

2nd SPCD 12-14 October 2016



Passive components :
Feedback of 5 years of analysis
From all Electronic Sectors

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1

Introduction

- SERMA Technologies

2

Facts & Figures on Failure Analysis (FA)

- Some figures about Passive FA
- Main defects observed on Components

3

Specific method for FA

- Voltage contrast coupled SEM



1- Introduction

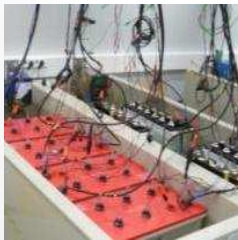
Information Technology
Security

Audits & Consulting



TECHNOLOGY & PROCESSES

Energy Storage Devices



Physical Expertise



Electrical Testing



The most important independent electronic laboratory in Europe

- > 20 years of experience - multi-sectoral
- > 6 000 analyzes / year

A WIDE RANGE OF EQUIPMENT

Physical / Chemical Analysis

Optical microscopes

SEM with EDX system

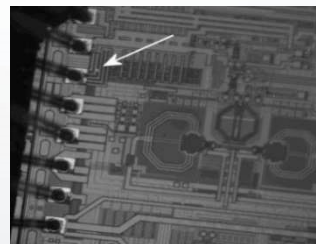
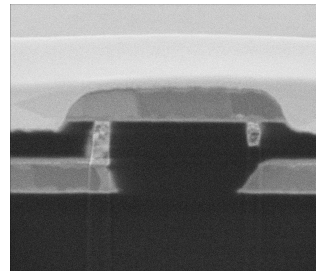
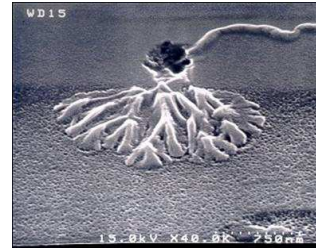
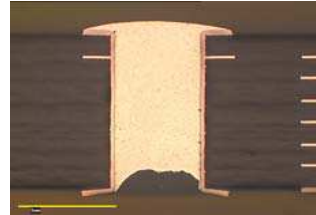
Focused ion Beam imaging

Transmission Electron Microscopy

3D Slice & View

X-Ray Fluorescence

IR Thermography



2D & 3D X-Ray

Electrical Tests

Emission Microscopy

Acoustic microscopy

Micro-probing

Laser Cutter

Wet etch and plasma dry etch

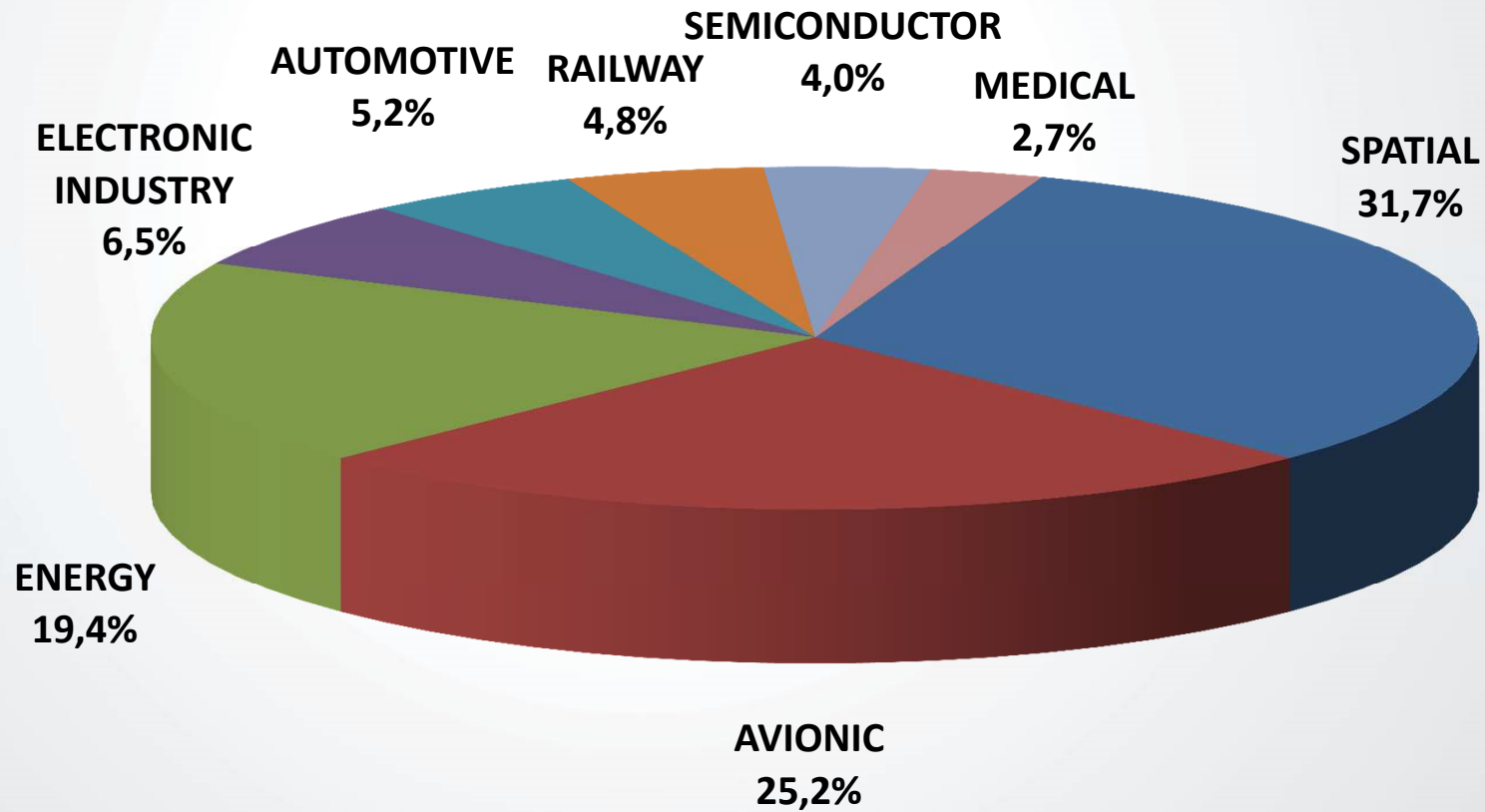




2- Facts & Figures on FA

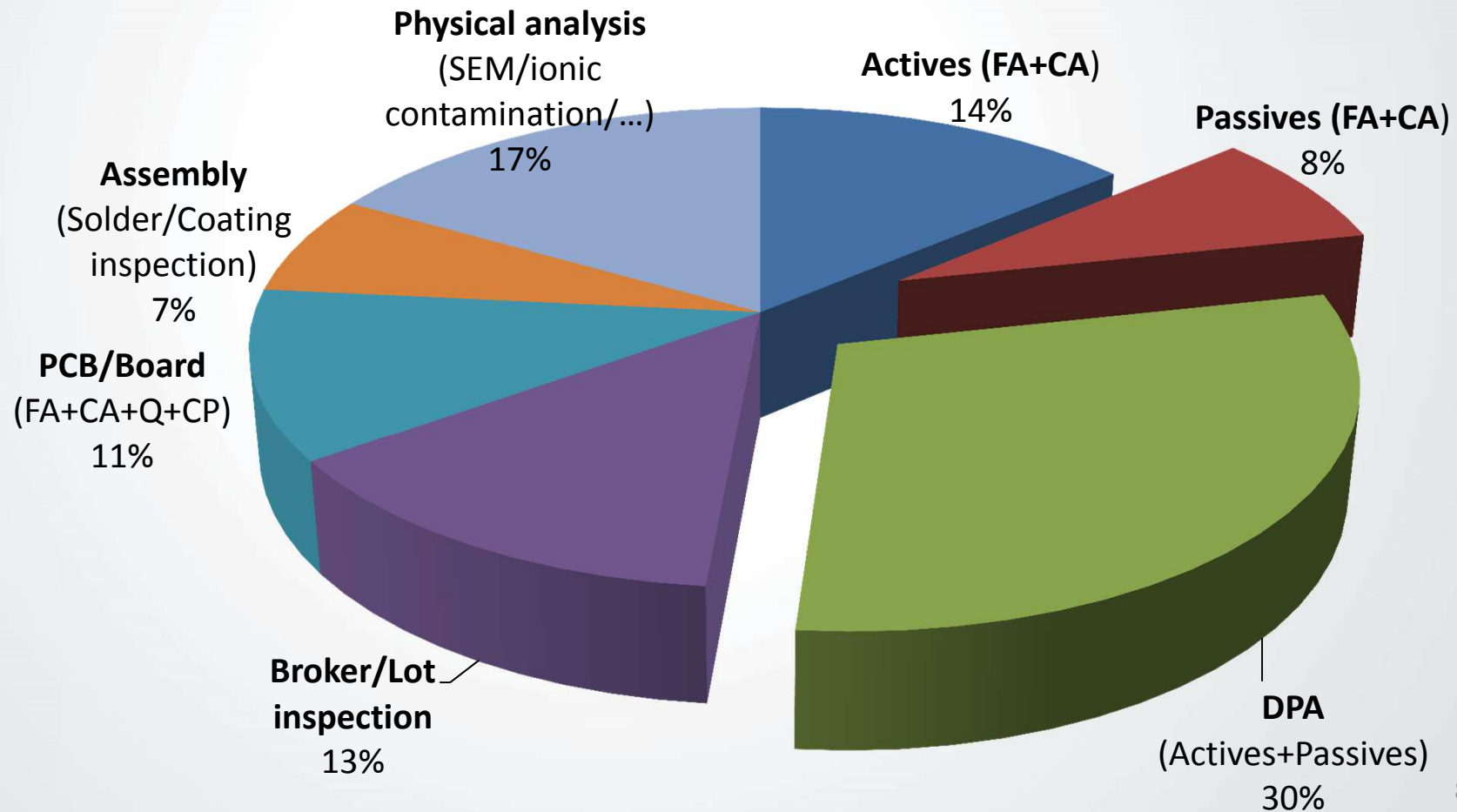
Ceramic Capacitors
Tantalum Capacitors
SMT Resistors

Physical Expertise Main sectors (by Turnover)



