASCOPE GOLD C precisely measures the conductivity of coins. The following diagram shows the conductivities and densities of various gold coins, which differ in the composition of their alloys and therefore in their electrical conductivity.



Electrical conductivity – a positive indicator for authenticity

Valuable precious-metal coins are made of precisely defined alloys. Their respective electrical conductivity values are known as well:

- Ducat: 25.4 MS/m
- Krugerrand: 9.7 MS/m
- 875 coin gold: 8.0 MS/m

This makes it possible to authenticate these items based on their electrical conductivity.

Schematic of counterfeit coins filled with a powdered tungsten alloy and covered with gold

The core of a counterfeit coin is often filled with another metal, which is hidden by the thin outer layer of the original alloy. Appearance and weight correlate with the original coin and do not allow superficial the identification of the counterfeit. However, this deceit considerably changes the coin's conductivity, making this method ideally suited for authenticity testing.

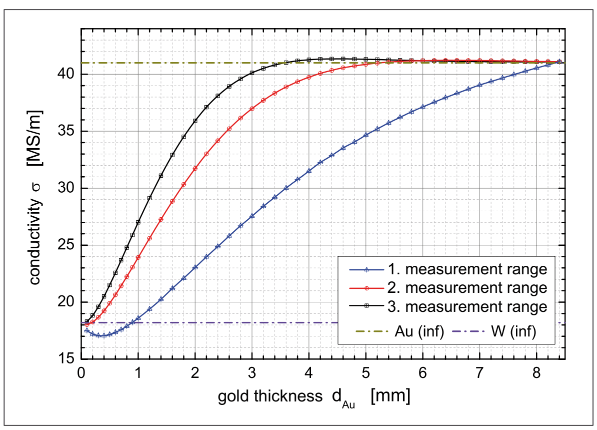
SIGMASCOPE GOLD B for testing bullion (approx. 1 oz to 1 kg)

The SIGMASCOPE GOLD B can determine the electrical conductivity of thicker gold bars up to approx. 1 kg in weight. As measurements are taken from both sides, the bars can be analysed in their full depth so the authenticity of the alloy or fine gold can be verified. Even concealed inclusions of ignoble materials with matching density (e.g. tungsten) can be detected clearly with SIGMASCOPE GOLD – and identified as fraudulent.

Schematic of counterfeit gold bar with a core of tungsten sticks and gold cover

Authentication of gold bullion

Because the SIGMASCOPE GOLD B is optimized for gold bars with various thicknesses, it operates with three different measurement ranges. To detect even small inclusions within the bar's core, the eddy currents must penetrate all the way to the middle. The diagram below shows that, at measurement range 1, the penetration depth is approx. 8 mm, which corresponds to the minimum bar thickness. To detect foreign material in the center of a larger bar using double-sided measurement, its thickness must not exceed 17 mm.



For every bullion size, the correct penetration depth to measure the electrical conductivity

Testing of a fine gold bar – even under a plastic cover

Before starting a measurement the SIGMASCOPE GOLD B asks for the thickness of the bar and automatically switches to the optimal measurement range with the ideal instrument setup. This makes handling of the SIGMASCOPE GOLD easy and self-explanatory.

Determining the electrical conductivity is a quick and easy method for authentication of precious metal products. A suitable complementary method for accurate determination of the composition is X-ray fluorescence analysis (XRF).

Features of the SIGMASCOPE GOLD product line

- Reliable determination of the electrical conductivity of coins and gold bars
- Non-destructive testing method
- Measurements within seconds
- Positive identification of forgeries

SIGMASCOPE GOLD C

- For testing coins and thin ingots up to approx. 100 g
- Identification of standard precious metal coins such as Krugerrand, Ducat, etc. using their known conductivity values

SIGMASCOPE GOLD B

- For testing large bars of precious metals of 1 oz (31.1 g) to 1 kg
- Detection of ignoble inclusions with similar density (e.g. tungsten)

Exact Determination of the Alloy Composition

FISCHERSCOPE® X-RAY XAN® 220 for high-precision analysis of gold and jewelry

As a complementary method to the electrical conductivity measurement, X-ray fluorescence analysis (XRF) determines accurately the composition of precious metals – quickly and non-destructively.

While the conductivity value is an ideal characteristic for detecting fraudulent inclusions buried inside an object, it cannot determine all the elements contained in an alloy. This is exactly where the x-ray fluorescence (XRF) method picks up: it has been established as an extremely precise, reliable and – above all – non-destructive method for material testing and measuring coating thickness of gold and jewelry items. But other valuables like coins and ingots can also be precisely analysed for their alloy composition using XRF.

Especially for assayers and refiners of precious metals, the measuring instruments they depend on must meet the highest standards. Here, it is crucial to ascertain not only the gold content, but also the full composition of the constituent elements, including platinum and silver. Furthermore, any undesirable elements should be detected, such as nickel or cadmium, among others. Using the XRF method, the FISCHERSCOPE X-RAY XAN product line enables the precise, non-descriptive measurement of all these components.

The right instrument for every purpose: in addition to the flexible high-end measurement system XAN 250, Fischer also offers a robust entry-level device, the XAN 315, and a high-precision standard system, the XAN 220. Fast and easy-to-use, all these measurement systems feature excellent long-term stability. With their silicon drift detectors, the XAN 220 and XAN 250 achieve repeatability precisions of 0.3‰ or better and are therefore comparable in accuracy to cupellation. Fischer also produces – in house, according to stringent quality standards – its own first-class, traceable calibration standards to ensure the accuracy of the measurement results.

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