Mühlbauer
High Tech International

MÜHLBAUER TECURITY®

GOVERNMENT SOLUTIONS

COMPANY

INTRODUCTION

- owner-managed group
- international market leadership in the fields of
  - Parts & Systems
  - Semiconductor Related Products
  - Document Solution Related Products
  - TECURITY® Solutions
- the Mühlbauer Group's philosophy: Our customers are our partners!

FACTS

BASIS

- 3,500 employees at 35 sites worldwide
- 400 engineers in R&D
- 400 trainees
- excellent sustainability standards

INVESTMENTS

- annual investments (approx. 15 million EUR) in
  - latest technologies
  - infrastructure
  - systematical & logical completion of the product chain

MARKET POSITION

PARTS & SYSTEMS – intersectoral parts manufacturing
AUTOMATION – market leader in the areas of RFID, semiconductor backend and Smart Card
TECURITY® – system partner for global technology- and know-how-transfer in the area of SmartID

HISTORY

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1981
Founding of the company by Josef Mühlbauer with only one machine for the production of precision parts

1985
Development of production equipment for the semiconductor backend industry

1988
First turnkey production solutions for the manufacturing of plastic cards and smart cards

1991
Opening of first sites abroad

1995
Development of the RFID factory

1998
Initial public offering of the company

2003
Positioning in the areas of government security & biometry

2008
Installation of the first fully automatic production facilities for flexible thin film solar technology

2014
Opening of the Mühlbauer TECURITY® Center in Roding, Germany

2016
Expansion of Technology Center in Nitra, Slovakia

2017
Mühlbauer launched MB PalaMax® production platform

2018
Opening of Technology Center in Newport News, USA

INTERNATIONAL SITES

- 35 production & service locations
- technology centers in the USA, Slovakia, Serbia, Malaysia and China
- inhouse precision-part production
- provision of
  - high-end semiconductor & RFID systems
  - reliable vision inspection technologies
  - innovative ID document end-to-end-solutions
  - secure access & border control systems

BUSINESS LINES

PARTS & SYSTEMS

Precision Parts
for Aerospace, Automotive,
Semiconductor & Engineering

AUTOMATION

Machines & Solutions
for SRP & DSRP

TECURITY®

Solutions
for Governments

THE INNOVATION PLATFORM

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SEMICONDUCTORS

intelligence for security and communication

RFID

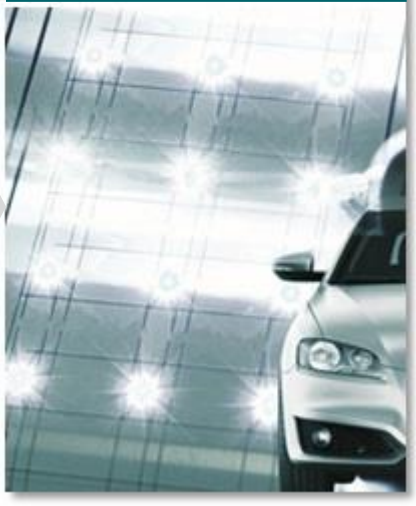
smart label technology for TECURITY & IOT

FLEXIBLE SOLAR

efficient solution for clean energy everywhere

LED

energy-saving light for the future



SECURITY & QUALITY CERTIFICATES

Mühlbauer
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Security Printer


INTERGRAF Certificate for
Management of Security Printing Processes
MÜHLBAUER GmbH & Co. KG:
TECHNOLOGY TRANSFER CENTER
Josef Mühlbauer Platz 1, 93426 RODING, Germany

Security Supplier


INTERGRAF
INTERGRAF Certificate for
Security Management System for
Suppliers to the Security Printing Industry
Security Supplier
Mühlbauer GmbH & Co. KG

IT Security ISO IEC 27001


CERTIFICATE
DEKRA
Mühlbauer
ISO/IEC 27001:2013
Mühlbauer GmbH & Co. KG

QM System ISO 9001:2008


CERTIFICATE
DEKRA
Mühlbauer
ISO 9001:2008
Mühlbauer GmbH & Co KG

ASSOCIATIONS & INITIATIVES

Mühlbauer
High Tech International

AFRIKA-VEREIN
DER DEUTSCHEN WIRTSCHAFT

Ghorfa
غرفة التجارة والصناعة العربية الألمانية
Arab-German Chamber of
Commerce and Industry e.V.

IATA Strategic Partner

MEMBERSHIP IN GOVERNMENTAL INITIATIVES, WORKING GROUPS AND COMMITTEES

- German-African Business Association
- Ghorfa Arab-German Chamber of Commerce and Industry e.V.
- IATA Strategic Partner
- INTERPOL Project S-Print
- Operation Genesius
  U.S. Department of Homeland Security

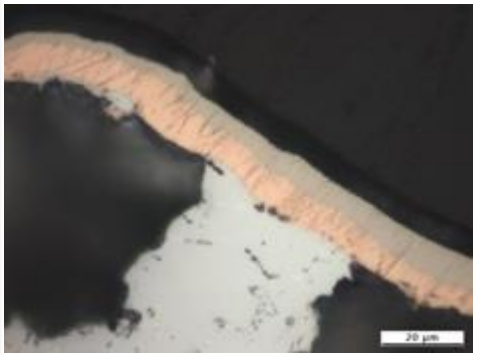
Looking at coins and blanks in different ways: visible light, X-ray, electro-magnetic sensors

Dr. Ralf Freiberger

Overview

1. Purpose
2. Determination of dimensions, surface check,

   relief check, counterfeit detection: visible light
3. Determination of composition / signature: XRF / EMS
4. Summary



Purpose

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Determination of dimensions, surface check → Quality (blanks) Visible light

Relief check, counterfeit check → Quality (new/used coins) Visible light

Determination of composition → Quality (blanks)
and counterfeit check → Quality (used coins) XRF and EMS

Overview

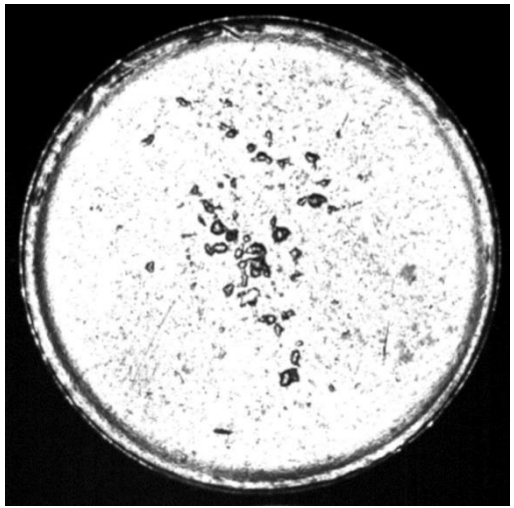
COIN INSPECT (2-side check, 3000 parts/min)

COIN TEST STATION (1-side check, 10 parts/min)

Determination of dimensions, surface check, relief check, counterfeit check

COIN INSPECT

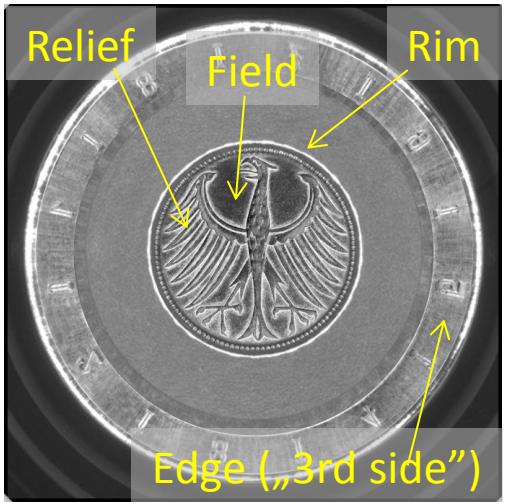
Determination of dimensions, surface check, relief check, counterfeit check



