

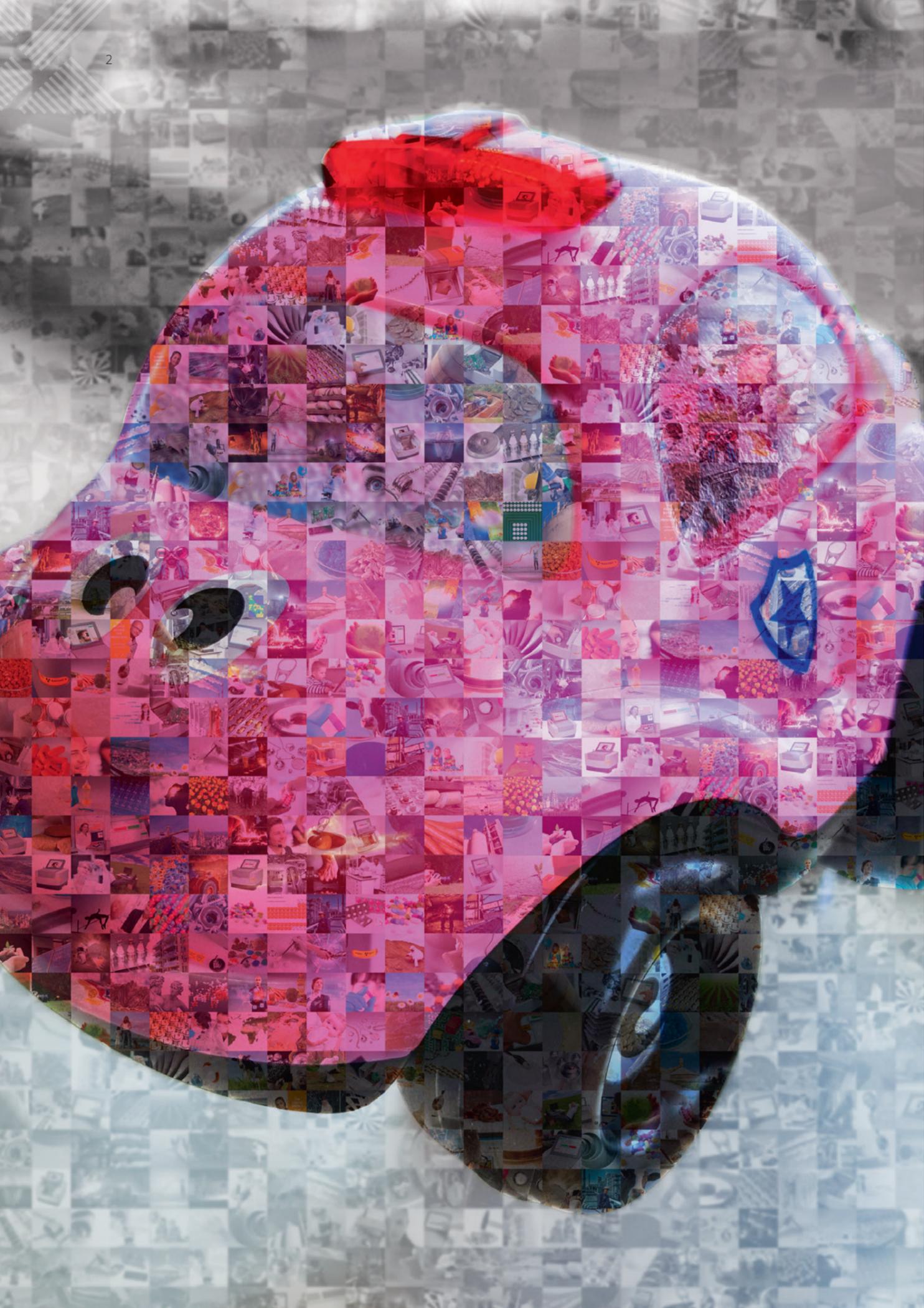


**Malvern  
Panalytical**  
a spectris company

# EPSILON 1 FOR SMALL SPOT ANALYSIS

Focus on the details to capture the bigger picture





# IT'S ALL IN THE DETAILS

## Flexible and spot-on elemental analysis

### Looking for the details in a sample?

The Epsilon 1 X-ray fluorescence spectrometer is an ideal analytical solution for flexible and precise analysis of small objects or small inclusions in rocks, electronic appliances, toys, jewelry or finished products. The small footprint and self-contained design make the Epsilon 1 an ideal solution for analysis, to be placed close to the sample location, like quarries, exploration sites, or even at crime sites for forensic investigation.

