

2nd SPCD 12-14 October 2016



**Passive components :
5 years failure analysis feedback
From all markets**

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1

Introduction

- SERMA Technologies

2

Facts & Figures on Failure Analysis (FA)

- Statistics about Passive FA
- Main defects observed on Passive Components
 - Ceramic capacitors
 - Ta capacitors
 - Thick + Thin films Resistors



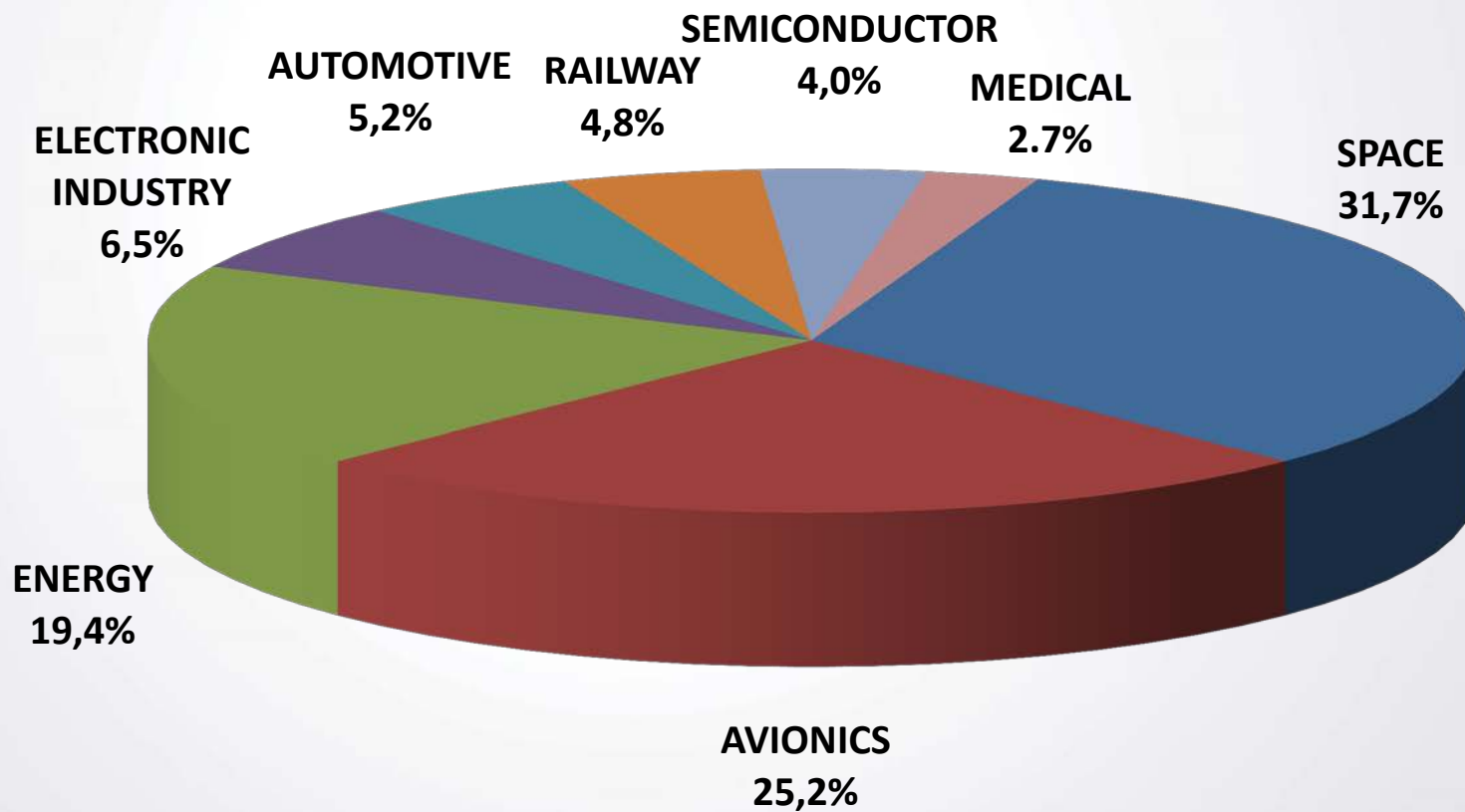
1- Introduction



The most important independent electronic laboratory in Europe

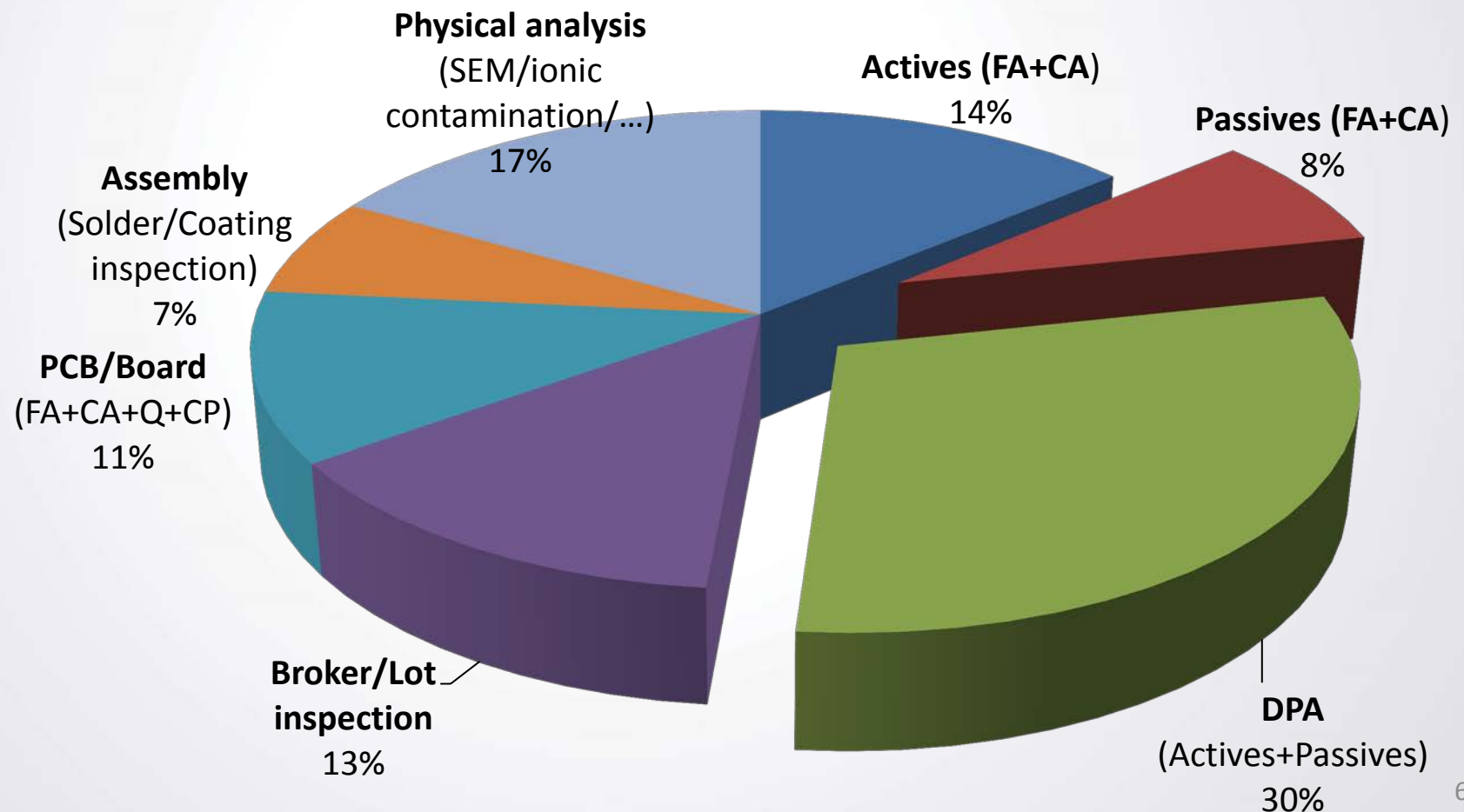
- > **6 000 analyses / year**
- > **20 years of experience - multi-sectoral**