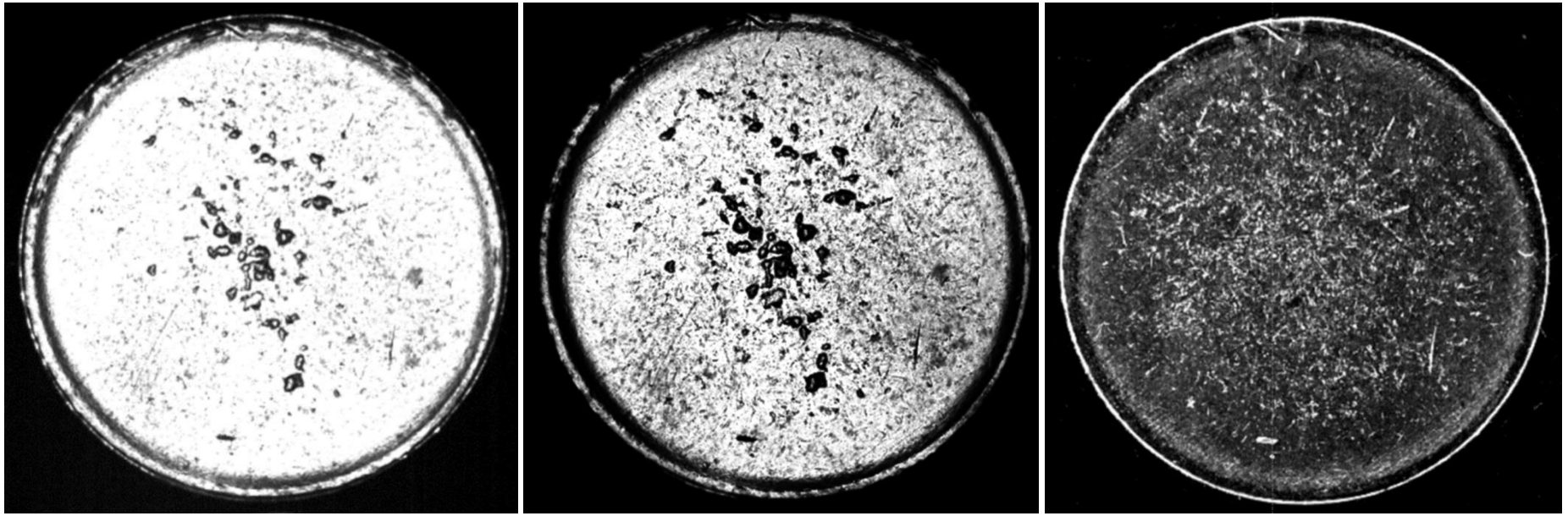
Demands are always the same → Quality

Quality concerning minted coins means:
100 % check from blank to minted coin

One machine for blanks and minted coins

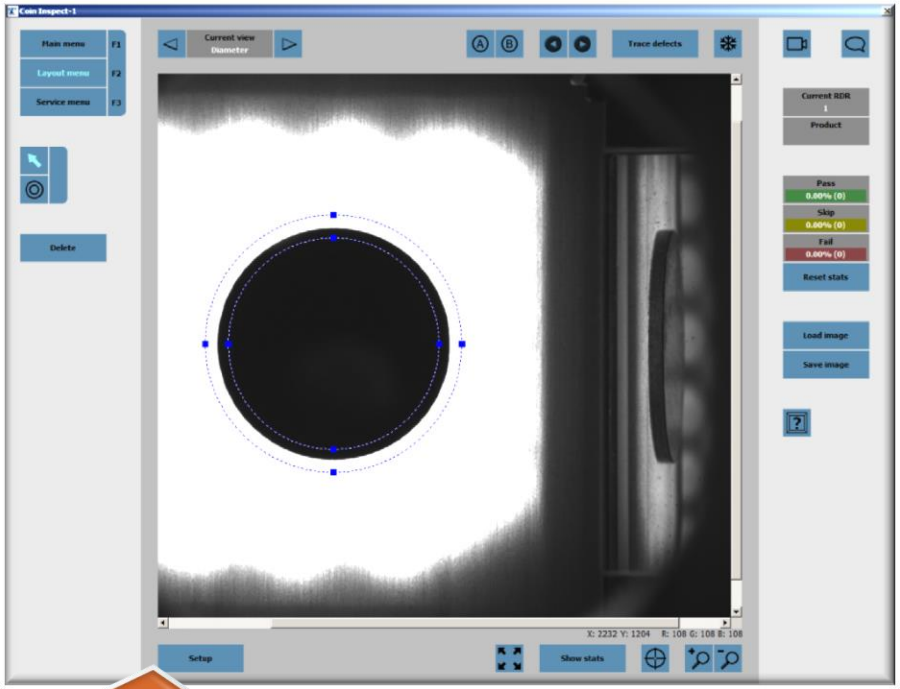


Surface check



Example: Same blank with different illumination techniques

Determination of dimensions



Diameter: σ = 4 µm
Thickness: σ = 14 µm

precision @ 3000 / min

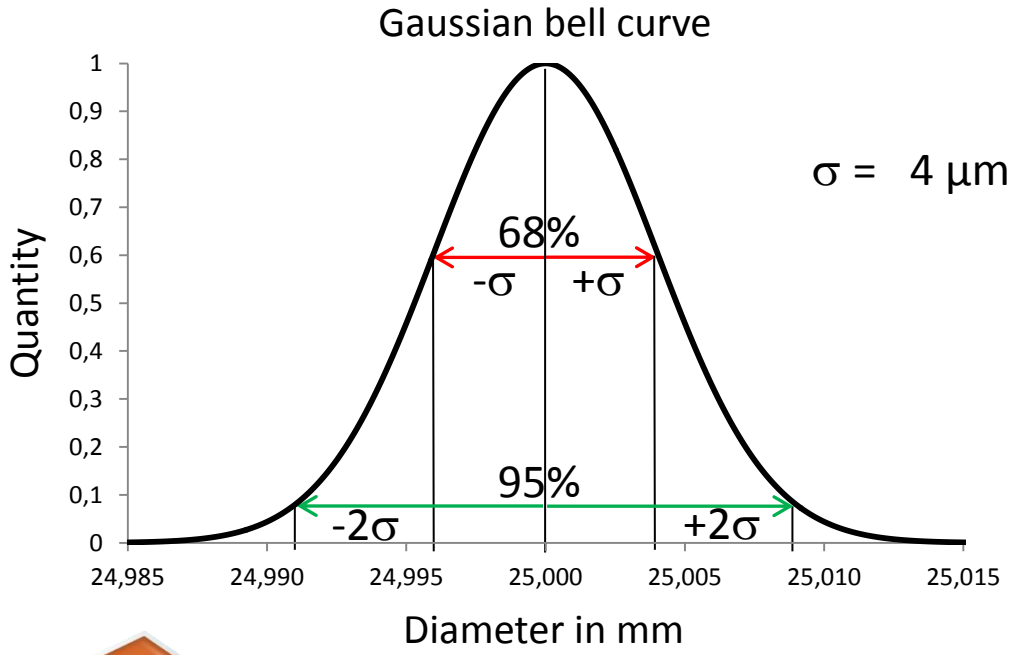
Special optical design

Exposure time (= flash time) 100 µs

v = 0.5 m/s

High contrast in images (black 0 % to white 100 %)

Determination of dimensions



σ = 4 µm

Diameter (example)

