

Counterfeit Gold Coins

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Counterfeit Gold Coins

Agenda

- Method of analysis
- Types of counterfeit gold coins
- Detailed view of counterfeit gold coins with tungsten cores
- Conclusion

Counterfeit Gold Coins

The National Analysis Centre of the Deutsche Bundesbank is engaged in:

- scrutinizing counterfeit bank notes and coins
- classifying counterfeits
- collaborating with law enforcement authorities

In 2016 we encountered **33,000 counterfeit Euro** coins compared to **1,570 counterfeit precious metal** coins.



Counterfeit Gold Coins

Methods of analysis

Methods of analysis

Counterfeit Gold Coins

Methods of analysis

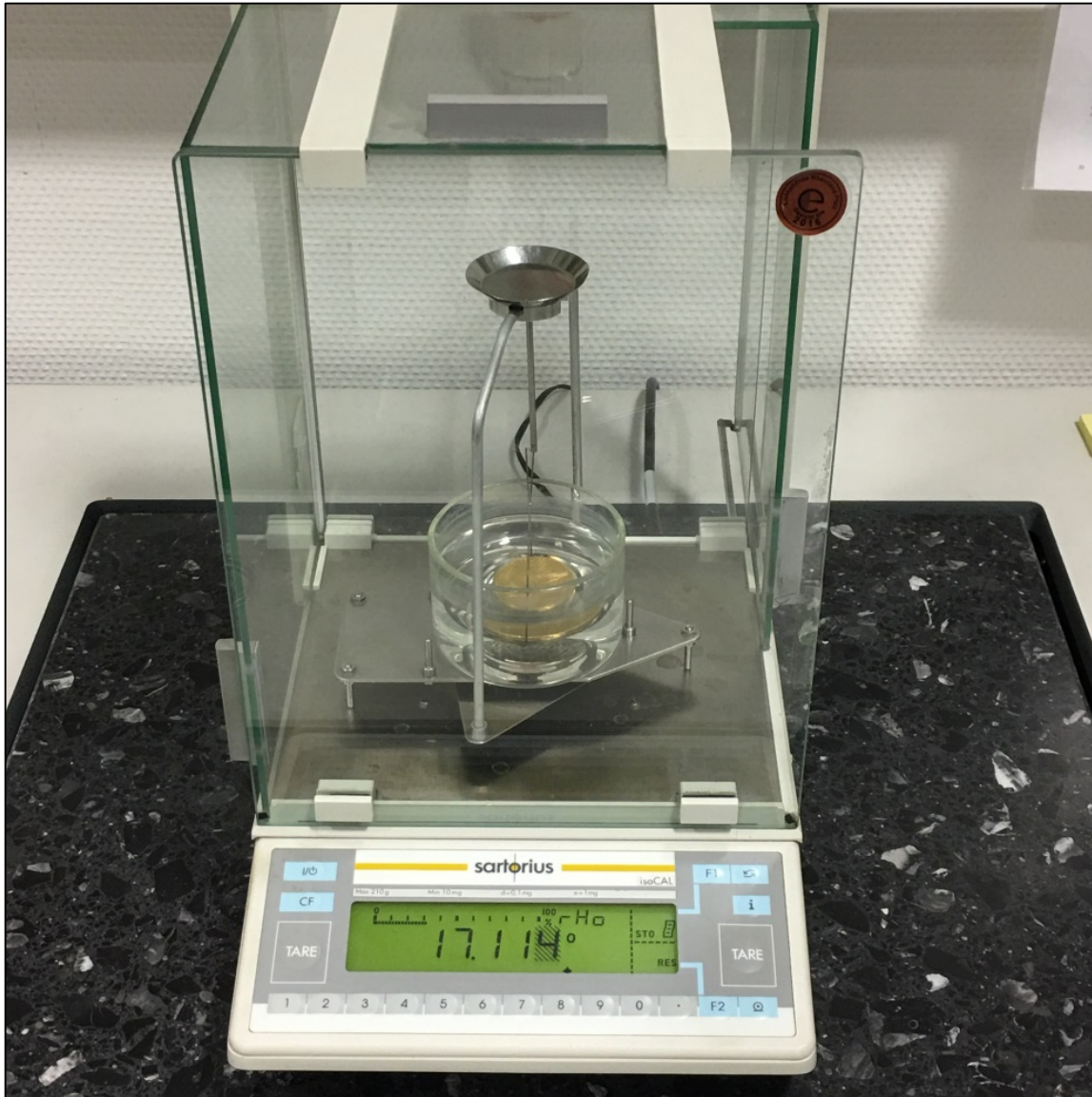
Microscope

- Detection of minting defects such as depressions, raised lines or points on the front and back of the coin.
- Detection of defects in the edge lettering
- Easy comparison between the minting quality of the genuine coin and the potential counterfeit



Counterfeit Gold Coins

Methods of analysis



Specific gravity balance

- Easy way to determine the weight and the specific gravity (density) even of complex geometries
- Simple detection of poor counterfeits made out of steel, brass, zinc, lead etc...
- Approximation of the gold content by comparing the density with the existing density of gold alloys