Regularly- and irregularly-shaped samples can be placed directly in the spectrometer without the need of any sample preparation. The combination of the color camera, the small measurement spot size and the straightforward positioning procedure is optimized for analyzing every detail in the sample. The performance of the spectrometer meets the standard test methods required by different directives and regulations in various industry markets, like RoHS-3 for electronics and CPSIA for many consumer goods.

Following standard test methods like ASTM F2617, specifications like ASTM F963 or methods for screening electronics per IEC 62123, an analysis report can be generated automatically after each measurement to save valuable time.

Spot-on results are provided for a wide range of applications. This is made possible by Omnian, Malvern Panalyticals' market-leading standardless analysis software package, also used on the more advanced XRF instruments.

Malvern Panalytical has a strong reputation for safe and high-end X-ray instrumentation. The high-quality X-ray shielding in the instrument guarantees the safety of your employees.

Epsilon 1 is built using our market-leading technology with superior quality, worldwide service and application support.

## THE TOTAL SOLUTION CONSISTS OF

- Self-contained Epsilon 1 XRF instrument
- Flexible user software
- Factory pre-calibrated for Omnian standardless analysis
- Validation sample to check the out-of-the-box accuracy of the instrument



## KEY FEATURES



Accurate manual positioning



< 1 mm<sup>2</sup> spot size on sample



Analysis report

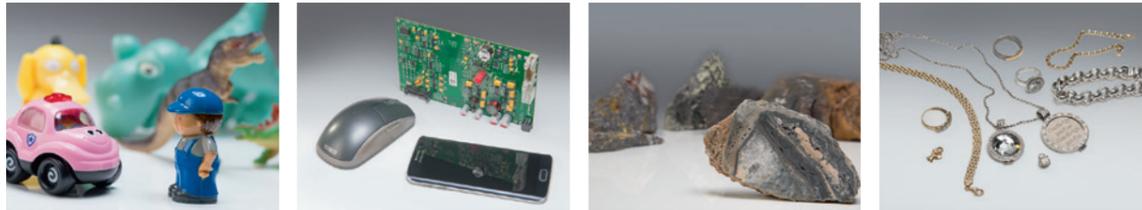


Color camera

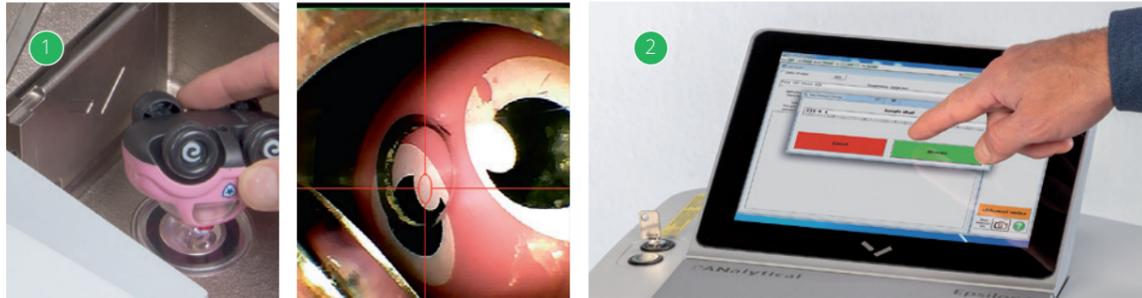
## READY FOR ANY SAMPLE

Epsilon 1 can handle a large variety of sample types, from weighing a few grams to larger bulk samples: solids, pressed powders, loose powders, liquids, fused beads, slurries, granules, films and coatings. Also large and irregularly shaped objects with maximum dimensions of 15 x 12 x 10 cm (W x D x H) can be analyzed.