68% of all measured values from a 25.000 mm blank are within ± 4 µm

95% of all measured values from a 25.000 mm blank are within ± 8 µm

Determination of composition / signature

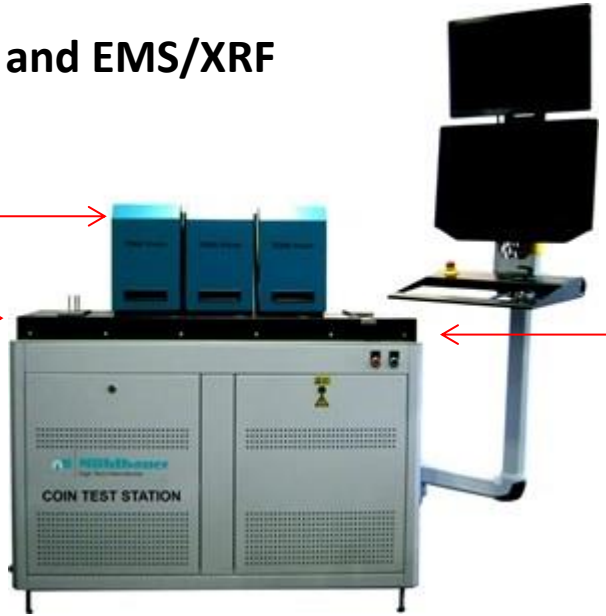
COIN TEST STATION

Determination of composition / signature

XRF (X-Ray Fluorescence) implemented (patent pending)

Determination of composition / signature

Concept: Combination of vision and EMS/XRF



Vision monitors

Vision units incl. EMS or XRF

Magazine loader

Coin output

Mobile Frame

Determination of composition / signature

Determination of composition is important for blank manufacturers (quality!) and for the sorting of used coins (counterfeit detection) as well.

Determination of composition / signature

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XRF = X-Ray Fluorescence
mass% of elements

EMS = ElectroMagnetic Signature
inductivity of material

Determination of composition

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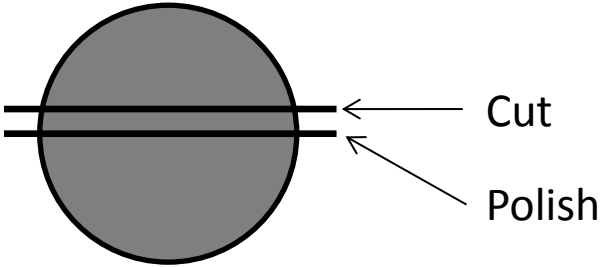
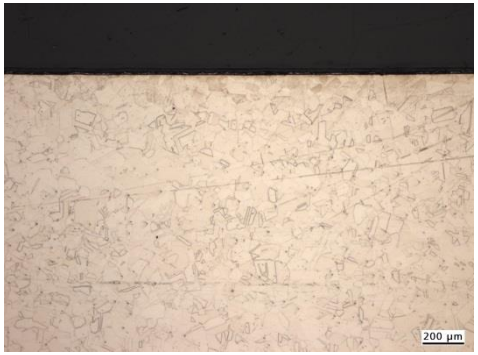
Why not *only* vision *or* EMS *or* XRF to check for counterfeit coins ?

Lets have a look *inside* some coins !