Technical basis:

Archimedes' Principle

weight in air : 41,728g

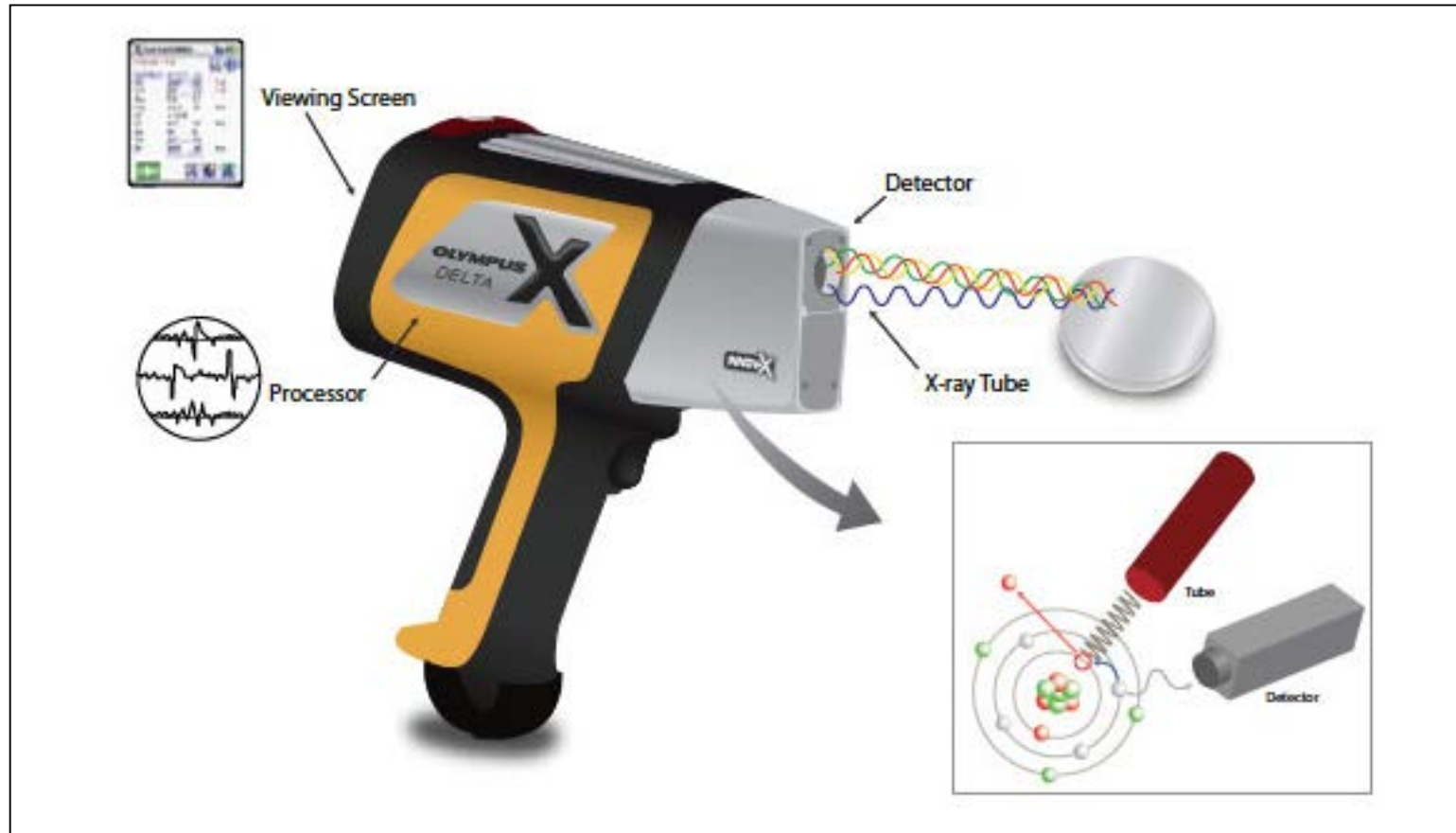
weight in water : 39,290g

$$\rho = m/v$$

$$41,728\text{g}/2,438\text{cm}^3 = 17,10\text{g/cm}^3$$

Counterfeit Gold Coins

Methods of analysis



Handheld X-ray fluorescence spectroscopy

- High flexibility, delivers a good overview
- Penetration depth $< 0.05\text{mm}$
- Very small area is checked $< 1\text{cm}^2$