### No sample preparation



### Simple to operate



Place your sample for positioning.

Enter sample name and push 'measure' button.

## CONVENIENT RESULTS VIEWING



### APPLICATIONS

- RoHS-3 (ASTM F2617-15)
- Toys (ASTM F963-16)
- Jewelry
- Rocks
- Polymer inclusions
- Product inspection
- Forensics

# BUILT FOR DETAILS

The Epsilon 1 is a fully integrated energy dispersive XRF analyzer consisting of a spectrometer, built-in computer and analysis software. Powered by the latest advances in excitation and detection technology, the Epsilon 1 is a star performer in the low-cost benchtop instrument class. A well-designed optical path, a wide range of excitation capabilities ranging from 7 to 50 kV for light and heavier elements and a highly sensitive SDD detector system contribute to the Epsilon 1's uniqueness.

## Self-contained system

Built-in computer running Microsoft Windows 10 with powerful CPU and 120 GB hard drive ensures flexibility to store and handle thousands of results.

## Repeatability for years

A low-drift 15 W X-ray tube and a handy drift correction routine give compliant results for years without the need for time-consuming re-calibration.

## Maximum sensitivity

The thin-window Ag anode X-ray tube, designed and manufactured by PANalytical, ensures high quality and sensitivity. The 15 W and 50 kV X-ray tube and generator are ideal for exciting heavier elements like cadmium, mercury, lead, bromine and chromium.

## Spillage protection

In order to shield the delicate heart of the system from spillage, a protection foil and plastic disc are in place. In case of spillage, the disc can be removed and the foil can be easily replaced by the operator.

## Economical footprint

Compact design with a built-in computer and touchscreen reduces the requirement of valuable lab space to less than 0.15 m<sup>2</sup>.

## Easy operation

High-resolution (1024 x 768), 10.4" LCD touchscreen for easy walk-up and operation.

## Easy communication / connection

USB and network connections for use of standard computer peripherals enable extended use, application development and seated operator.

## Small analyzing spot

Small pieces or small inclusions in samples can easily be analyzed with a collimated X-ray beam. The spot size on the sample is typically 0.8 x 1.2 mm or 3 x 5 mm.

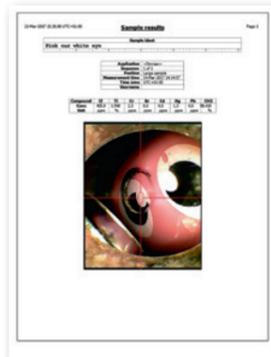
## Sample positioning

With the help of the color camera and crosshair in the picture, the user can manually position the sample on the analyzing spot of the instrument.

## Analysis report

After each analysis, the picture from the camera is stored on the built-in computer.

When an analysis report is generated, the picture is automatically included.



## Safety guaranteed

Epsilon 1 complies with the latest Machinery Directive, CSA, IEC, EMC, Vollschutz norms and standards for protection and radiation safety to guarantee a safe instrument for the operator.

## ADVANTAGES OF XRF

- Unmatched analytical precision and accuracy compared to other analytical techniques
- Quick quantification method
- Simple, fast and safe sample preparation
- Non-destructive analysis
- Wide analytical concentration range (ppm - %) reducing the necessity for dilution and associated errors

Z		Possible to analyze with Epsilon 1																Z																
H	He																	He																
Li	Be	B	C	N	O	F	Ne																	Ne										
Na	Mg	Al	Si	P	S	Cl	Ar																	Ar										
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																	Xe
Cs	Ba	L	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																	Rn
Fr	Ra	A	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og																	Og
		L	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																	
		A	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																	