Physical Expertise Main markets (by Turnover)



Physical Expertise Type of analysis (by quantity)

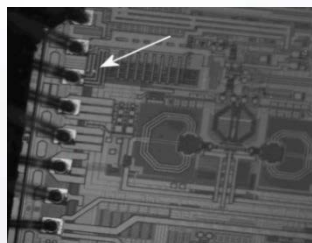
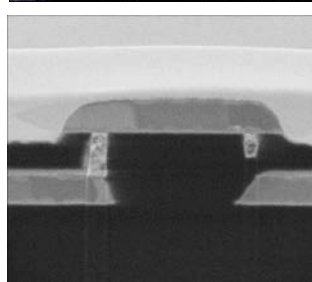
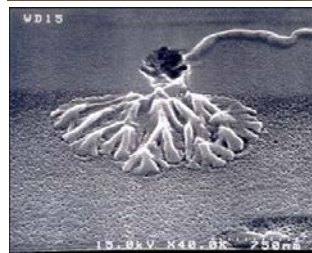
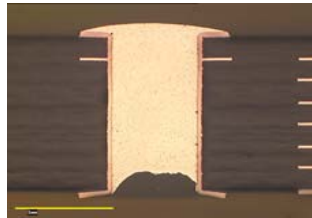
- 2011 - 2015: 19 700 analyses in Serma's Lab



A WIDE RANGE OF TECHNIQUES

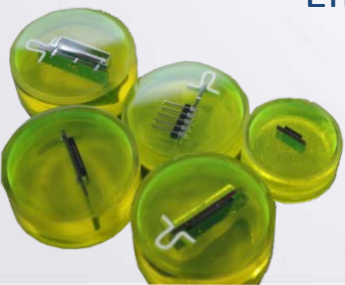
Non Destructives:

Optical microscopes
2D & 3D X-Ray
Electrical Tests
Micro-probing
X-Ray Fluorescence
IR Thermography
Acoustic microscopy
Emission Microscopy



Destructives:

Cross section
Laser Cutter
Chemical etch and plasma dry etch
SEM with EDX system
Focused ion Beam imaging
3D Slice & View
Transmission Electron Microscopy





2- Facts & Figures on FA

2009: Creation of a Data base
→ Fulfillment of a Key Words
Sheet after each analysis

FICHE mots clés

Critères de recherche Une fois votre critères sélectionnés appuyez sur F5 pour exécuter.

Analyste: _____ Client: _____

Date: 02/07/2009 Affaire: AF09-2193

Référence: CAPA TANTALE Fabricant: SAMSUNG

Expertise: FA Passif Composant: Capacité tantale

Boitier: CMS Technologie: _____

MODES de DEFAILLANCE

Défaillance 1: Défaut ASSEMBLAGE

Défaillance 2: Fissuration Défaillance 3: _____

CARACTERISTIQUES PCB

Finition: _____ Nature PCB: _____

Stade étude: _____

PROCEDE D'ASSEMBLAGE et ALLIAGE UTILISE

Procédé: _____ Alliage: _____

Fiche mots clés

(1) DATE: _____ (2) N° D'AFFAIRE: _____

(3) DIFFERENCIE CLIENT: _____ (4) FABRICANT: BPC (Sager) Tania

(5) TYPE D'EXPERTISE

CA (Châssis)	CA (Axi)	CA (Passif)	Expertise physique	Expertise électrique
CA (Châssis)	CA (Axi)	CA (Passif)	Expertise physique	Expertise électrique
CA (Châssis)	CA (Axi)	CA (Passif)	Expertise physique	Expertise électrique
CA (Châssis)	CA (Axi)	CA (Passif)	Expertise physique	Expertise électrique
CA (Châssis)	CA (Axi)	CA (Passif)	Expertise physique	Expertise électrique