Counterfeit Gold Coins

Methods of analysis



Measuring of the Electrical Conductivity

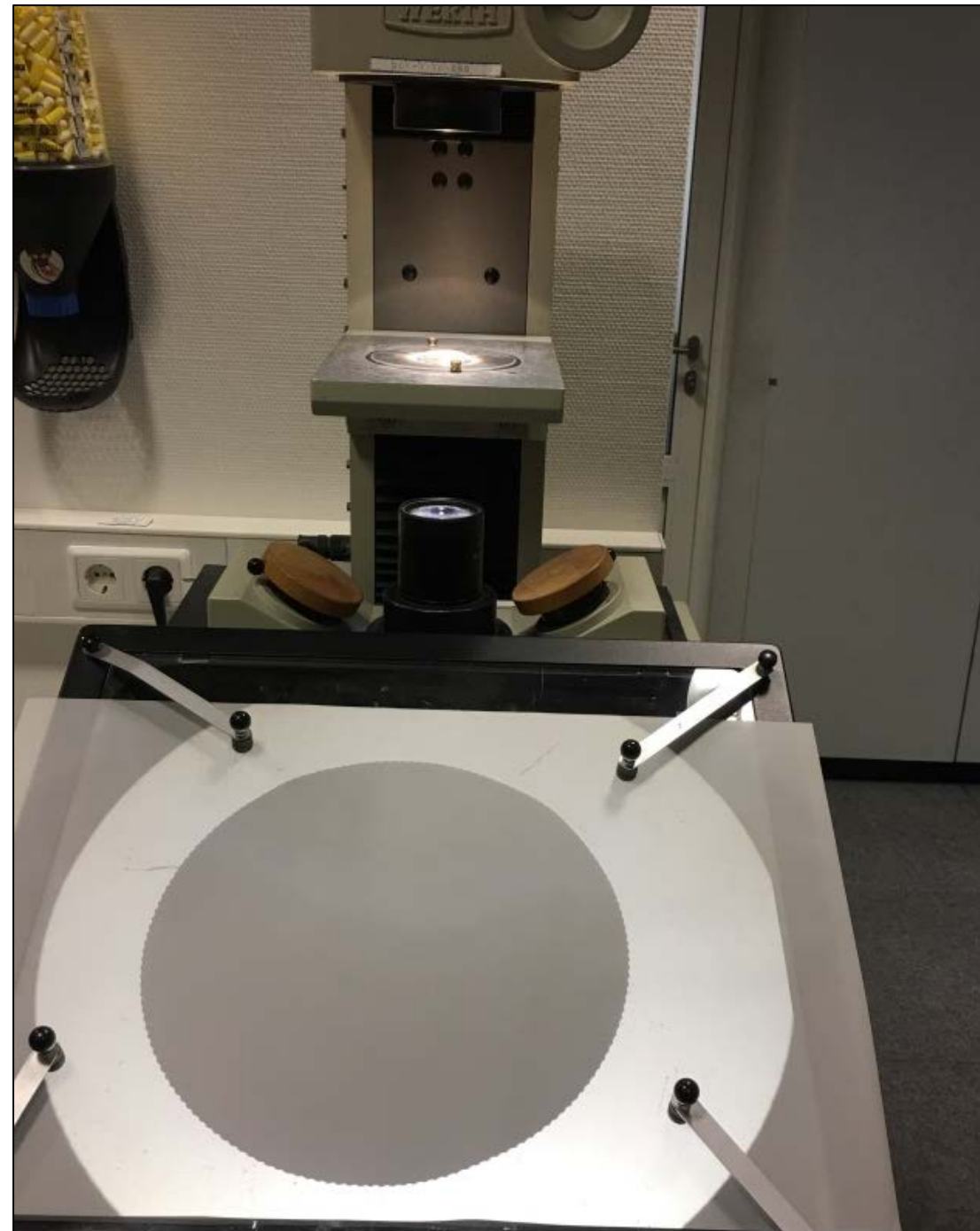
- Quick measurement
- Penetration into test specimen
- Penetration depth can be varied by the frequency
- $100\text{Hz} \approx 12\text{mm}$, $120\text{kHz} \approx 0,4\text{mm}$
- Measurement through plastic foil possible (0,5mm)
- Bullions and coins can be tested with the seal unbroken
- Typical Unit: MS/m (Mega Siemens/m)
 $\% IACS$ (International Annealed Copper Standard)
- Typical Conductivities
Fine Gold (99,99%): 44MS/m
Krugerrand (91,67%): 9,7MS/m

Counterfeit Gold Coins

Methods of analysis

Projector

- Mainly used for the quality inspection of Euro circulation and Euro collector coins
- Very helpful in counting the number of mills



Counterfeit Gold Coins

Types of counterfeit gold coins

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Counterfeit Gold Coins

Types of counterfeit gold coins

1. Counterfeits with a significant gold content

Typical features:

- Gold content close to the original, typically between 450/1000 and 930/1000
- Deviation in the minting quality especially of the edge lettering
- Deviation in the number of mills

Counterfeit Gold Coins

Types of counterfeit gold coins

1. Counterfeits with a significant gold content

Examples:



20 Mark
German Kaiserreich



20 CHF (Swiss)
„VRENELI“



Sovereign
Great Britain

Counterfeit Gold Coins

Types of counterfeit gold coins

1. Counterfeits with a significant gold content



Known in Germany since 1971!