## ROBUST AND FLEXIBLE QUANTIFICATION FOR ROHS-3, WEEE AND ELV

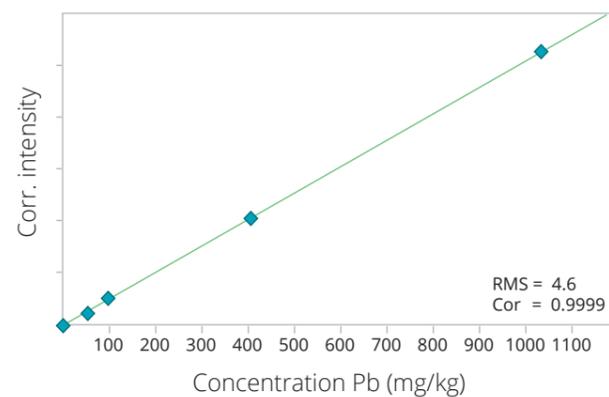
XRF is a well-established technique for screening and quantification of toxic metals and compounds regulated by global directives, like RoHS-3/WEEE/ELV. The Epsilon 1 is specifically designed to analyze a wide range of samples in accordance to these regulations. With a dedicated calibration the Epsilon 1 complies with the ASTM F2617-15 test method, as proven with reference materials.

### Dedicated calibration

A set of reference materials was used to set up calibrations for chromium, bromine, cadmium, mercury and lead in polyethylene, in compliance with the ASTM F2617-15 test method. For each standard, two hot-pressed discs of 2 mm each were used. The measurement time was 10 minutes per sample. The calibration graph for lead in polyethylene demonstrates a high degree of accuracy for the method.

### Complying with ASTM F2617-15

Measurement precision is an important requirement of ASTM F2617. To test the precision of the method, reference standard ERM-EC681k was measured twenty times consecutively. The certified and average concentrations, maximum achieved difference between successive measurements and the difference allowed by ASTM F2617-15, are presented for chromium, bromine, cadmium, mercury and lead in the table. This precision is illustrated graphically for lead (Pb). The green lines show the maximum difference allowed by ASTM F2617-15.



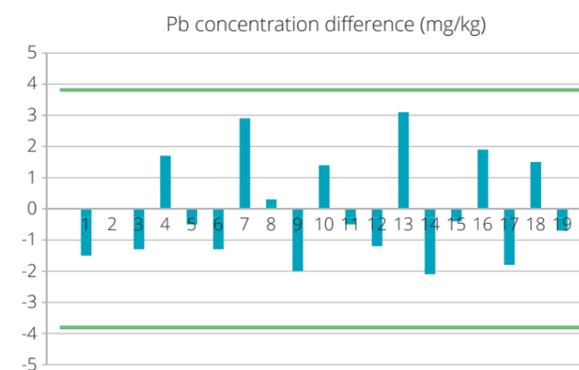
Calibration graph for lead (Pb) in polyethylene

Element	Certified conc. (mg/kg)	Average conc. (mg/kg)	Largest diff. (mg/kg)	Max permitted diff. by ASTM F2617-15 (mg/kg)	LLD (mg/kg, 300 s)
Cr	100 ± 5	100	12.4	14	2
Br	770 ± 40	782	6.7	8.7	0.5
Cd	137 ± 4	140	14.3	16	6
Hg	23.7 ± 0.8	22.5	2.1	10	1
Pb	98 ± 6	98	3.1	3.8	1

### Flexible RoHS-3 screening

For characterization and analysis of unidentified sample types, or in situations where certified standards that match specific sample characteristics are not available, Malvern Panalytical's Omnic package is the solution of choice.

Without using any dedicated calibrations, Omnic was used to quantify the restricted elements of the RoHS-3 directive in the reference standard ERM-EC681k. Also other elements present in the sample are reported by Omnic. The measurement time was 10 minutes and repeated five times to show the repeatability of the method.