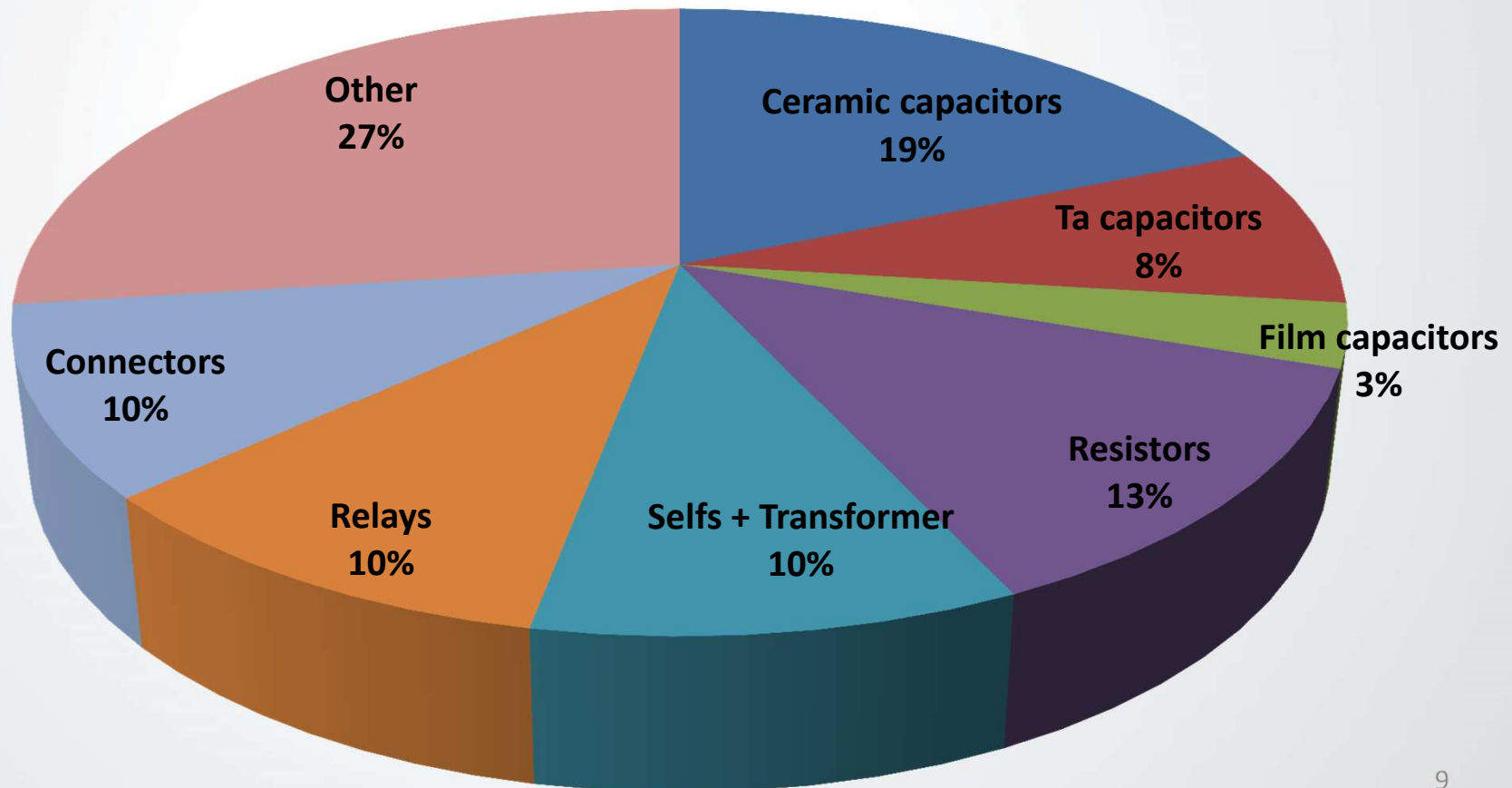
Physical Expertise Type of analysis (by quantity)

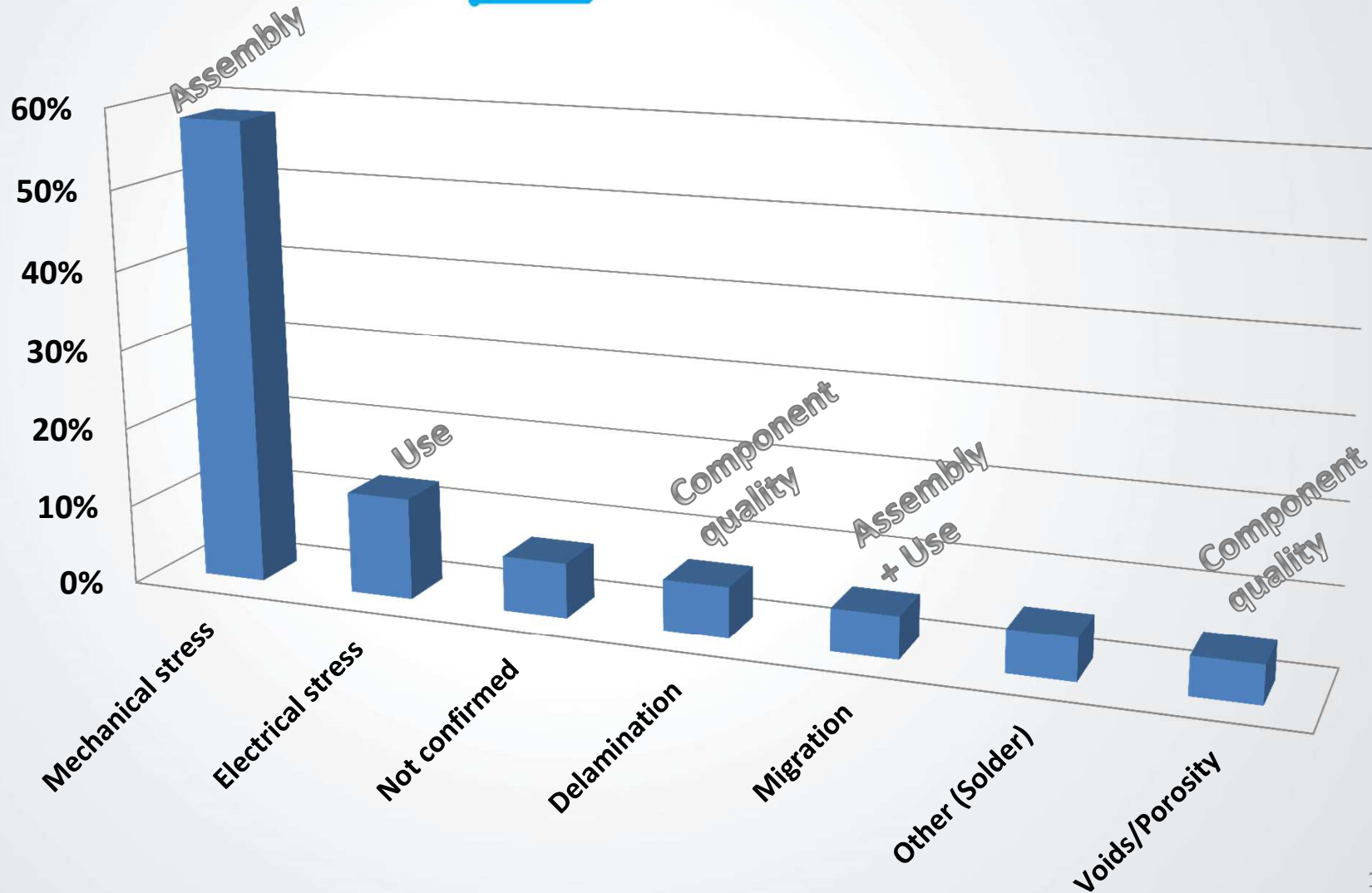
- From 2011 to 2015: 19 700 analysis

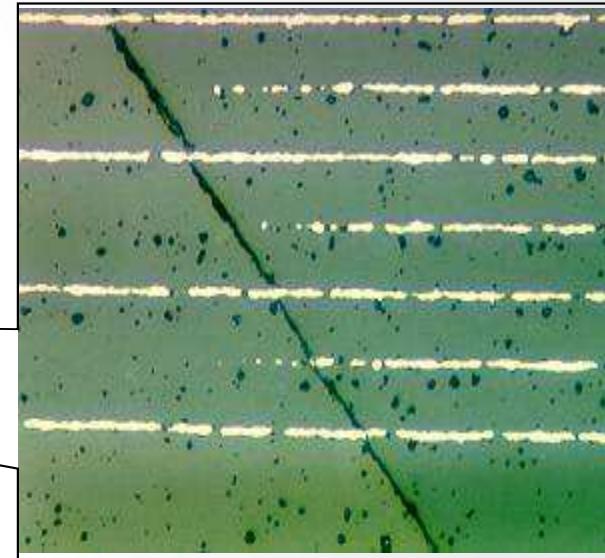
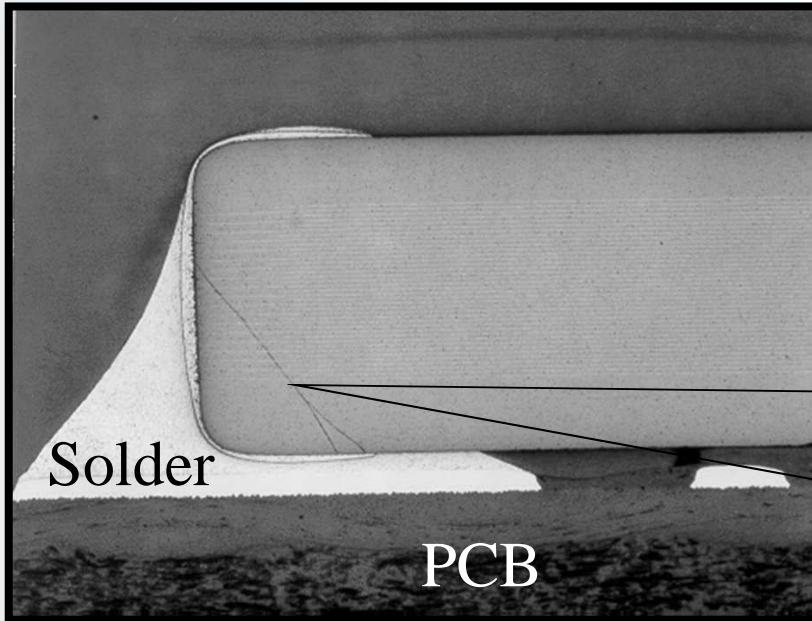