50 MXP	Counterfeit	Genuine
Weight (g)	41,67	41,72
Density (g/cm ³)	17,11	17,13
Standard	893	895
Electric conductivity (%IACS)	14,8-15,3	15,1-15,4 (8,6-8,7MS/m)
Diameter (mm)	37,07	36,96
Thickness (mm)	2,65-2,72	2,72-2,75

Counterfeit Gold Coins

Types of counterfeit gold coins

2. Counterfeits with a non-gold base material

Typical features:

- Base Material is in general steel, zinc or a copper based alloy, new versions have a tungsten core
- Normally coated with a thin gold layer ($<0.03\text{mm}$)
- Can easily be detected through variations in outer dimensions and/or weight and magnetism (except tungsten)

Counterfeit Gold Coins

Types of counterfeit gold coins

2. Counterfeits with a different base material



4 Ducats Austria

4 Ducats	Counterfeit	Genuine
Weight (g)	11,950	13,958
Density (g/cm ³)	8,40	18,97
Standard	63,4%Cu 36,3%Zn	986
Electric conductivity	25,8%IACS	26,2 MS/m 42,16% IACS
Diameter (mm)	39,82	39,65
Thickness (mm)	1,19	0,72
Groves / Mills	210	283

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Types of counterfeit gold coins

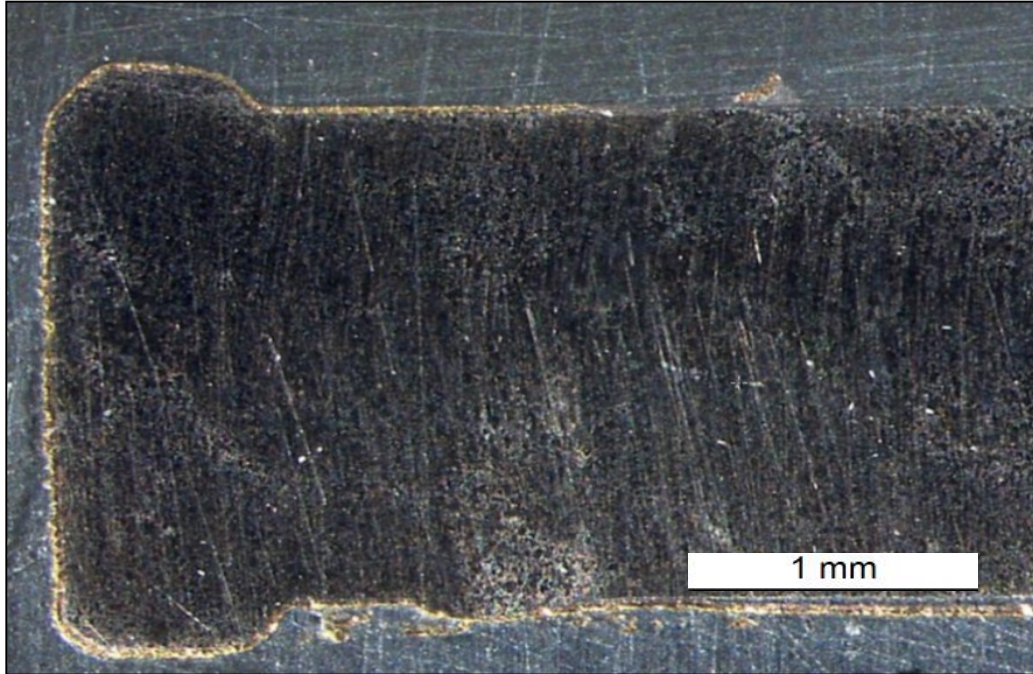


50 USD	Counterfeit	Genuine
Weight (g)	33,919	33,947
Density (g/cm ³)	15,89	17,62
Standard	Tungsten	916,7 Rest Copper and Silver
Electric conductivity %IACS	disturbed	18,4
Diameter (mm)	32,71	32,69
Thickness (mm)	2,76	2,82
Groves / Mills	160	161