(6) TYPES de COMPOSANTS

Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor

(7) TYPES de BOITIER

Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor

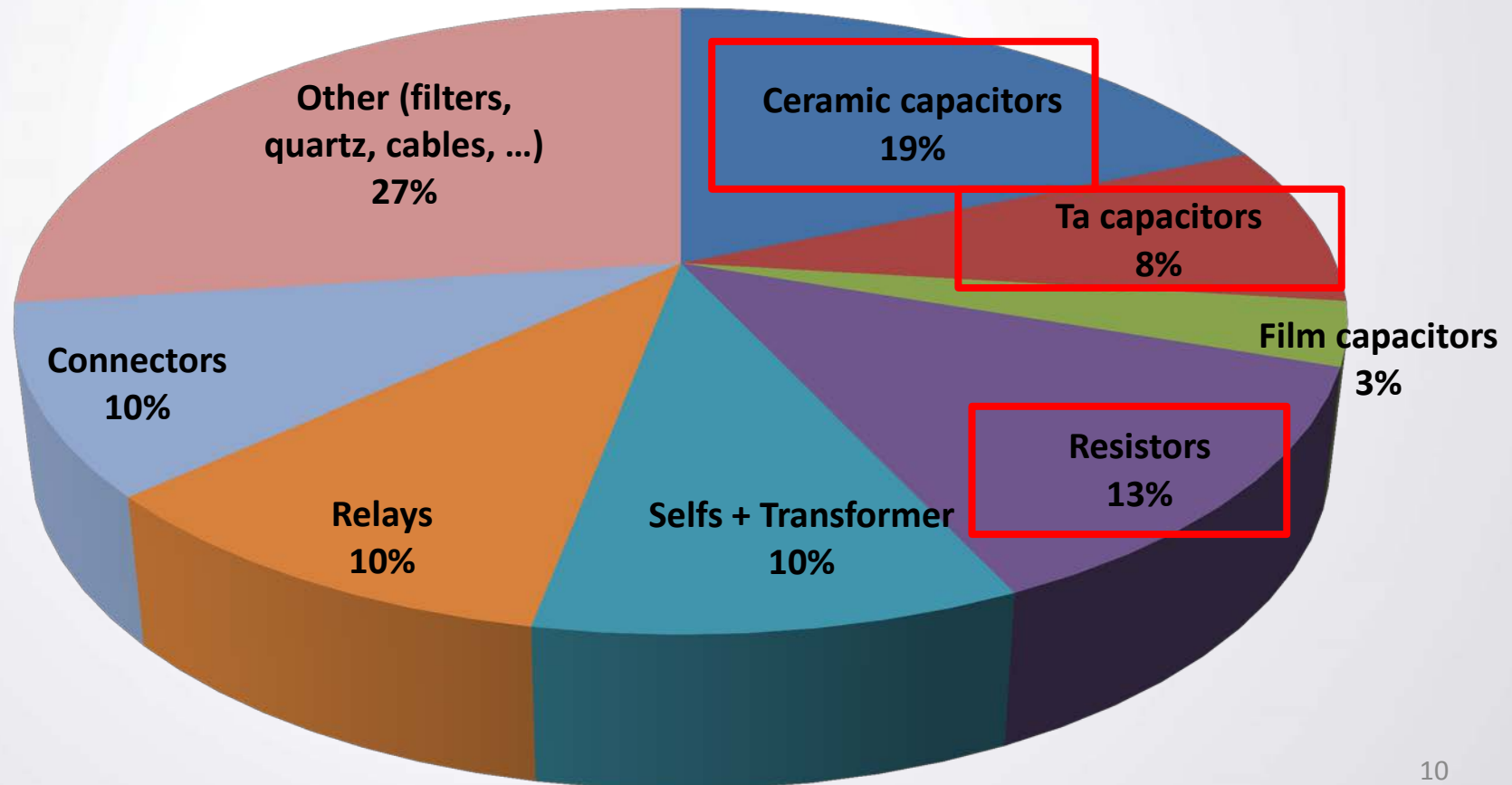
(8) TECHNOLOGIE

Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor
Autotransformateur	Capteur divers	Diode	Inductance	Transistor