Type of component (by quantity)

- From 2011 to 2015: 1 200 failures analysis on passive components



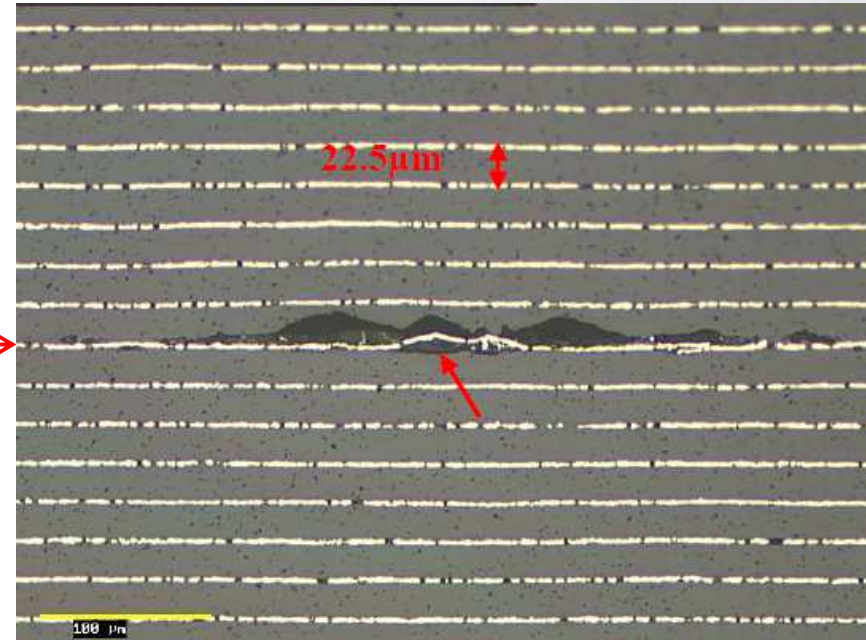
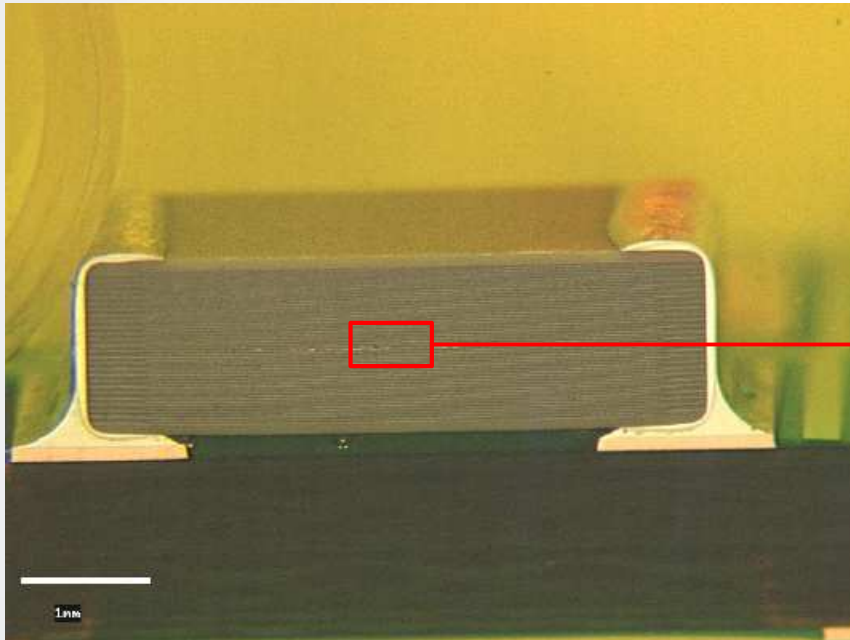




Diagonal cracks (@45°) due to Thermo and/or Mechanical stresses soldering/testing/depanelization/handling...

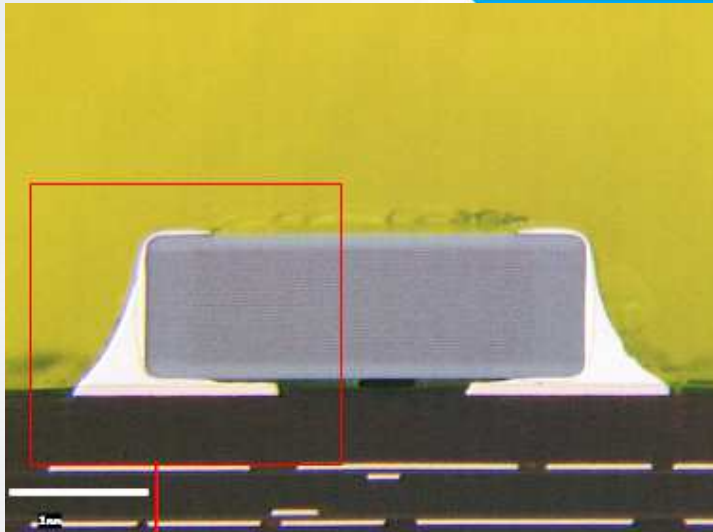
→ **Short circuit when opposite electrodes are cracked**

Ceramic Capacitors Delamination: Electrode/Ceramic

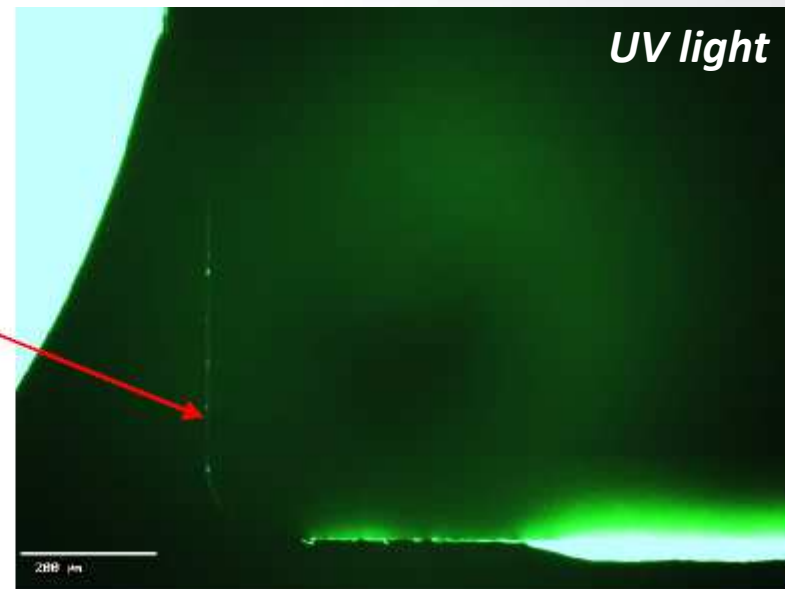
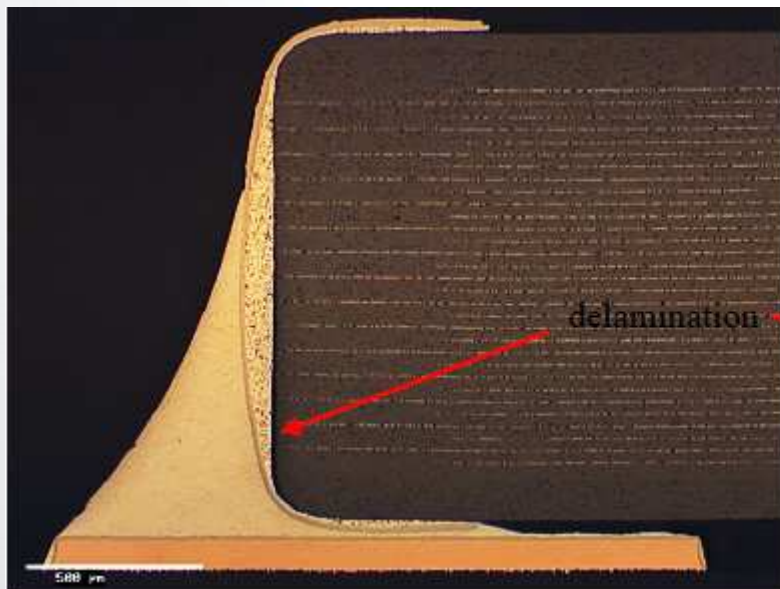


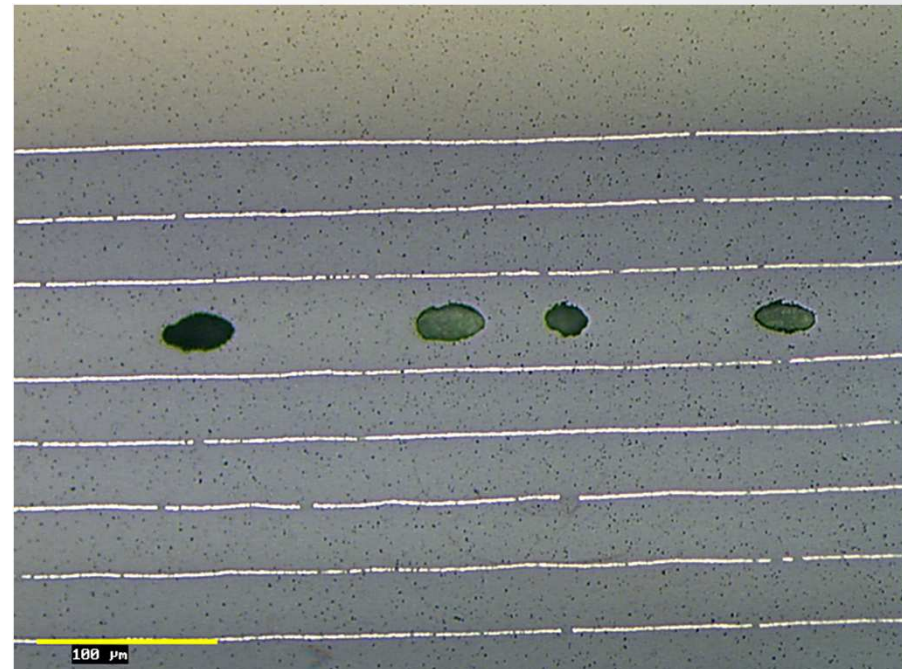
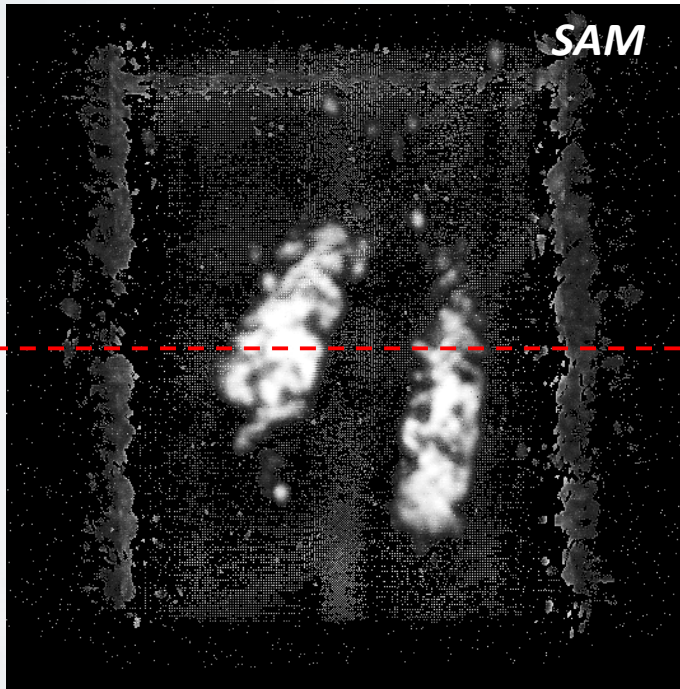
Delamination relative to the component process: Sintering
→ **Insulation reduction up to Short circuit**