Counterfeit Gold Coins

Types of counterfeit gold coins

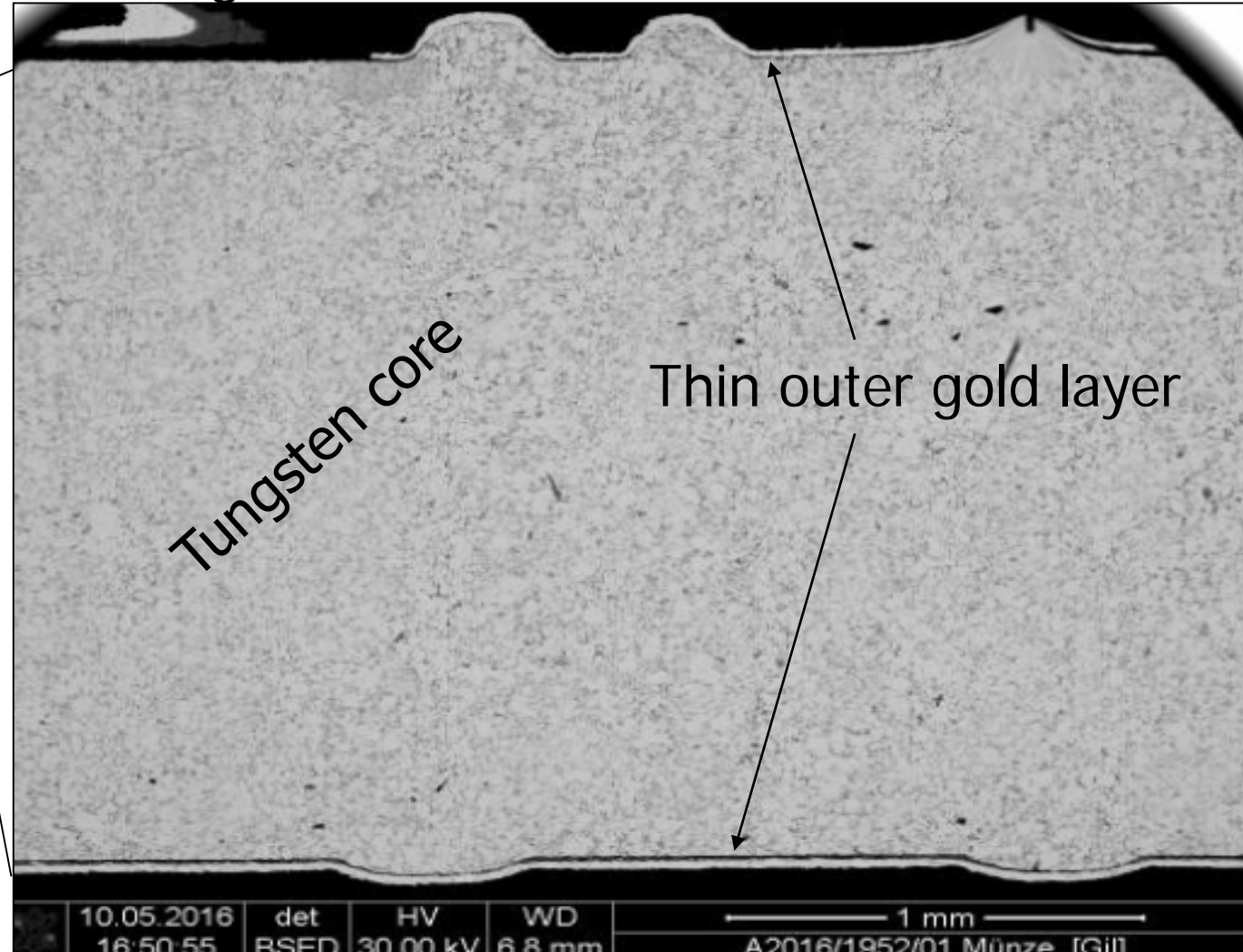
Micrograph of a 50US tungsten counterfeit