Determination of composition

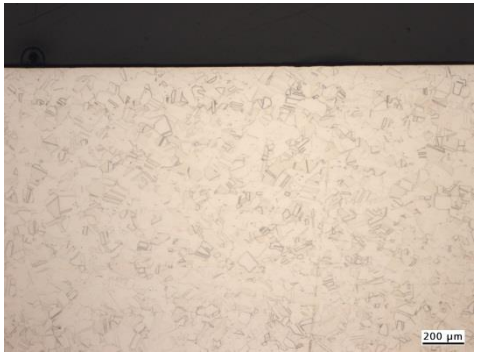


Determination of composition



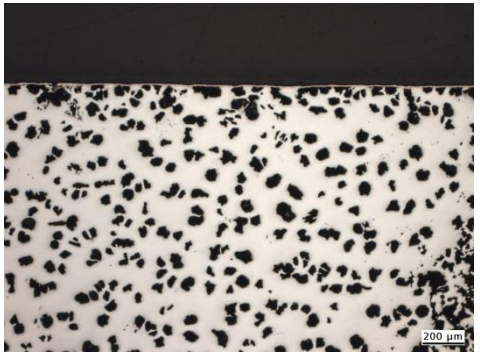
#1 (genuine)
α-Cu-structure

wrought alloy



#2 (counterfeit)
α-Cu-structure

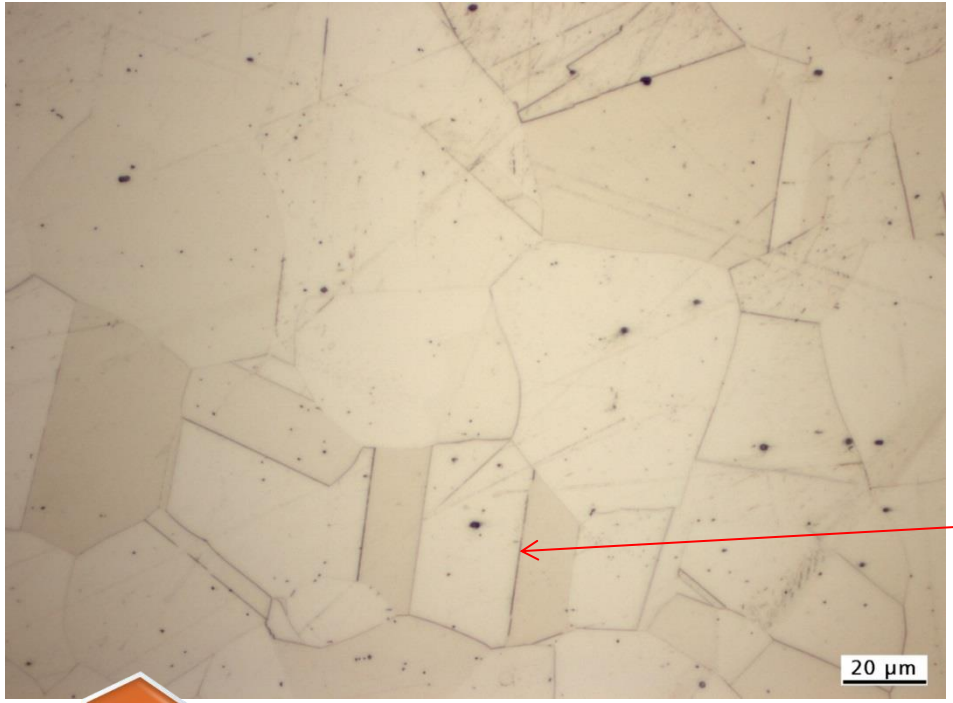
wrought alloy



#3 (counterfeit)
Aluminum

cast alloy

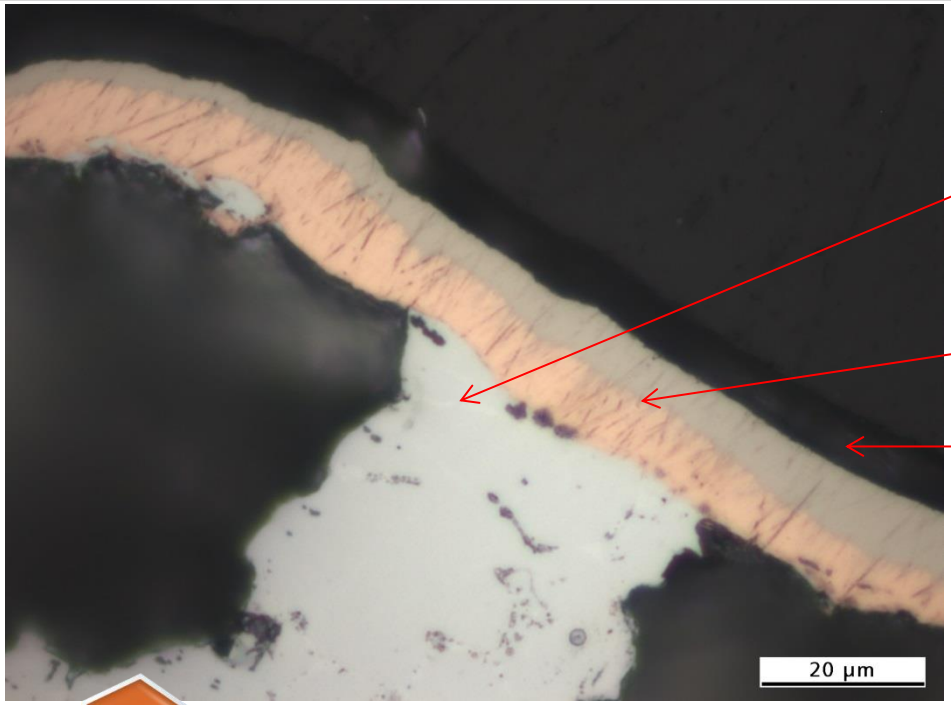
Determination of composition



Cupronickel CuNi25

#1 (genuine) and #2 (counterfeit)
α-Cu-structure
cubic area-centered
twinned grain boundaries
wrought alloy

Determination of composition



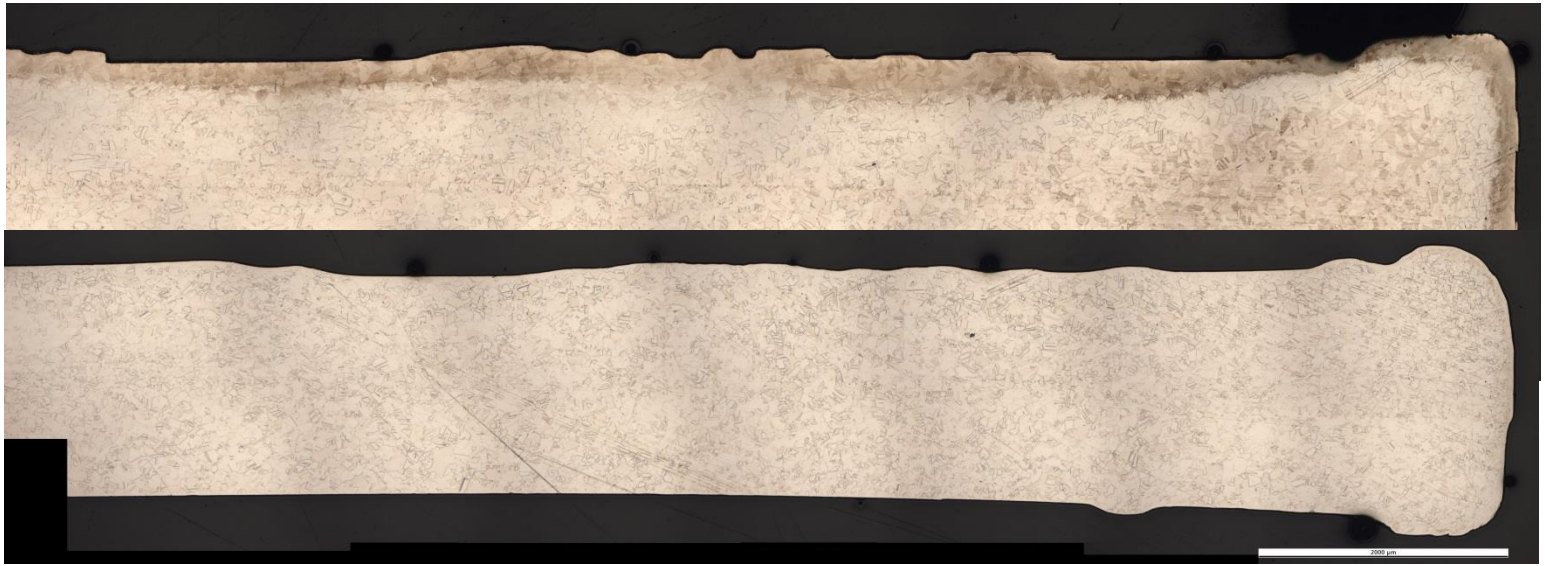
#3 (counterfeit)

aluminum
cast alloy

copper

nickel

Determination of composition

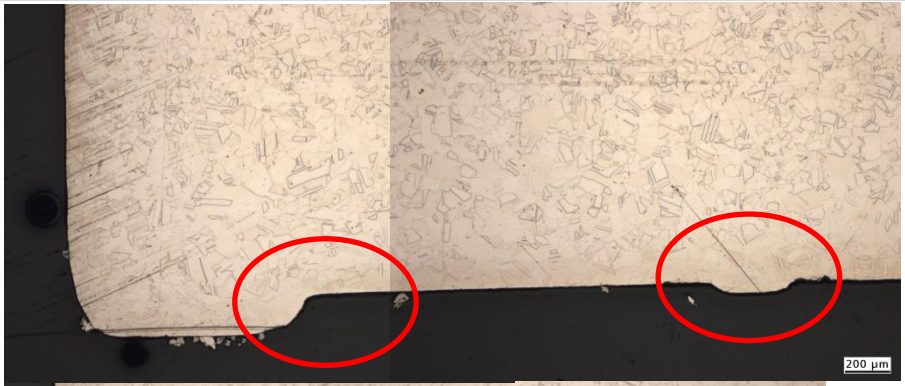


#1 (genuine)
steep relief

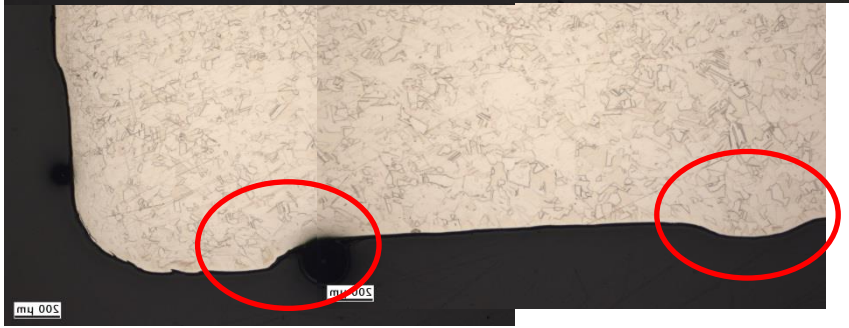
#2 (counterfeit)
flat relief
(→ impact-dies)