Ceramic Capacitors Delamination Electrodes/Termination

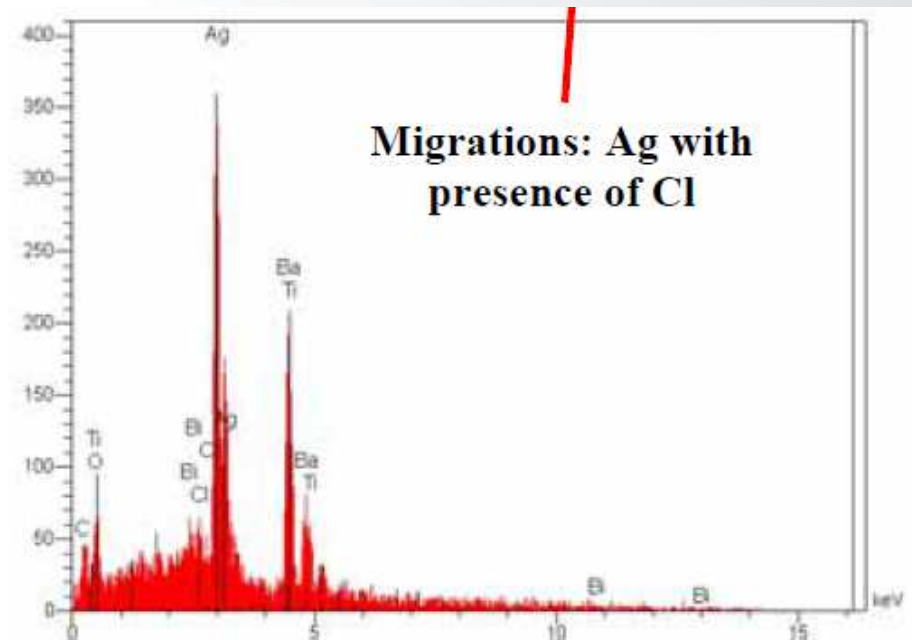


Soldering process + Component Weakness
→ **Loss of capacitance up to Open circuit**





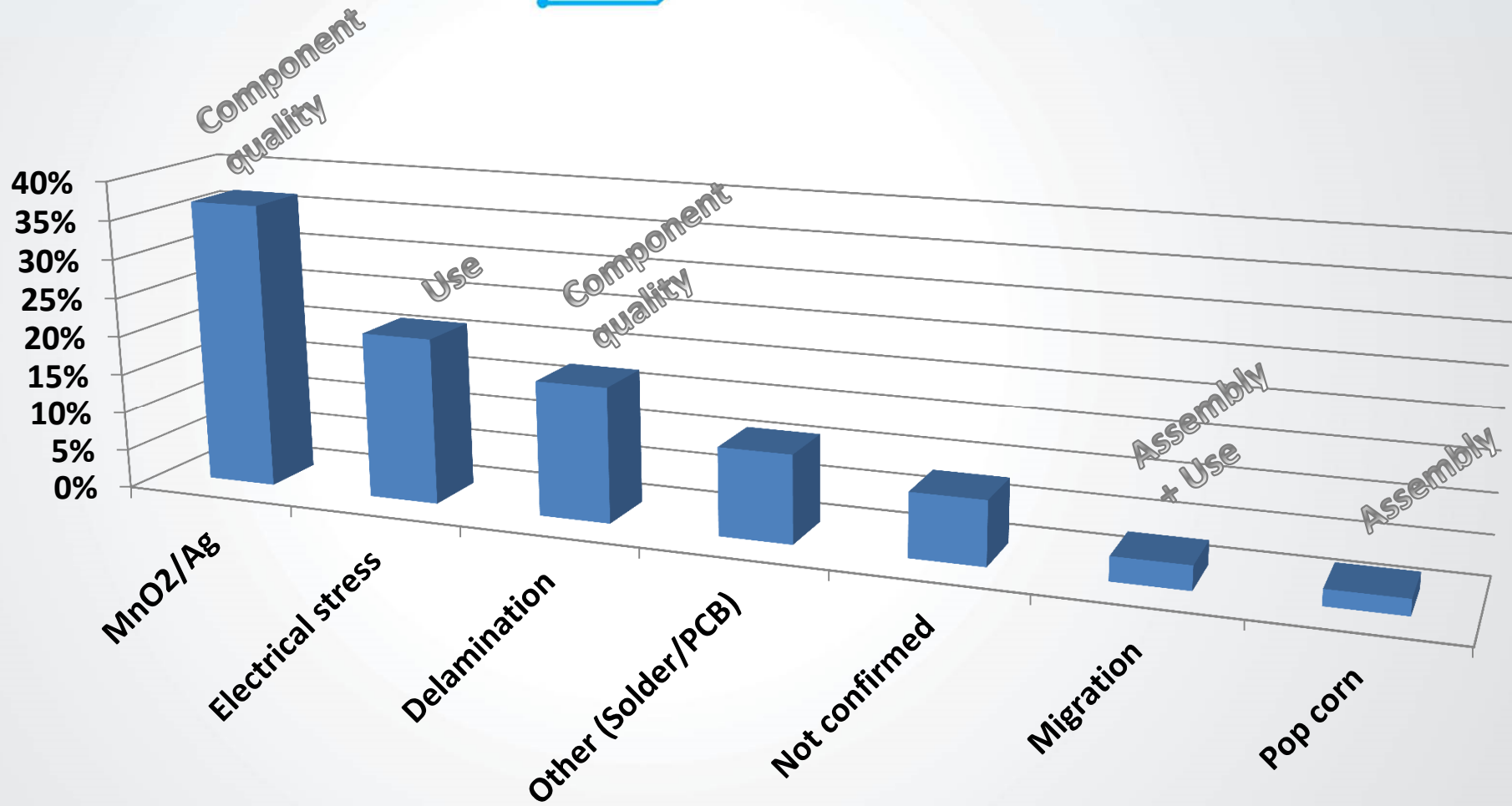
- Component quality
 - Ceramic preparation issue or organic/inorganic contamination
- Insulation reduction up to short circuit**



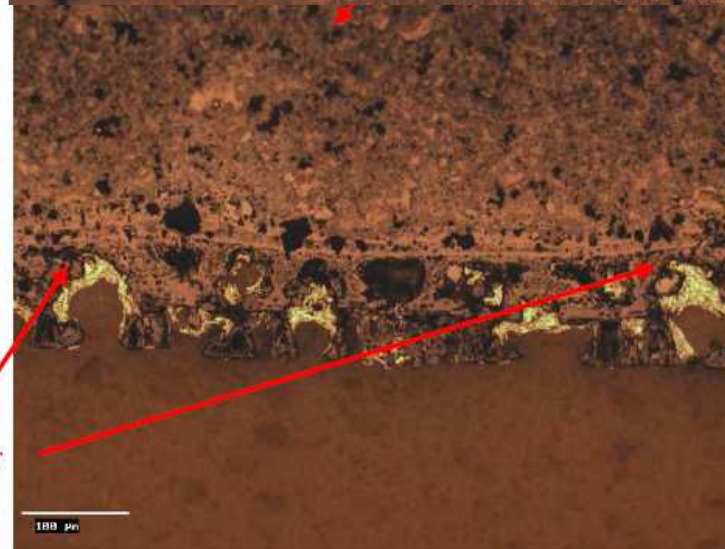
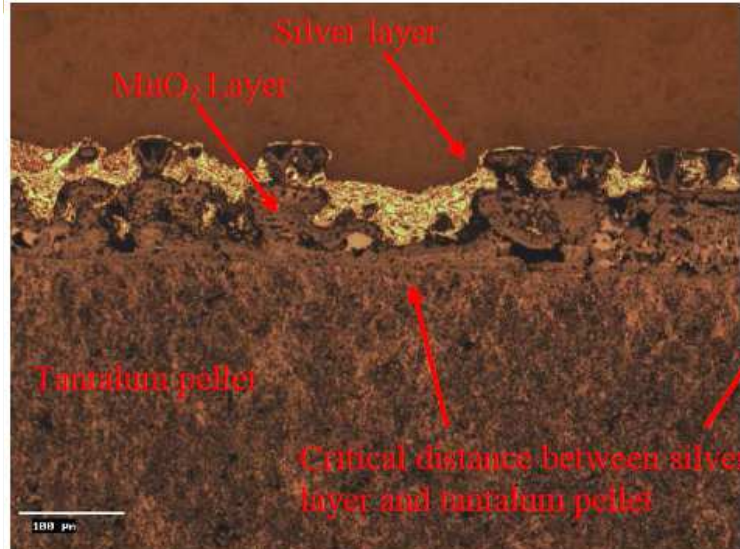
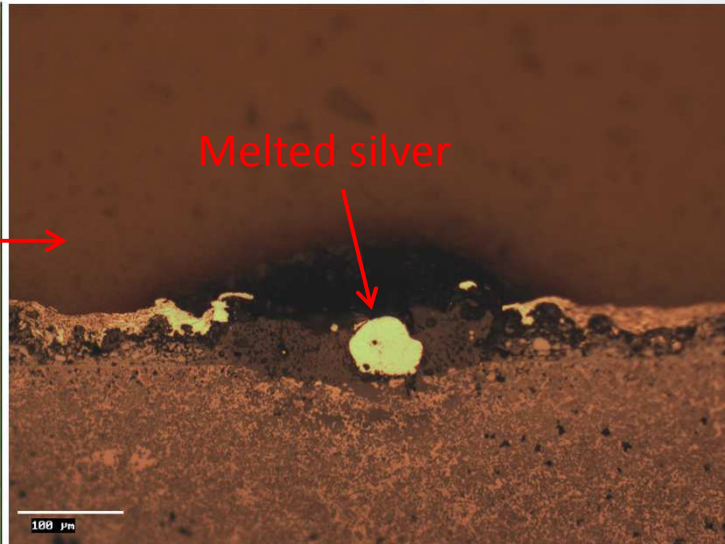
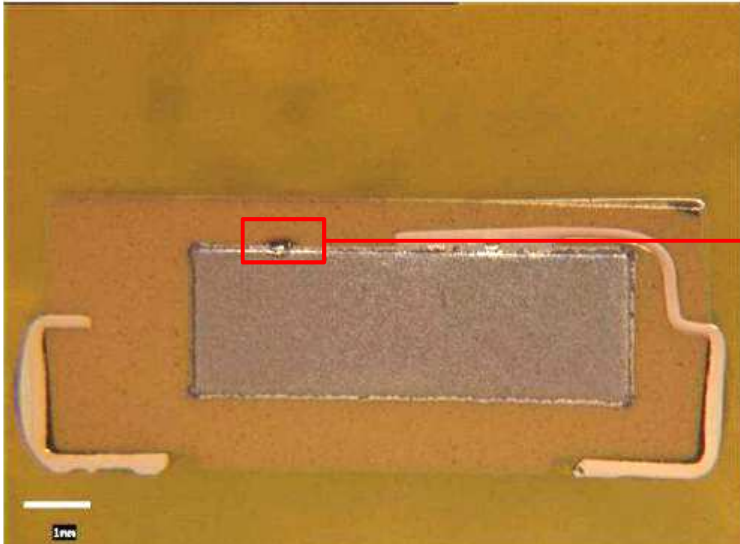
Environment: moisture and contaminant (Cl,..) leading to a dendritic growth of metallic material (Cu, Ag, ...)