Magnification with a light optical microscope

Source:

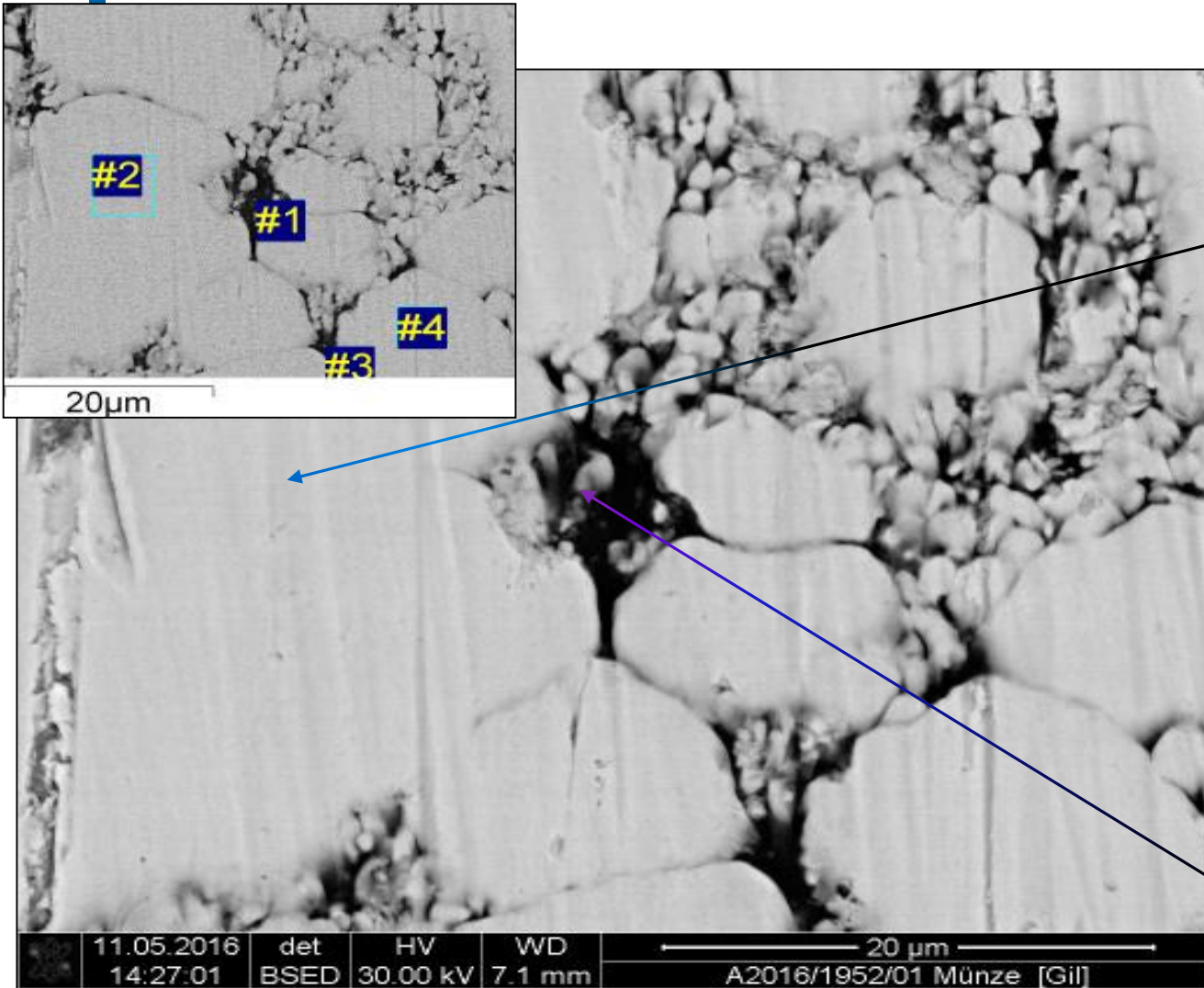
Forensic Institute of the Federal
Criminal Police Office