Element	Certified concentration (mg/kg)	Measured concentration (mg/kg)
Cr	100 ± 5	104 ± 1
Br	770 ± 40	851 ± 2
Cd	137 ± 4	144 ± 7
Pb	98 ± 6	94 ± 2
Hg	23.7 ± 0.8	20.3 ± 0.5
As	29.1 ± 1.8	15 ± 1
Sb	99 ± 6	97 ± 15





**OTHER AVAILABLE SOFTWARE OPTIONS**

**Stratos**  
Thickness and composition analysis software for multi-layer samples

**Enhanced Data Security**  
Protect your data and track any changes

**FingerPrint**  
Quick Pass-Fail analysis and cluster representation

# FLEXIBLE AND FAST SCREENING

Malvern Panalytical's Omnia standardless analysis package is the solution for quantification and fast screening of small objects or small inclusions in rocks, electronic appliances, toys and jewelry, or failure analysis and troubleshooting of finished products. The following data show results of a plastic toy, rock and ring with gemstone, obtained using Epsilon 1 and Omnia. The measurement time was only 2 minutes per analysis and repeated five times to show the repeatability of the method.

**Children's toys**

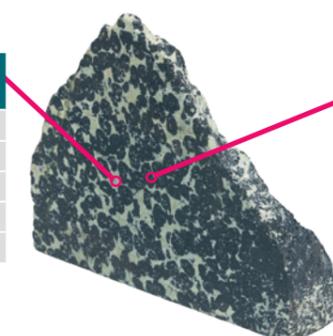
Element	Concentration (mg/kg)	ASTM F963 limits after leaching (mg/kg)
Ti (wt%)	0.15 ± 0.01	-
Cl	99 ± 12	-
Cr	< 6	60
As	< 3	25
Se	< 3	500
Cd	< 25	75
Sb	< 30	60
Ba	< 20	1000
Hg	< 4	60
Pb	< 4	90



Element	Concentration (mg/kg)	ASTM F963 limits after leaching (mg/kg)
Ti (wt%)	1.17 ± 0.09	-
Cl	412 ± 40	-
Cr	< 6	60
As	< 3	25
Se	< 3	500
Cd	< 25	75
Sb	< 30	60
Ba	< 20	1000
Hg	< 4	60
Pb	< 4	90

**Chromium ore**

Major compounds	Concentration (wt %)
Cr <sub>2</sub> O <sub>3</sub>	0.3 ± 0.1
SiO <sub>2</sub>	41.1 ± 0.2
MgO	49.3 ± 0.3
Fe <sub>2</sub> O <sub>3</sub>	5.7 ± 0.1
Al <sub>2</sub> O <sub>3</sub>	< 0.5



Major compounds	Concentration (wt %)
Cr <sub>2</sub> O <sub>3</sub>	64.7 ± 0.5
SiO <sub>2</sub>	2.3 ± 0.1
MgO	11.5 ± 0.6
Fe <sub>2</sub> O <sub>3</sub>	14.3 ± 0.1
Al <sub>2</sub> O <sub>3</sub>	5.1 ± 0.2

**Ring with gemstone**

Element	Concentration (wt %)
Au	58.9 ± 0.4 (14K)
Ni	14.0 ± 0.3
Cu	18.6 ± 0.2
Zn	7.1 ± 0.1
Rh	1.0 ± 0.2



Element	Concentration (wt %)
ZrO <sub>2</sub>	82.4 ± 0.1
Y <sub>2</sub> O <sub>3</sub>	15.2 ± 0.1
HfO <sub>2</sub>	2.2 ± 0.1



## WHY CHOOSE MALVERN PANALYTICAL?

We are global leaders in materials characterization, creating superior, customer-focused solutions and services which supply tangible economic impact through chemical, physical and structural analysis.

Our aim is to help you develop better quality products and get them to market faster. Our solutions support excellence in research, and help maximize productivity and process efficiency.

Malvern Panalytical is part of Spectris, the productivity-enhancing instrumentation and controls company.  
[www.spectris.com](http://www.spectris.com)

## SERVICE & SUPPORT

Malvern Panalytical provides the global training, service and support you need to continuously drive your analytical processes at the highest level. We help you increase the return on your investment with us, and ensure that as your laboratory and analytical needs grow, we are there to support you.

Our worldwide team of specialists adds value to your business processes by ensuring applications expertise, rapid response and maximum instrument uptime.

- Local and remote support
- Full and flexible range of support agreements
- Compliance and validation support
- Onsite or classroom-based training courses
- e-Learning training courses and web seminars
- Sample and application consultancy



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