→ **Short circuit**

Tantalum Capacitors Main Defects

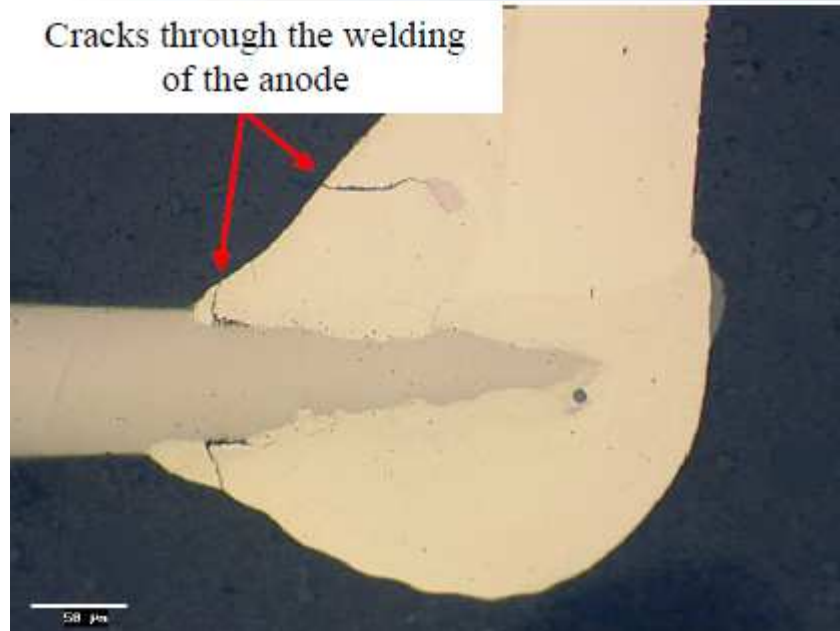
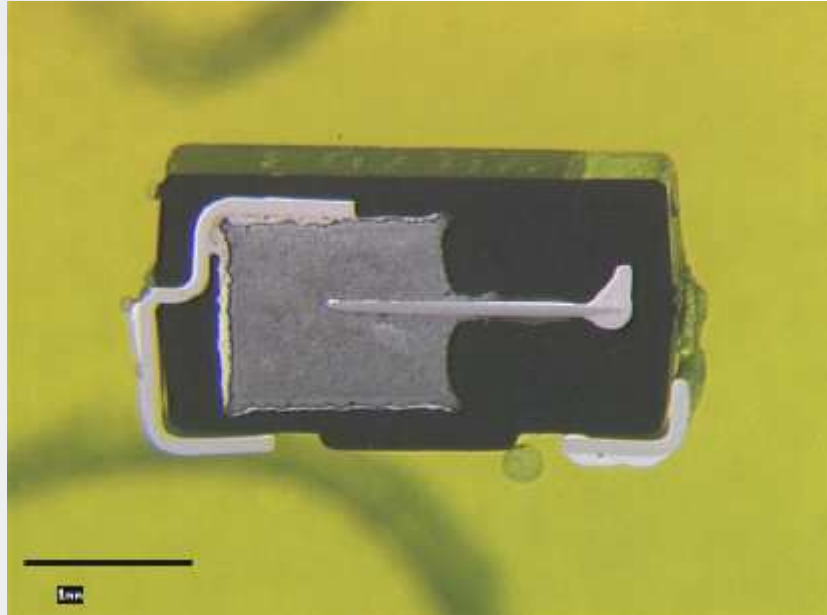


Tantalum Capacitor MnO₂ deposition

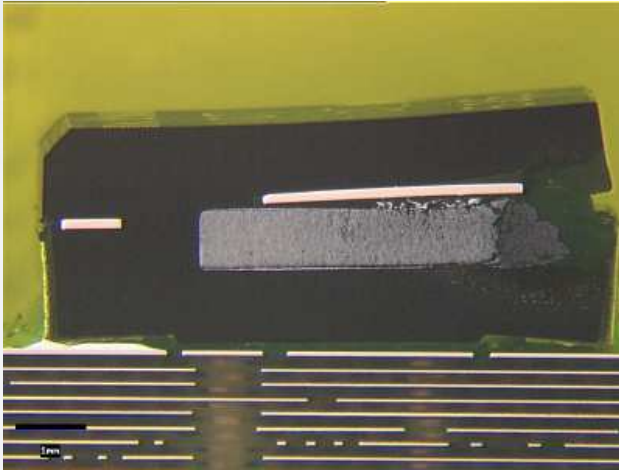


- Component quality
 - MnO₂ layer not homogeneous
 - Ag penetration
- Short circuit**

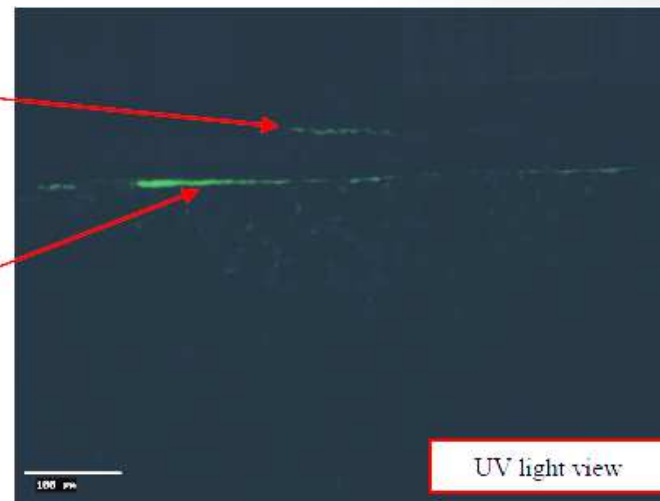
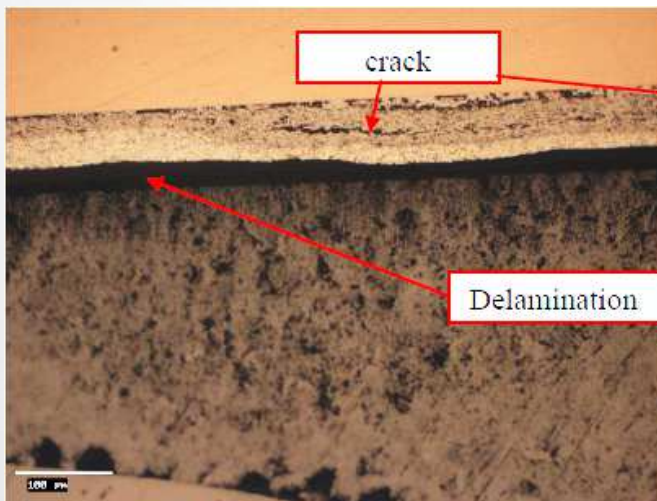
Tantalum Capacitors Anode Welding