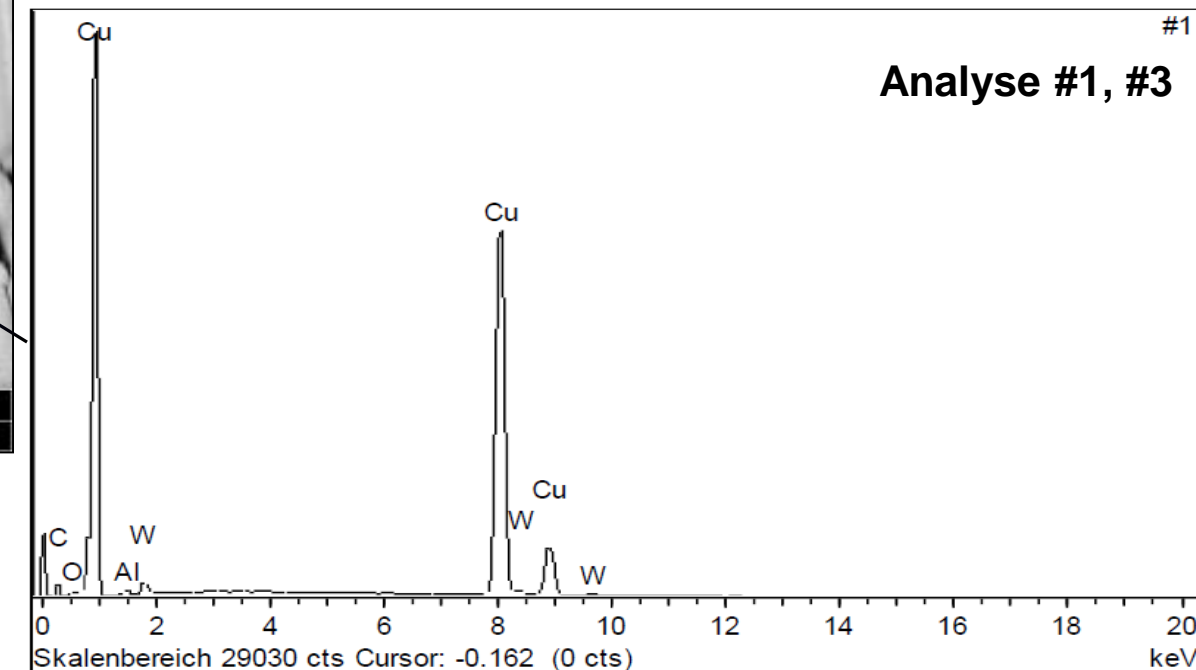
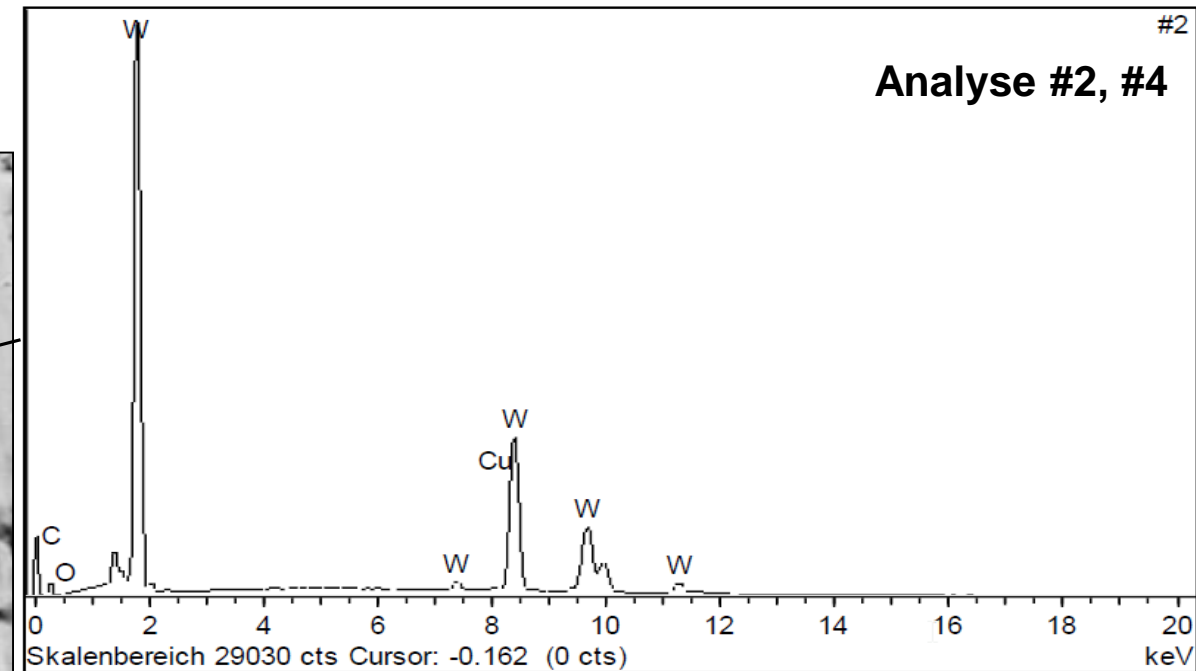
Magnification with an Electron Microscope (SEM)