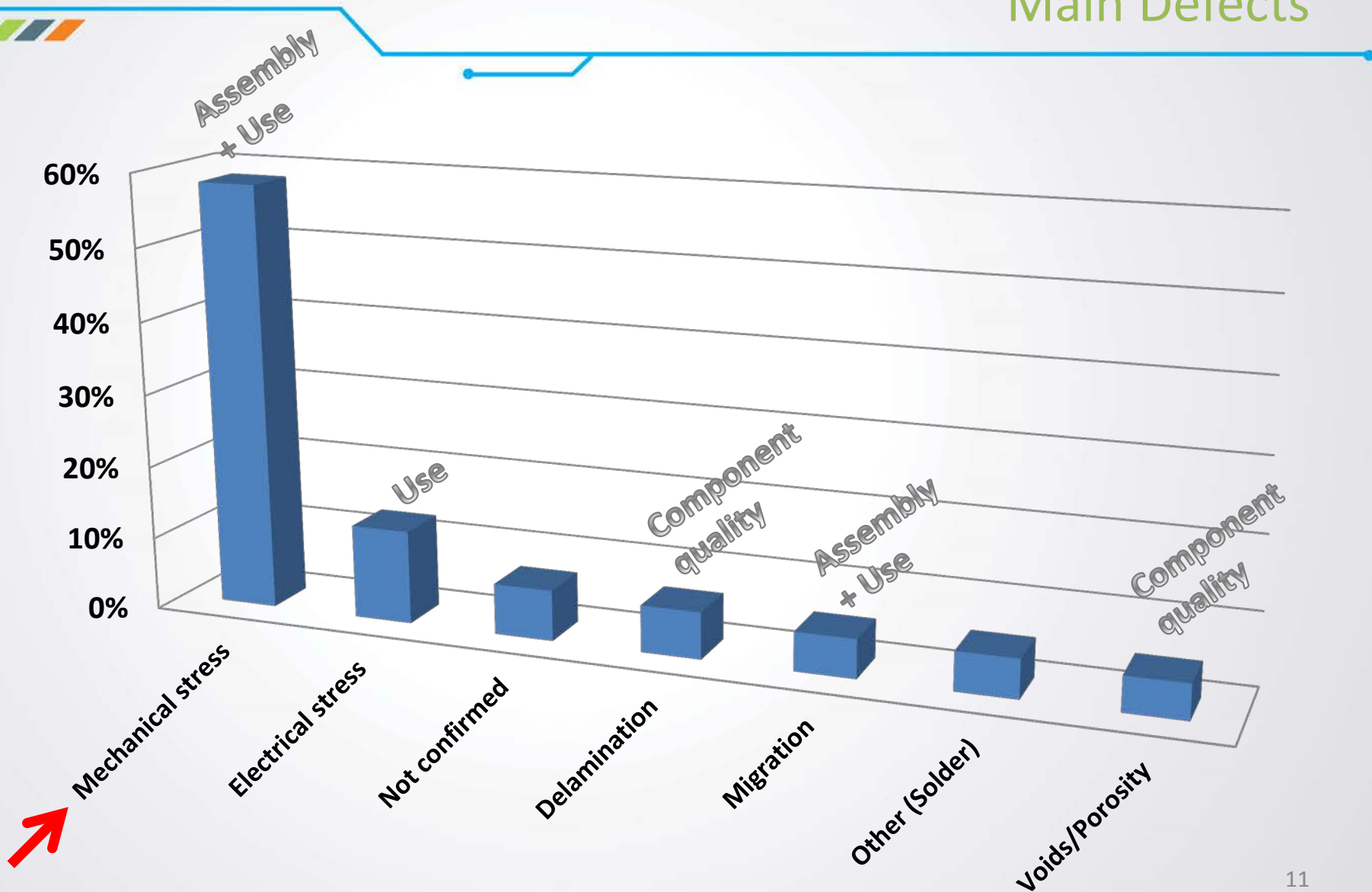
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