- Component quality
 - Cracks on the anode solder
- **ESR increase**

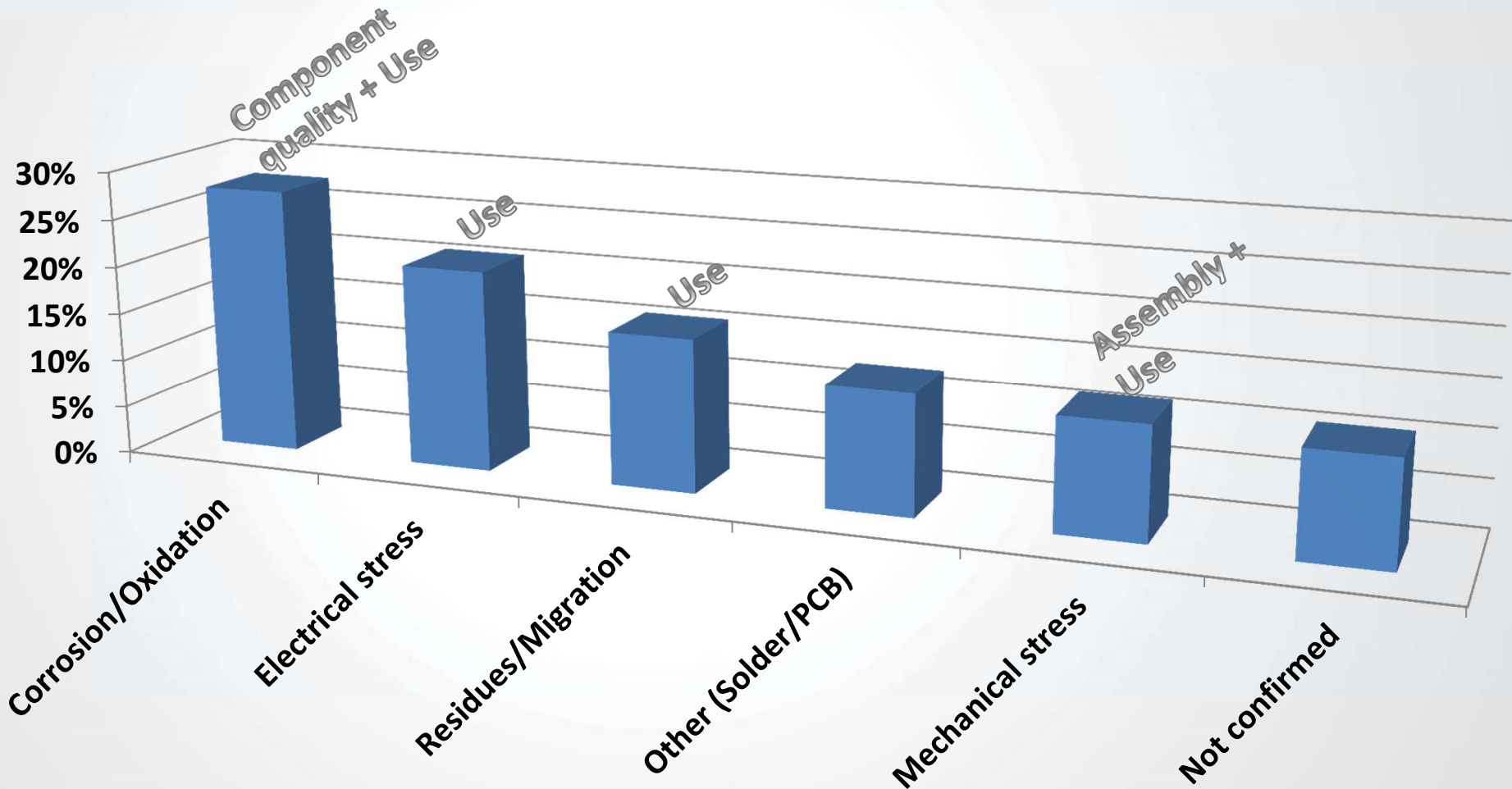


Delamination due to component quality or assembly process
→ ESR increase up to thermal runaway

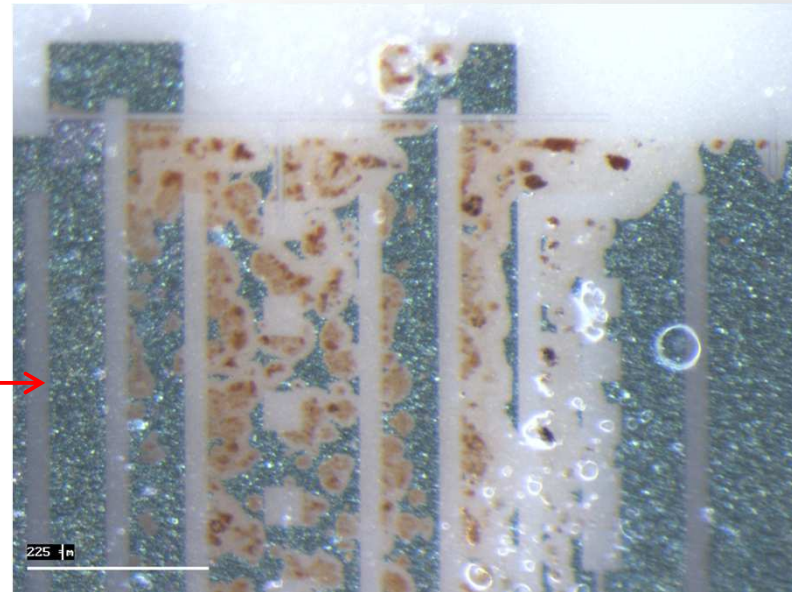
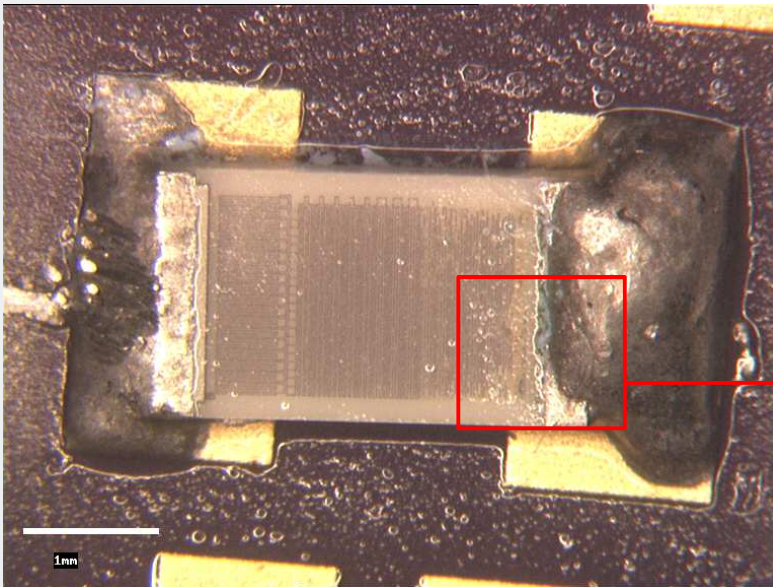


SMT Resistors (Thick+Thin film)

Main defects

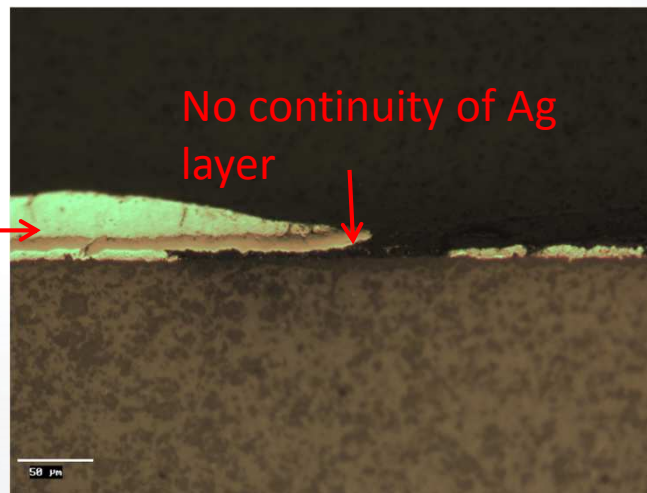
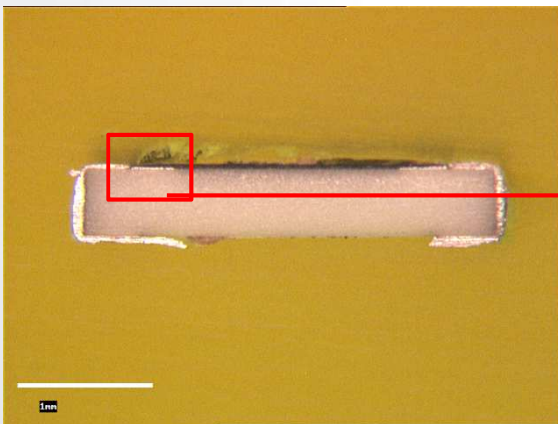
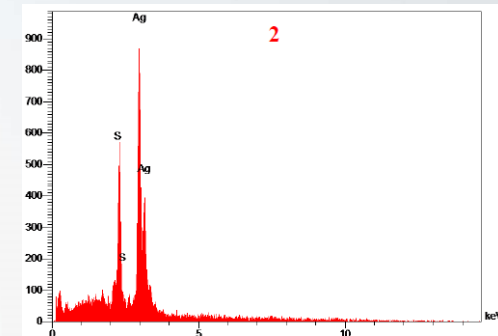
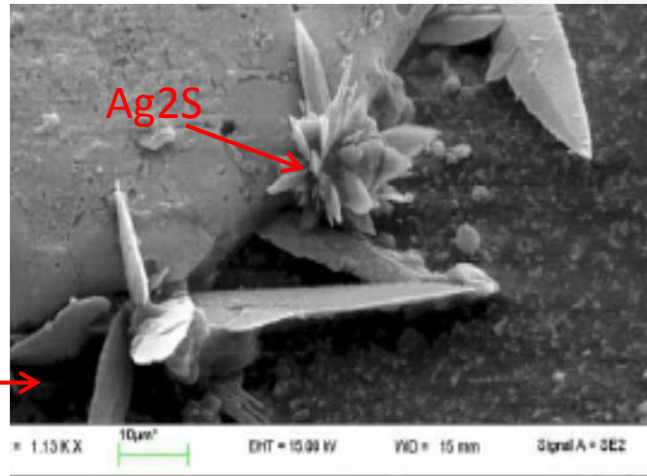
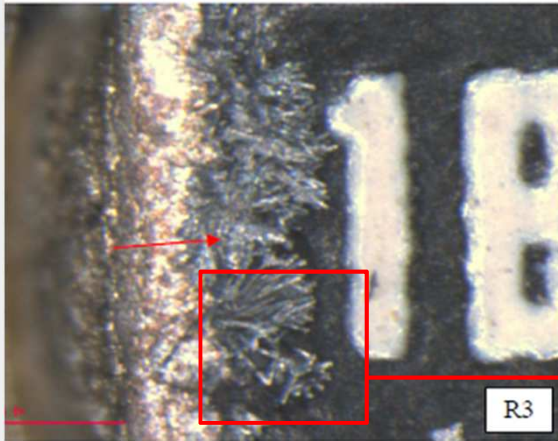