wrought alloy → plastic deformation

Determination of composition



#1 (genuine)
steep relief

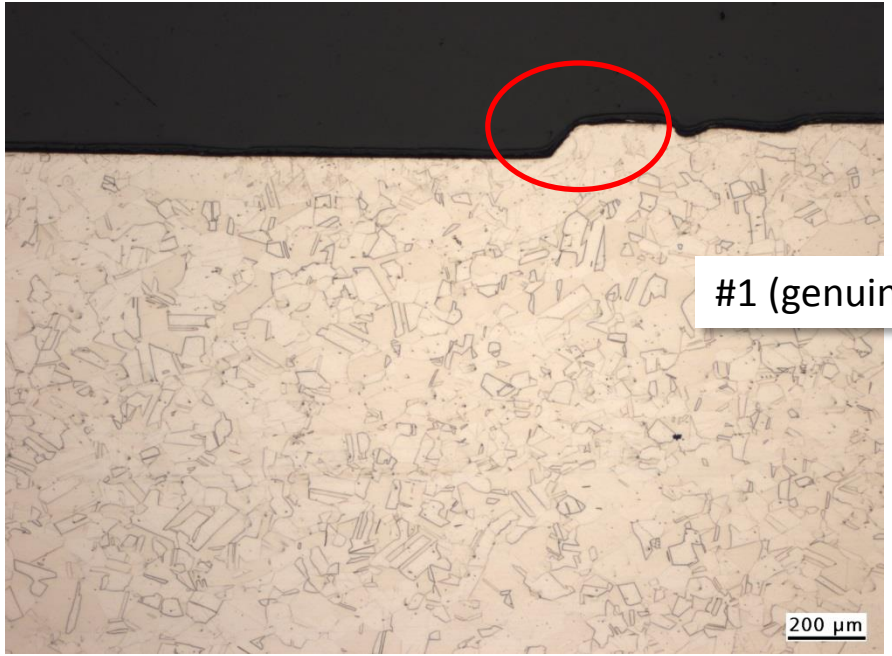


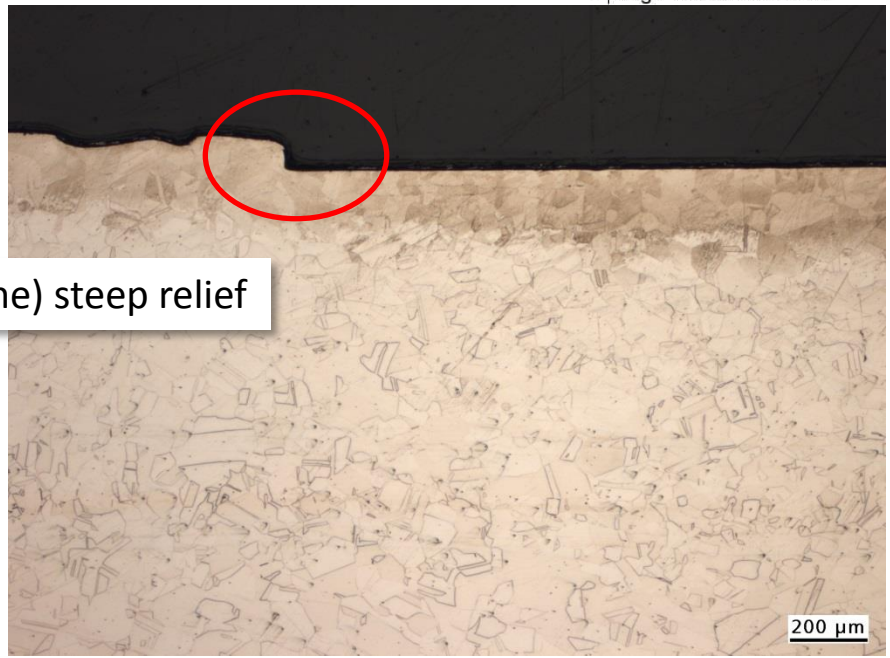
#2 (counterfeit)
flat relief
(→ impact-dies)