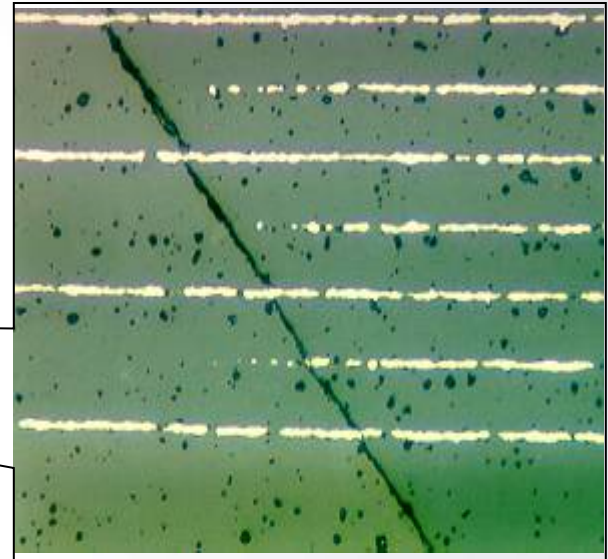
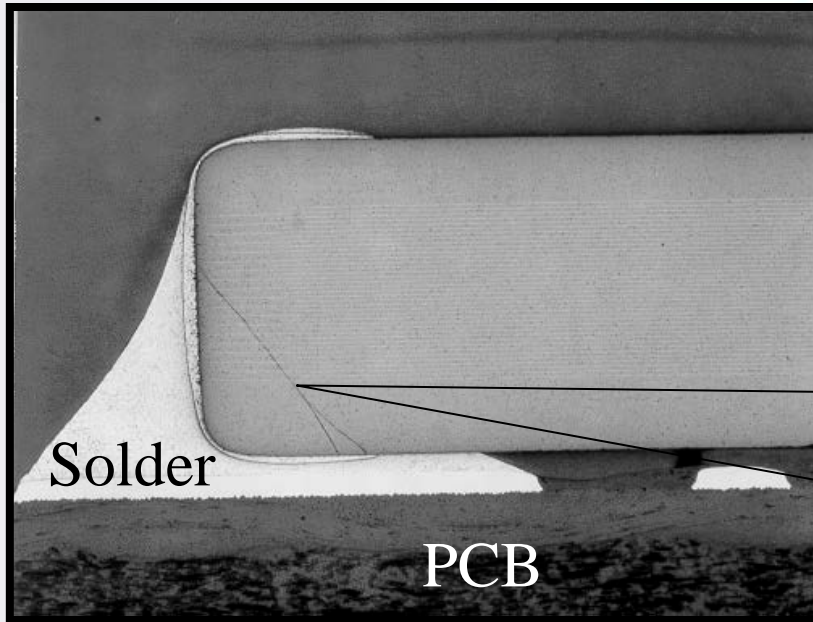
Type of component (by quantity)