SMT Resistors (Thin film) Corrosion



Oxidation of the resistive layer in presence of humidity
→ **Resistance increase to Open circuit**

SMT Resistors (Thick film) Corrosion (sulfuration)



Environment:
Sulfur attack of silver occurs at the interface of the glass passivation layer and the resistor termination

→ **Open circuit**

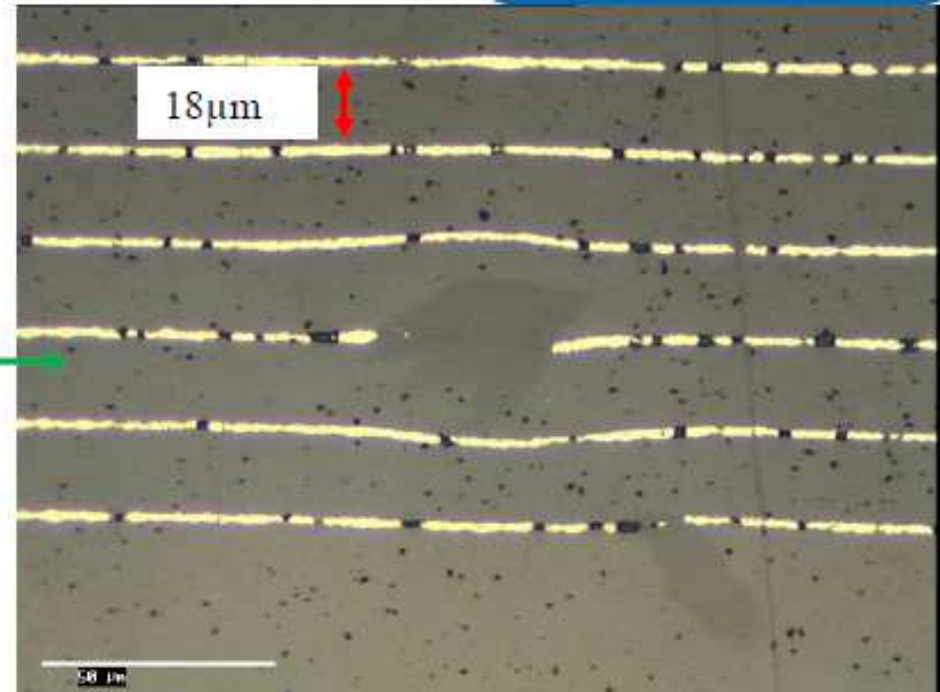
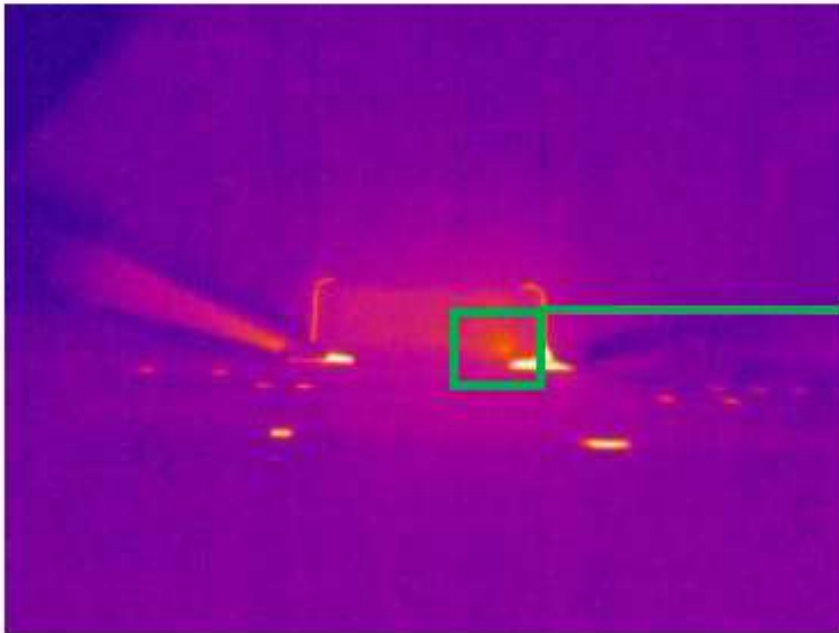


3- Specific method for FA

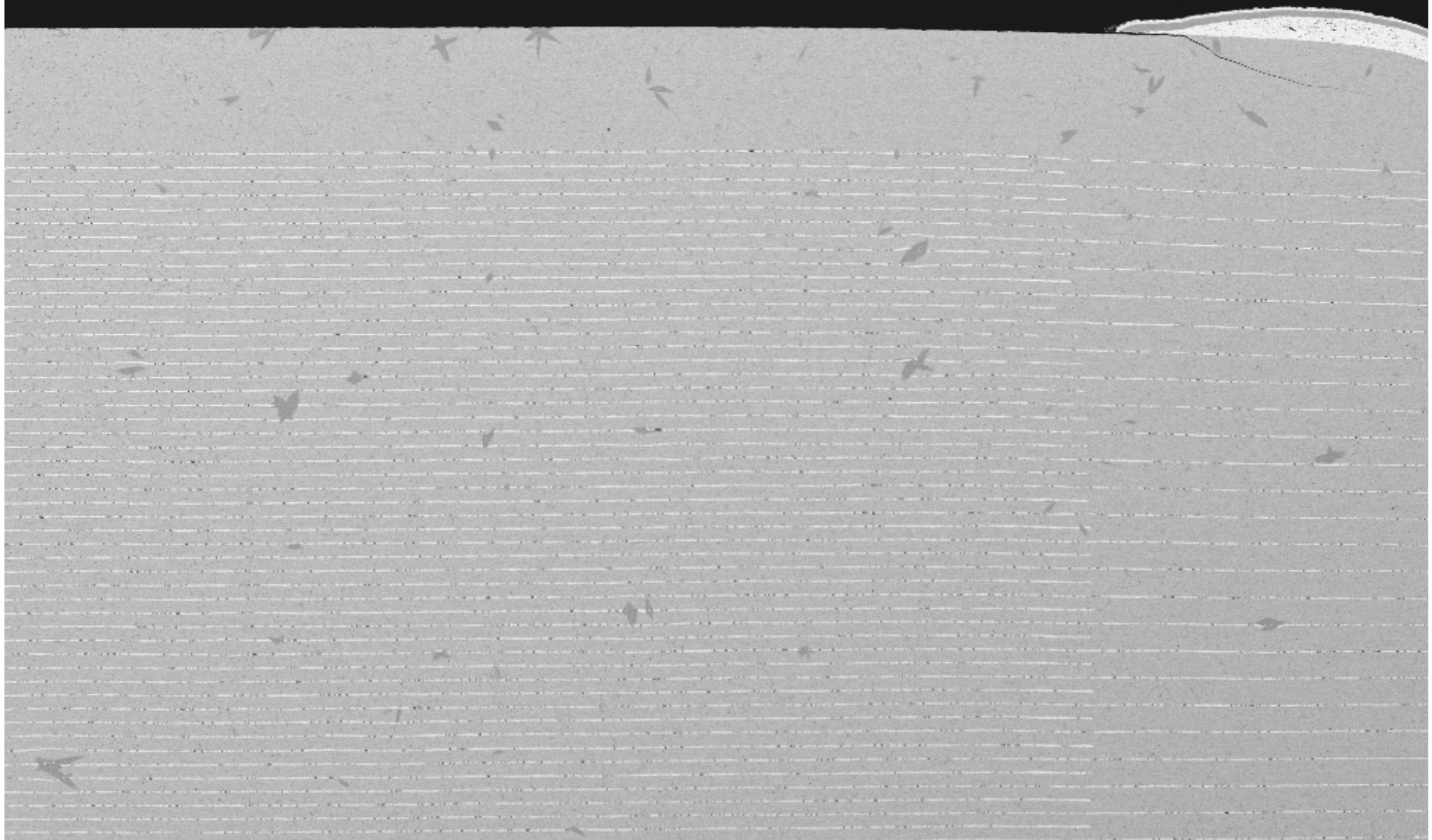
Voltage contrast coupled SEM

Particular Technique Voltage contrast coupled SEM

- Presence of a short circuit on a ceramic capacitor,
 - Infra red thermography confirm the presence of the SC
 - Cross section showed the presence of specific phases
- **Conductive or not?**