symbolic illustrations for demonstration

specially designed lighting

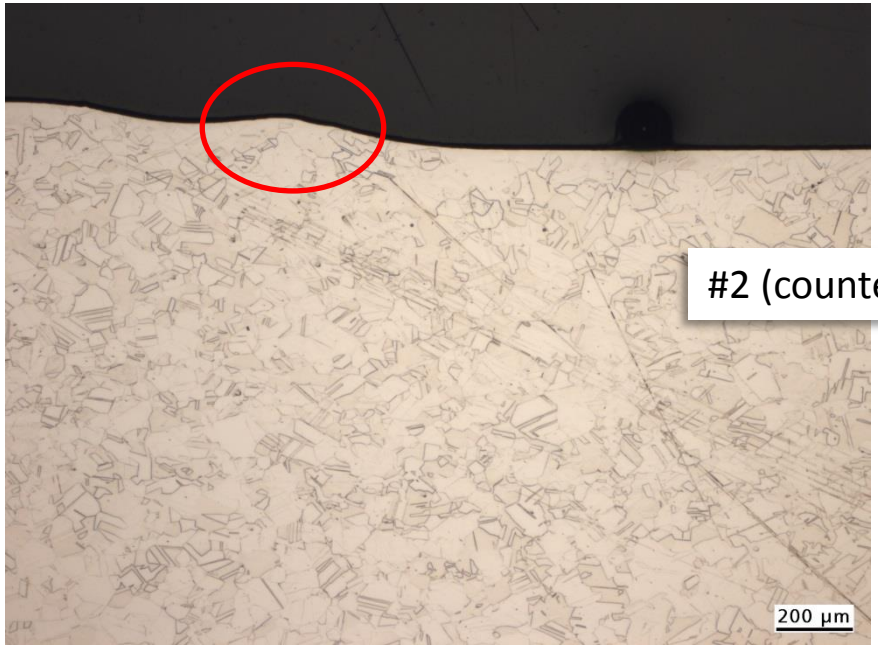
Determination of composition

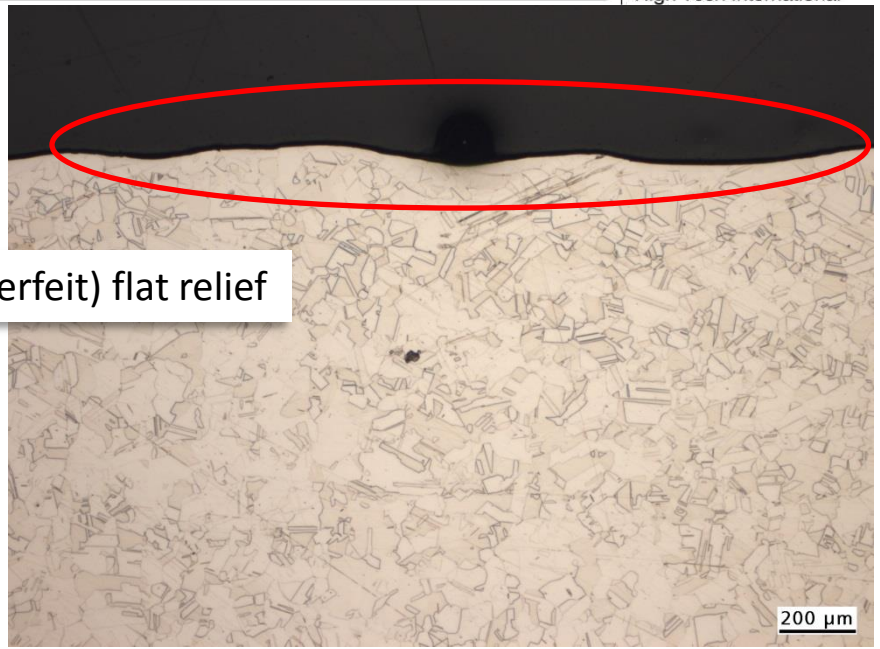




#1 (genuine) steep relief

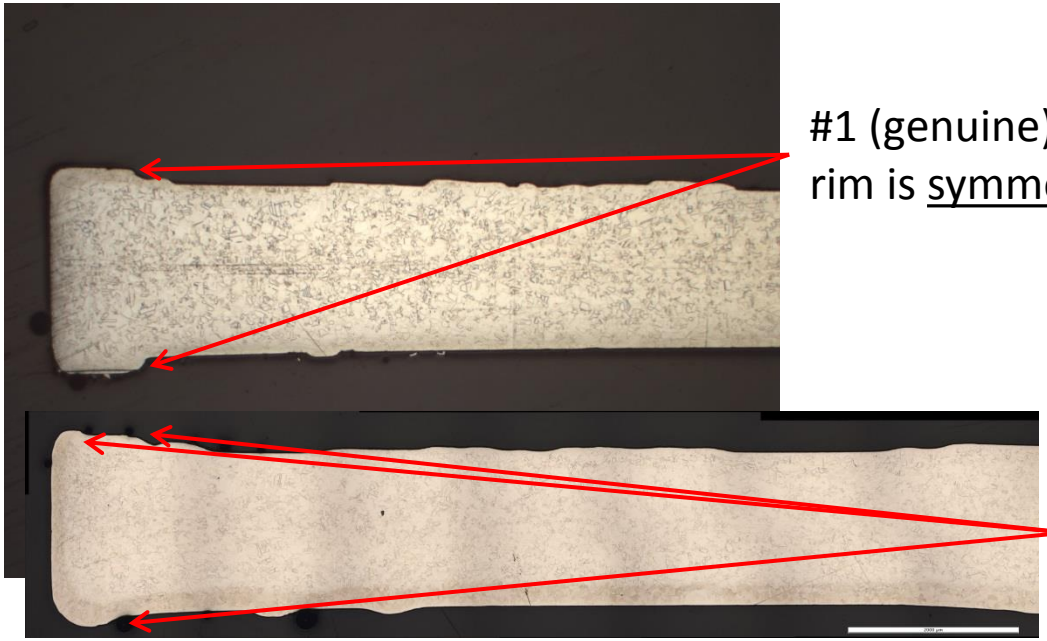
Determination of composition





#2 (counterfeit) flat relief

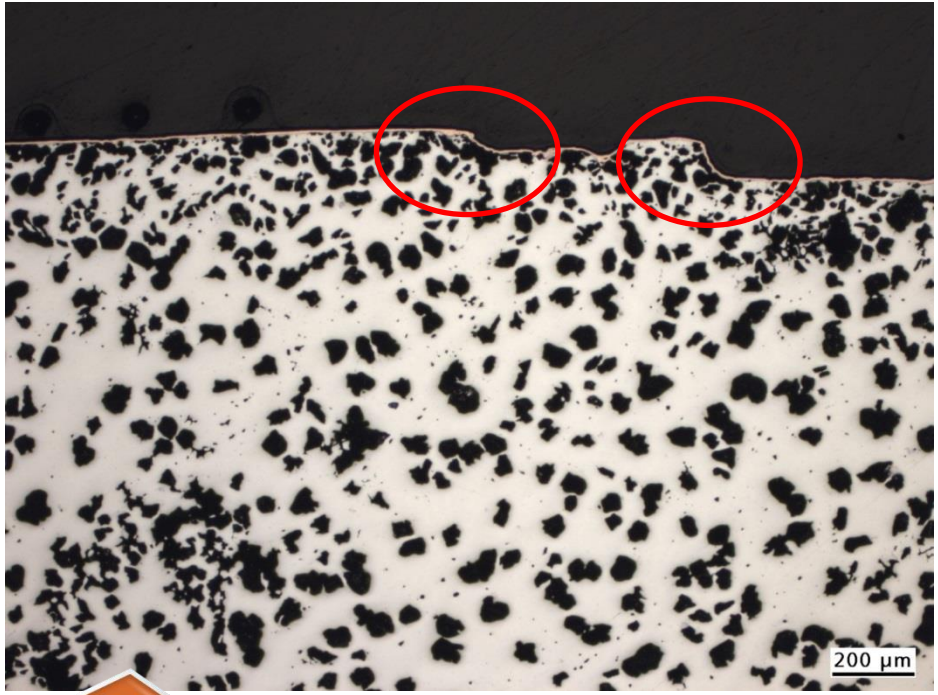
Determination of composition



#1 (genuine)
rim is symmetrical (obverse/reverse)

#2 (counterfeit)
rim is asymmetrical (obverse/reverse)

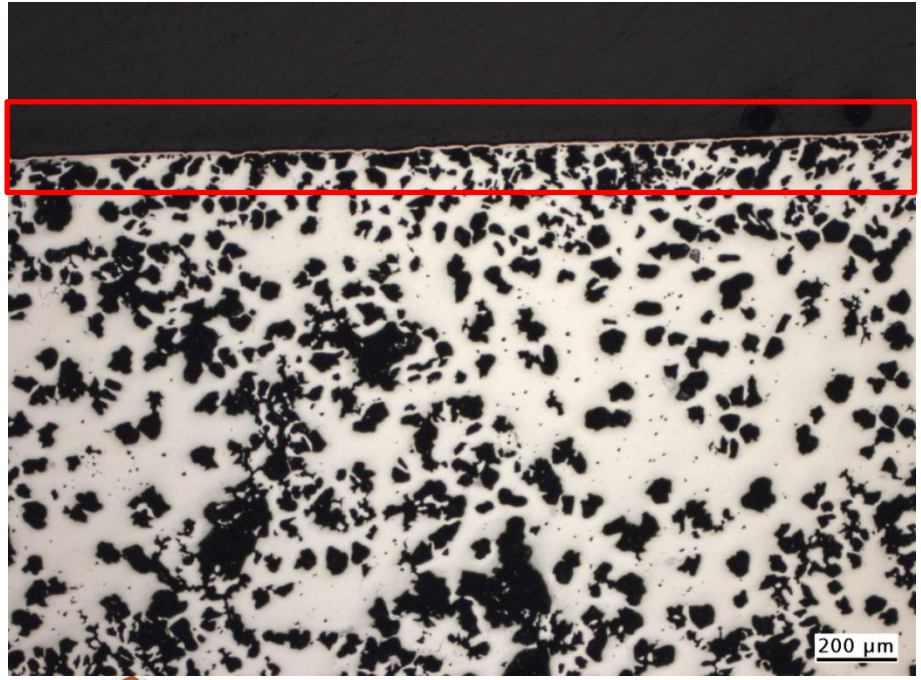
Determination of composition



#3 (counterfeit)
steep relief

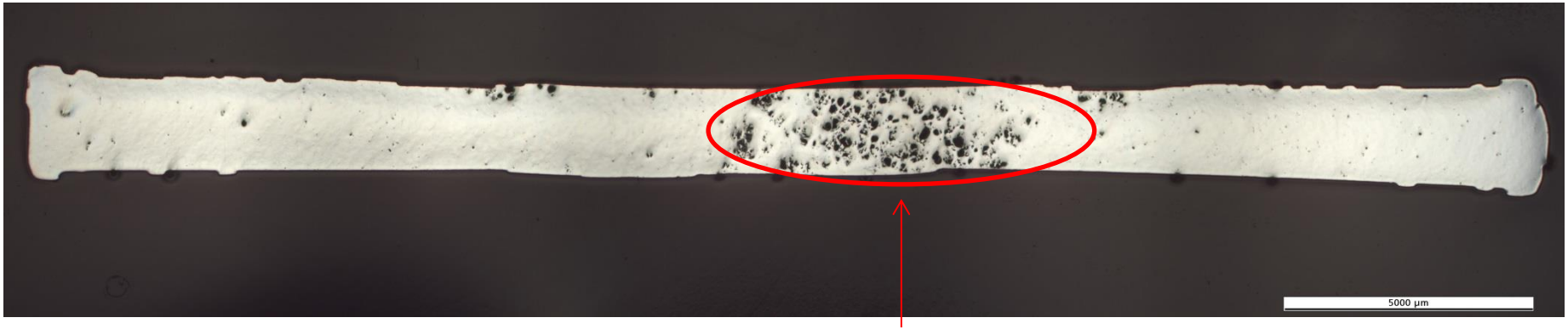
corrosive attack during polishing
→ “cow pattern“