- 2011 - 2015: 1 200 failure analyses on passive components



Ceramic Capacitors Main Defects



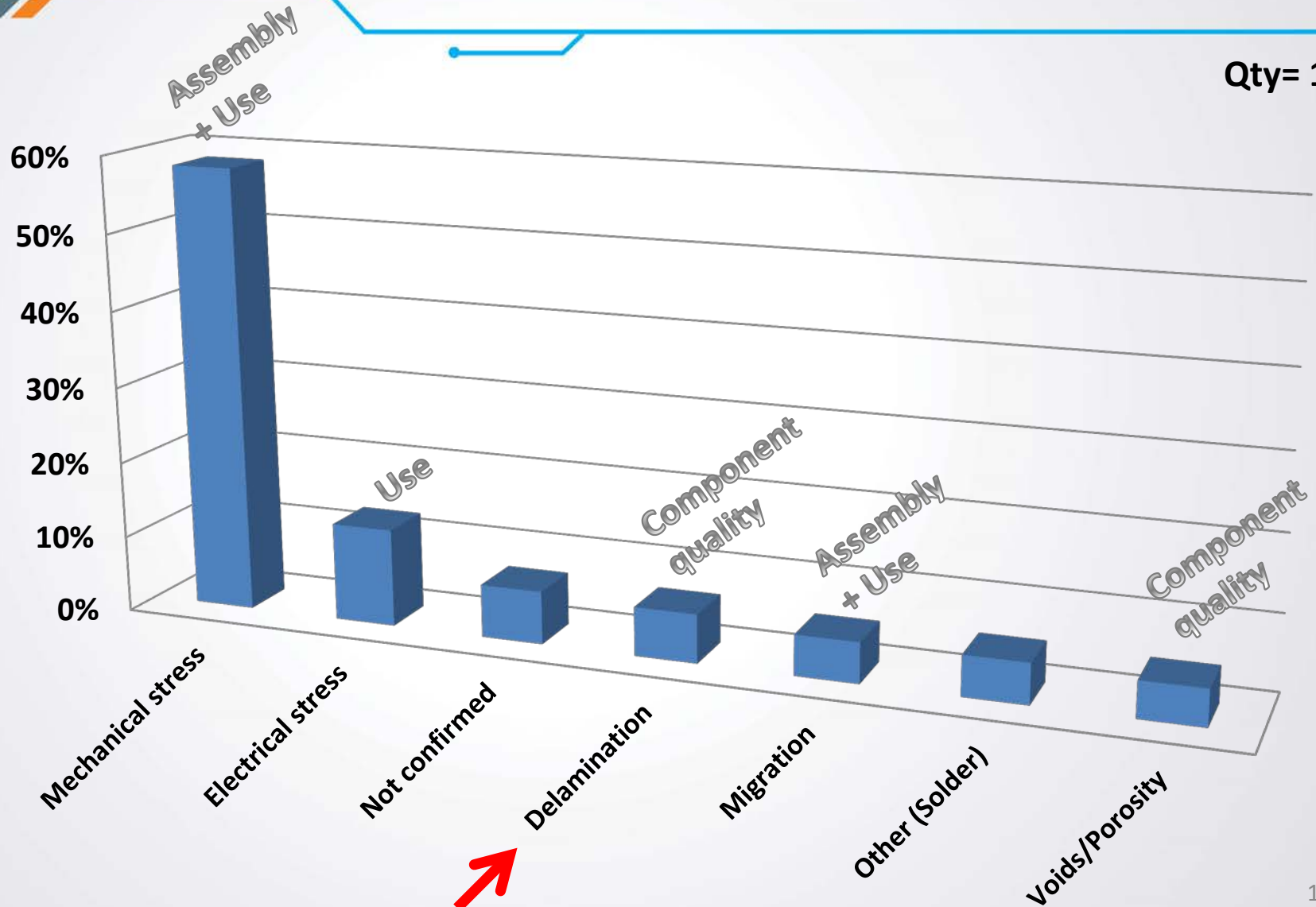


Diagonal cracks (@45°) due to Thermo and/or Mechanical stresses caused by soldering/testing/depanelization/handling...