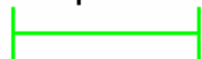


*Classical SEM view
(Chemical contrast)*



Mag = 55 X

200µm



WD = 13 mm

EHT = 20.00 kV

Signal A = RBSD

O: 13.5%W
Ti: 50.0%W
Ba : 36.5%W

*Classical SEM view
(Chemical contrast)*

O: 11.7%W
Ti: 29.4%W
Ba: 59.9%W

Mag = 1.02 K X

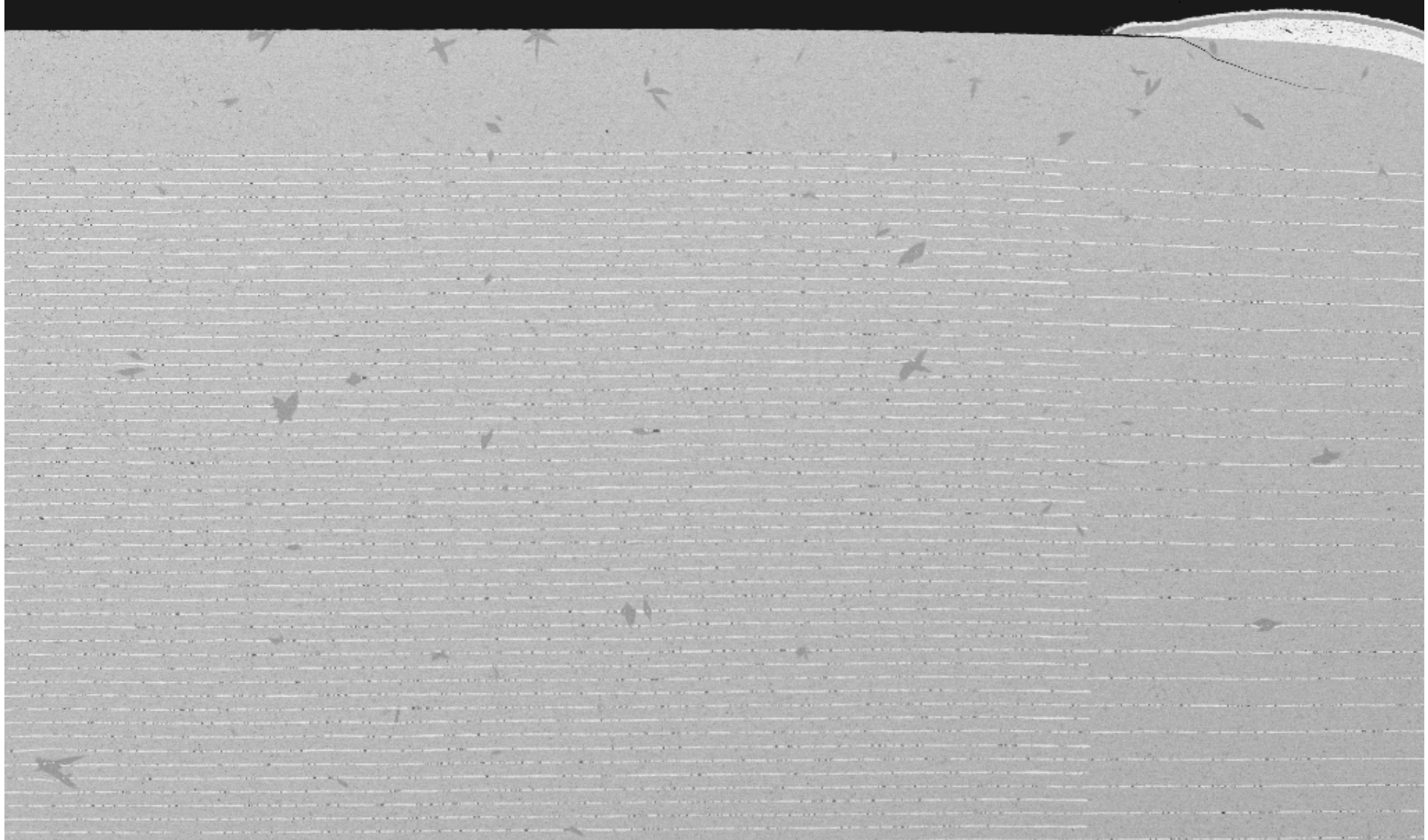
10µm

WD = 12 mm

EHT = 20.00 kV

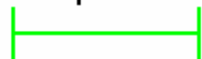
Signal A = RBSD

*Classical SEM view
(Chemical contrast)*



Mag = 55 X

200µm

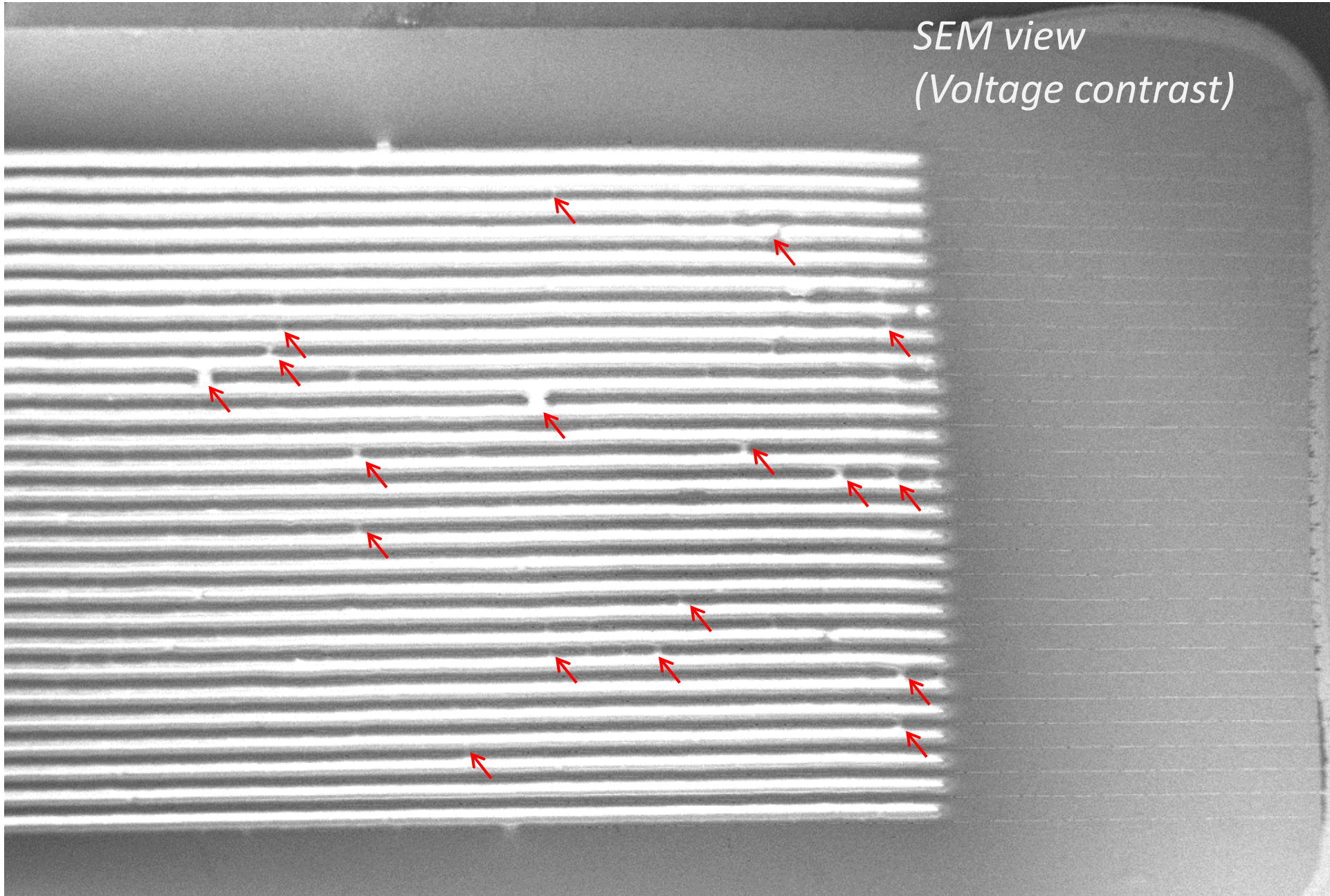


WD = 13 mm

EHT = 20.00 kV

Signal A = RBSD

*SEM view
(Voltage contrast)*



Mag = 54 X

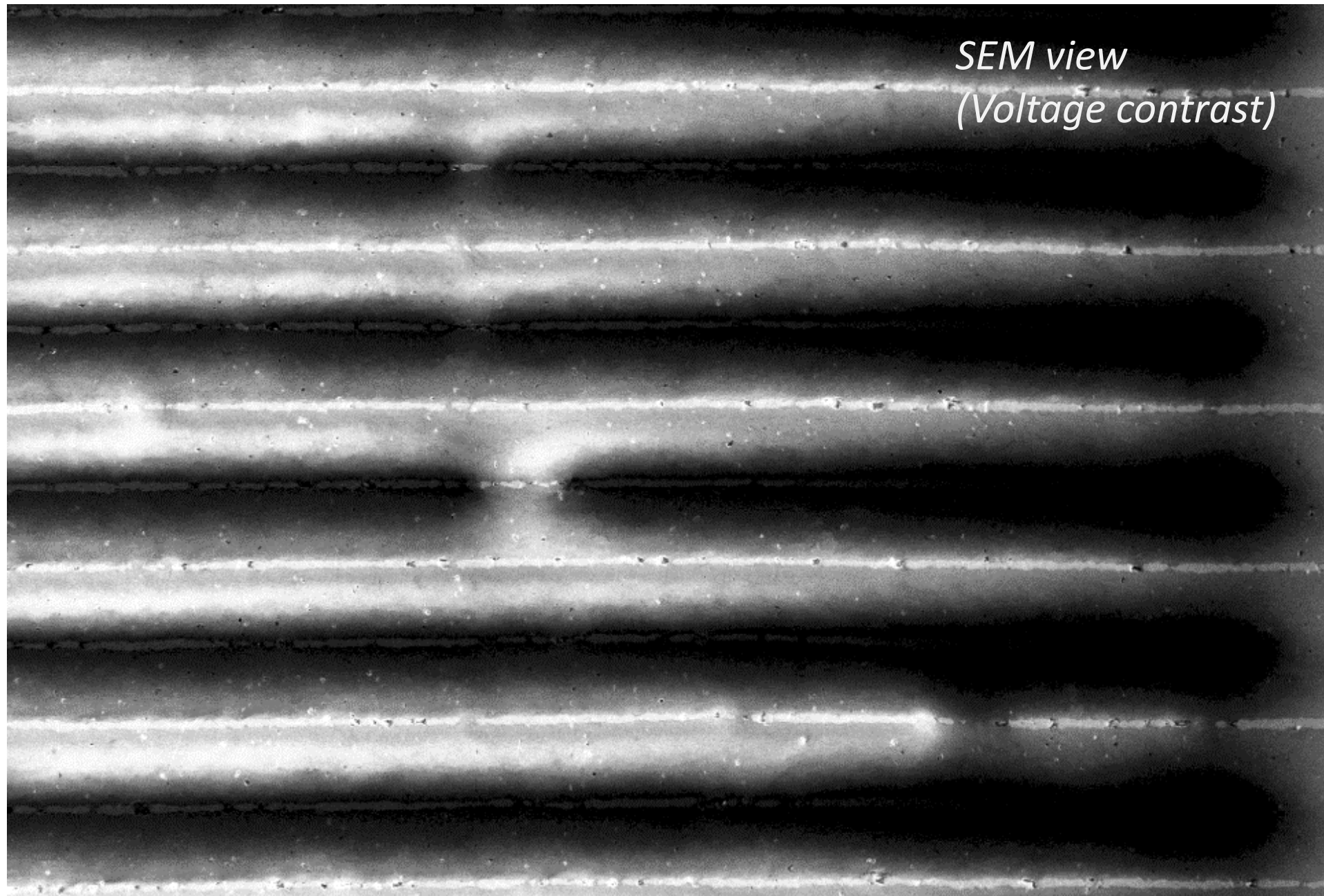
100µm
|-----|

WD = 10 mm

EHT = 5.00 kV

Signal A = InLens

*SEM view
(Voltage contrast)*



Mag = 338 X

20 μ m



WD = 10 mm

EHT = 5.00 kV

Signal A = InLens

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