Determination of composition



#3 (counterfeit)
surface (field): high roughness

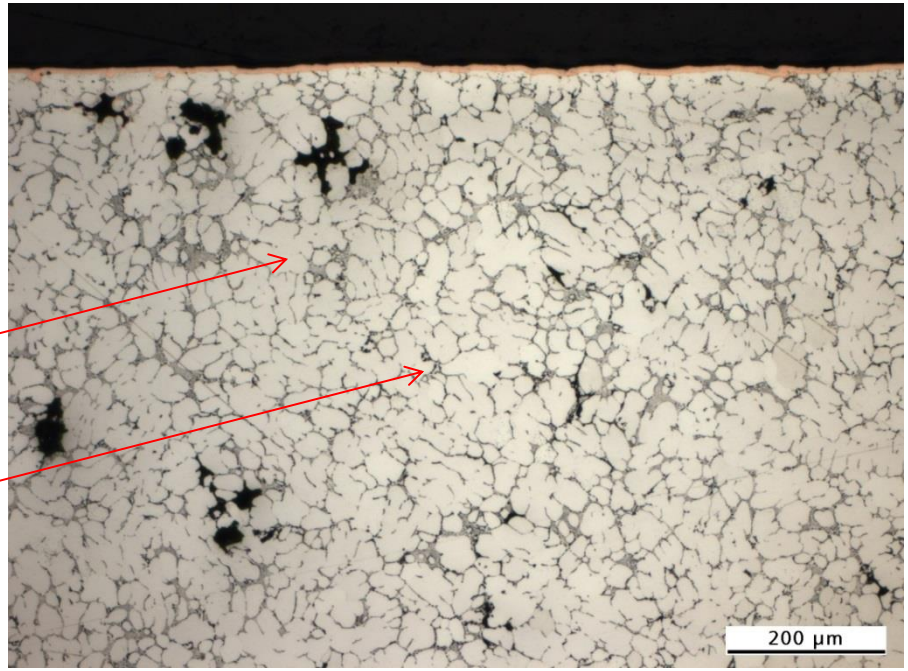
Determination of composition



#3 (counterfeit)
shrinkage cavities
thickness not constant

Determination of composition

#3 (counterfeit)
etched with NaOH
Al-mixed crystal grains (bright) and
solidified eutectic from Al
and intermetalic compound (grey)



Determination of composition

#1 (genuine)
α-Cu-structure
wrought alloy

Optical method
(XRF)
~~**EMS**~~

~~**Optical method**~~
XRF
EMS

How to distinguish

#2 (counterfeit)
α-Cu-structure
wrought alloy

#3 (counterfeit)
Aluminum
cast alloy

Determination of composition

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Why not *only* vision *or* EMS *or* XRF to check for counterfeit coins ?

The combination of these methods increases the detection performance dramatically !

Determination of composition: XRF

Example: XRF
XRF = X-Ray Fluorescence

- Bremsstrahlung → photoelectric effect → emission of characteristic fluorescent X-rays
- Energy dispersive measurement (EDXRF)
- Checks for the right alloy (qualitatively and quantitatively)
- Penetration depth ≈ 100 µm
- Checks for the correct composition of the material (order number Z=12 (Mg) or higher)
- Detects slightest contaminations with other elements, especially with high order number
- Mg / Al / Si longer time for measurement because of less energy from emitter (SNR)
- 3 - 4 sec / object

Determination of composition: XRF

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Examples of composition of cupronickel-counterfeits

Cu	Ni	Zn	Sn	Pb	Mn	Fe
75.39	24.13				0.47	
75.35	24.18				0.46	
75.34	24.18				0.47	
75.35	24.20				0.44	
63.82	17.45	18.33		0.01	0.05	0.33
75.40	24.13				0.46	
75.23	24.28				0.48	
75.10	24.41				0.46	
63.60	17.54	18.48		0.01	0.10	0.27
96.23	3.64	0.10				0.04
91.64	8.24		0.03			0.09

mass %
$\sigma < 0.4$ %

Genuine coins have a ratio of 25 % nickel (Ni) and 75 % copper (Cu), but +/- 1%

Determination of signature: EMS

EMS = Electromagnetic Signature

Determination of signature: EMS

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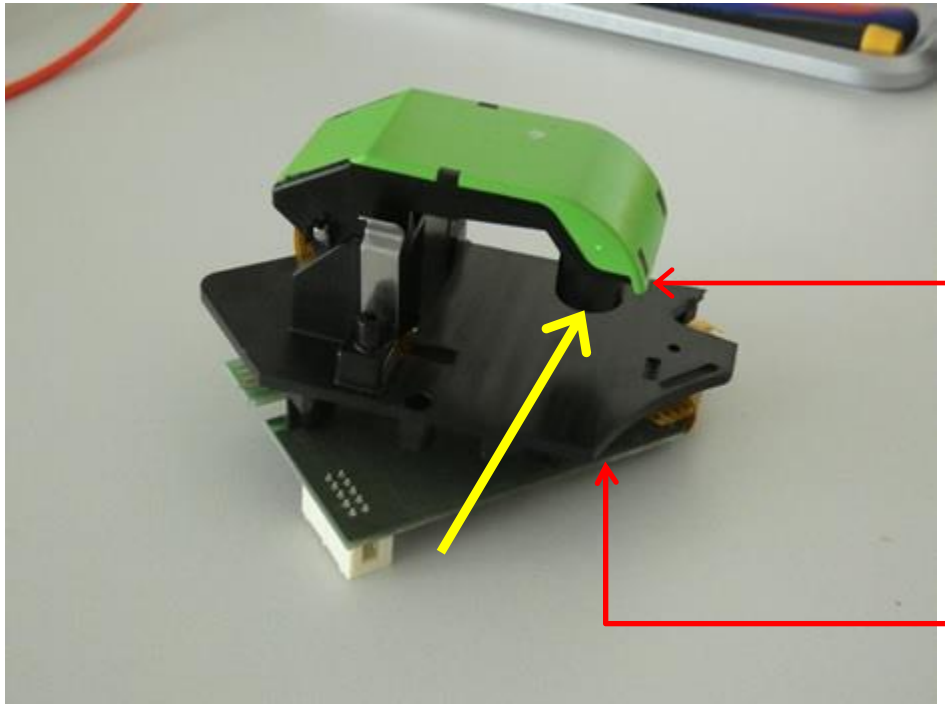
Different frequencies

f high → surface
f low → core

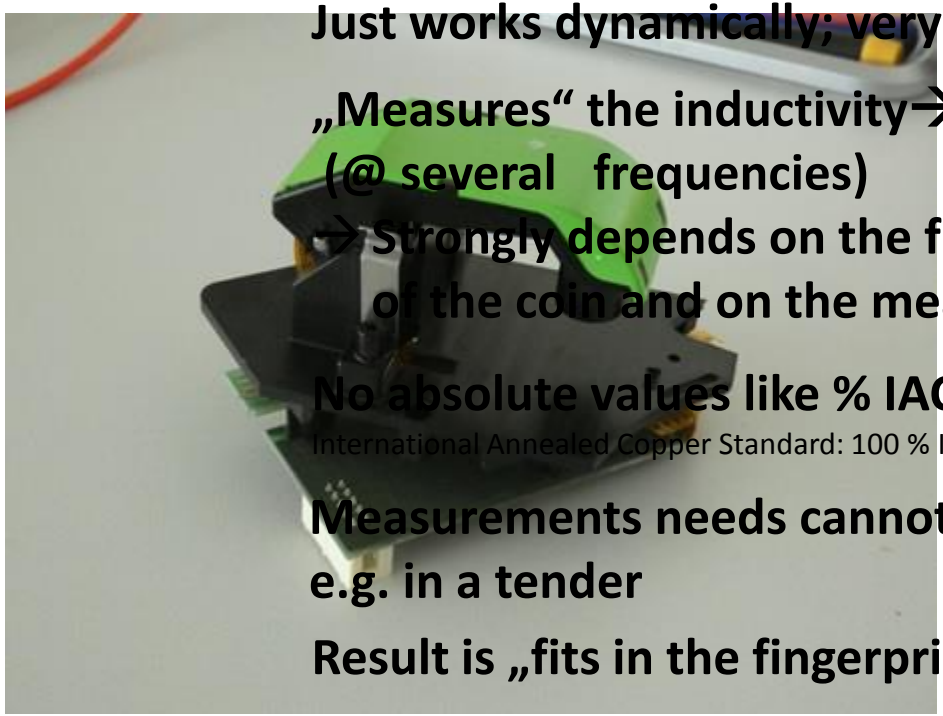


EMS-Sensor

el. coil (reflective)

el. coil (transmissive)