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Types of counterfeit gold coins

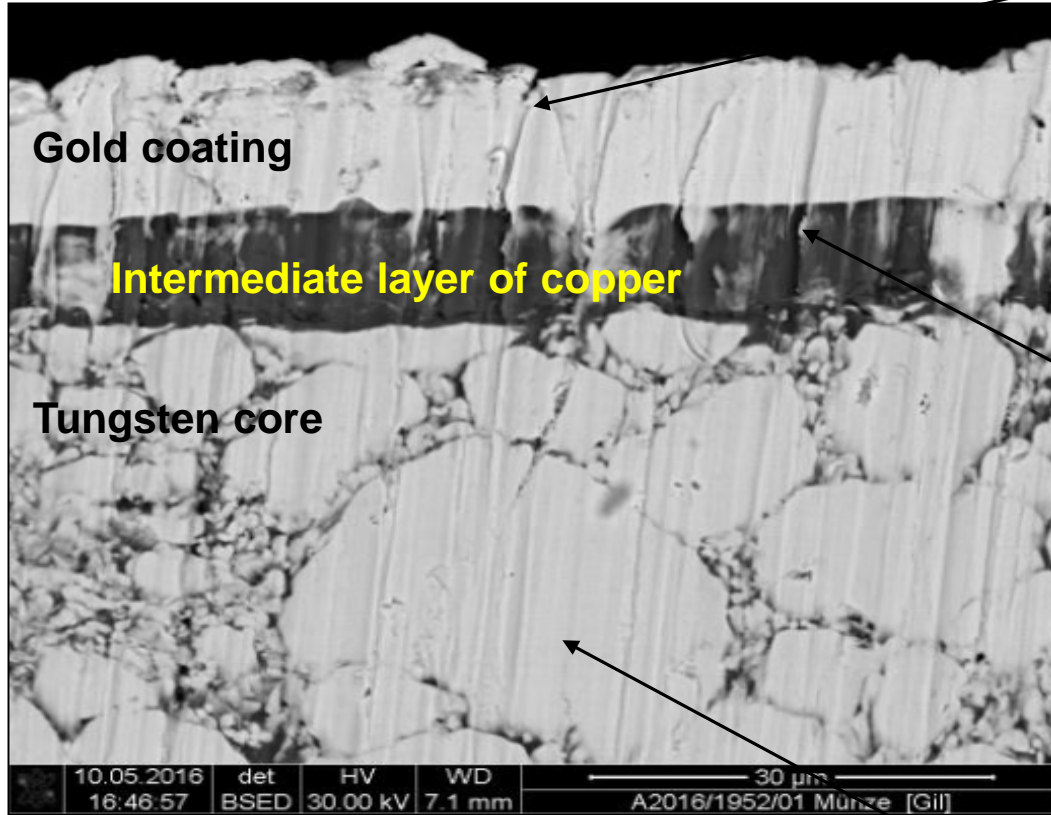


Microstructure of the inner core

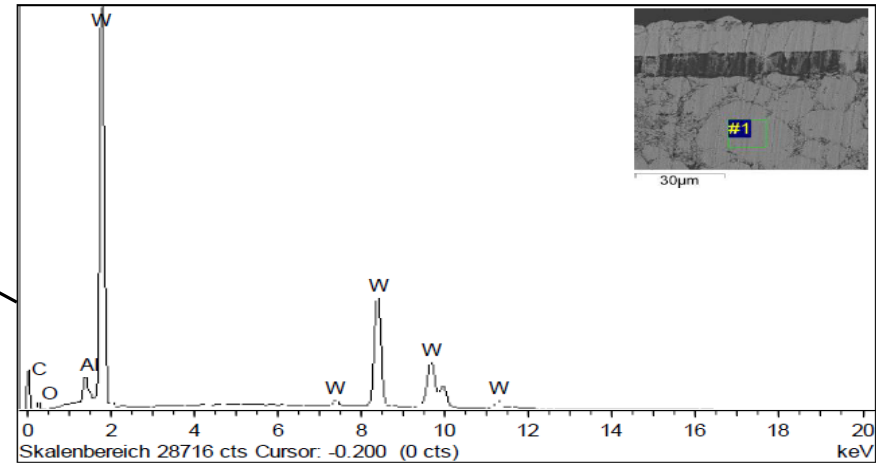
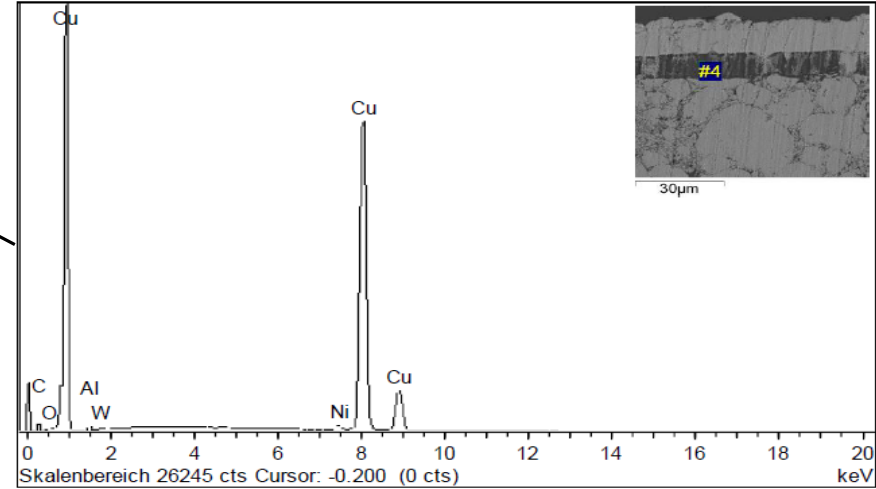
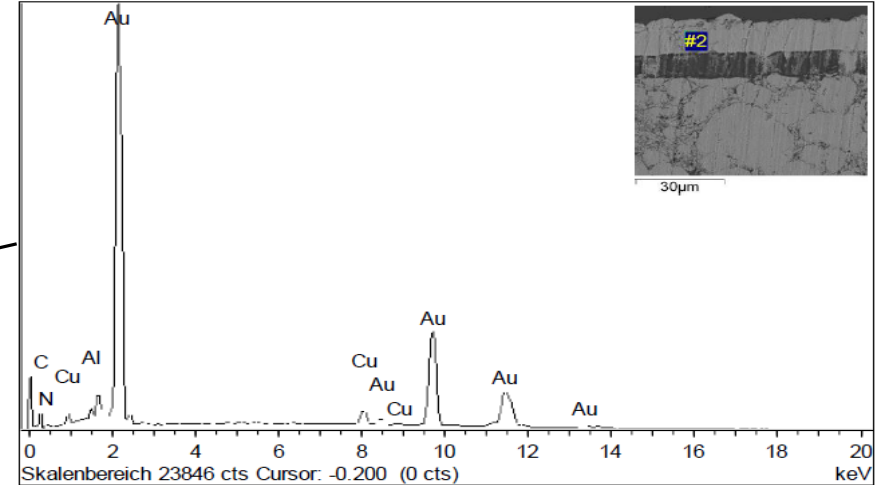


Counterfeit Gold Coins

Types of counterfeit gold coins



Analysis of the outer layer



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Types of counterfeit gold coins

- The microstructure of the core consists of tungsten grains of different sizes, which are embedded in a copper matrix.
- The chemical composition of the core can be described as 90% tungsten and 10% copper.
- To achieve a better connection between the base material and the gold layer the tungsten core is coated with copper. Beside gold the outer layer also contains approximately 4% copper and 1% aluminium.
- The thickness of both layers together varies between 10µm and 35µm.

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Conclusions

- Counterfeit coins appear in different variations
- For a thorough examination more than one method of analysis should be applied
- To increase the hurdle for counterfeiters it might be worthwhile to discuss the use of security features for modern coins

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Thank you very much