Determination of signature: EMS



Just works dynamically; very fast

„Measures“ the inductivity→ fingerprint
(@ several frequencies)
→ Strongly depends on the fitness
of the coin and on the measurement conditions

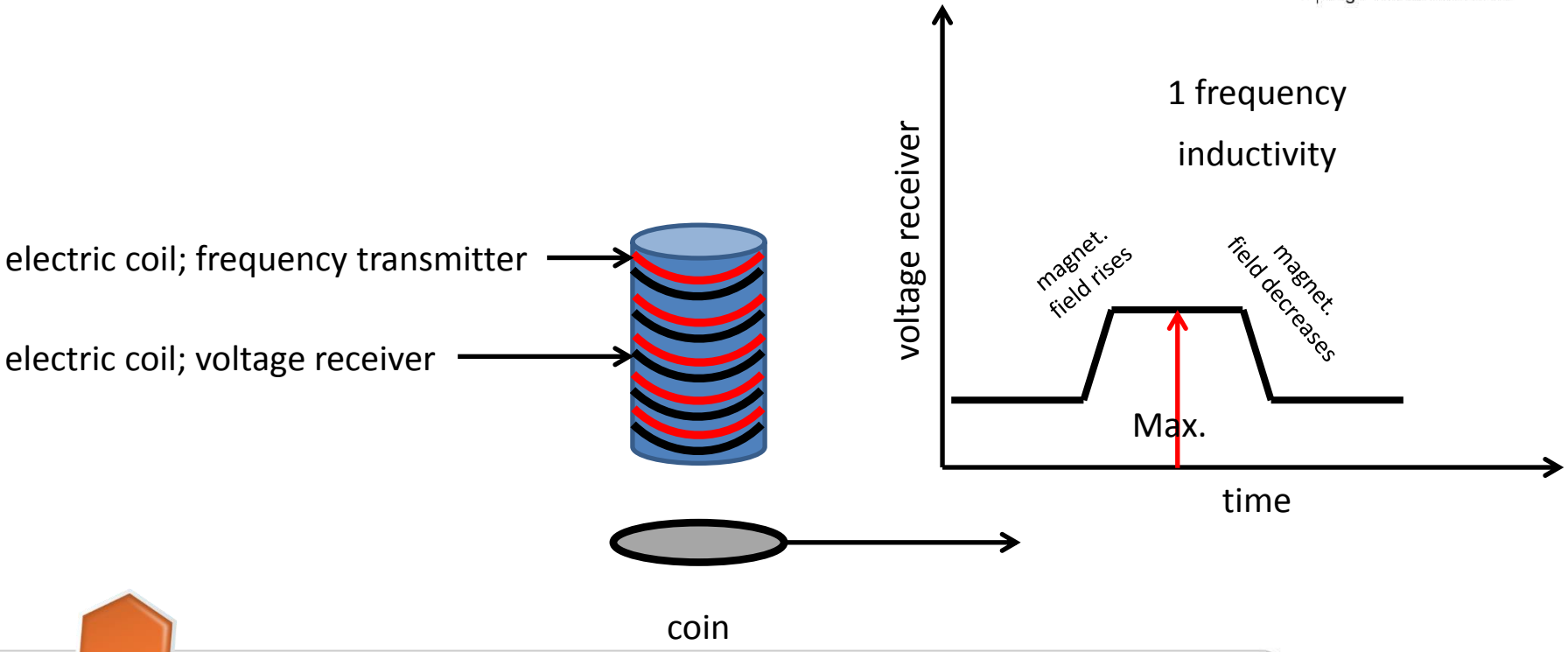
No absolute values like % IACS (conductivity)

International Annealed Copper Standard: 100 % IACS = $58 \cdot 10^6$ S/m

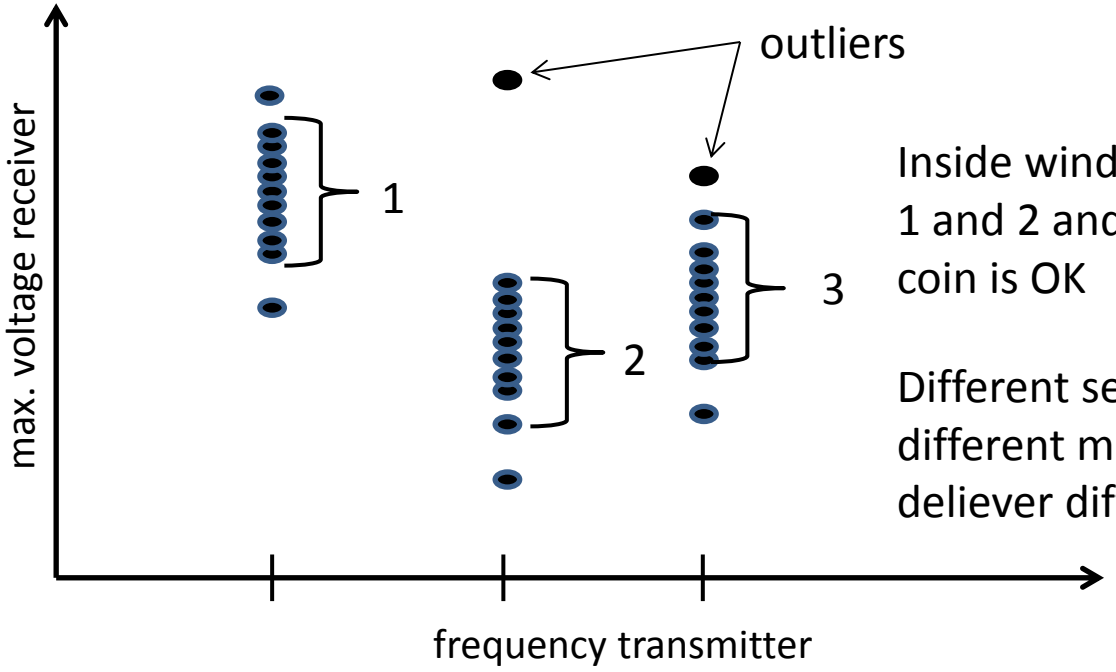
Measurements needs cannot be described
e.g. in a tender

Result is „fits in the fingerprint-window“ or not

Determination of signature: EMS



Determination of signature: EMS



Inside windows
1 and 2 and 3
coin is OK

Different sensors from
different manufacturers
deliever different results

Summary

- Determination of dimensions, surface check, relief check, counterfeit check → visible light
- Determination of composition / signature → XRF / EMS
- **100 % check for counterfeit coins → visible light + EMS / XRF**

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