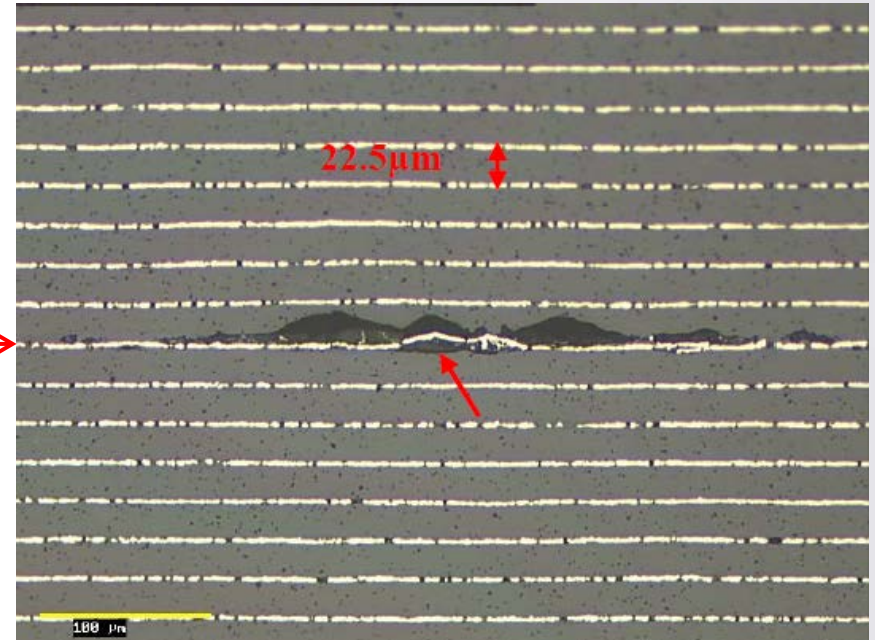
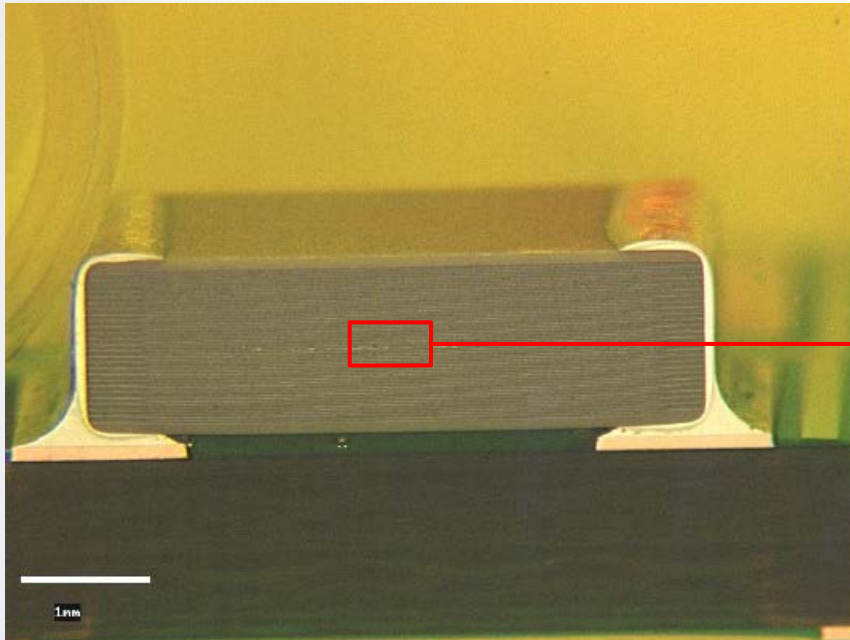
→ Short circuit occurs when dielectric between opposite electrodes is cracked

Ceramic Capacitors Main Defects

Qty= 187



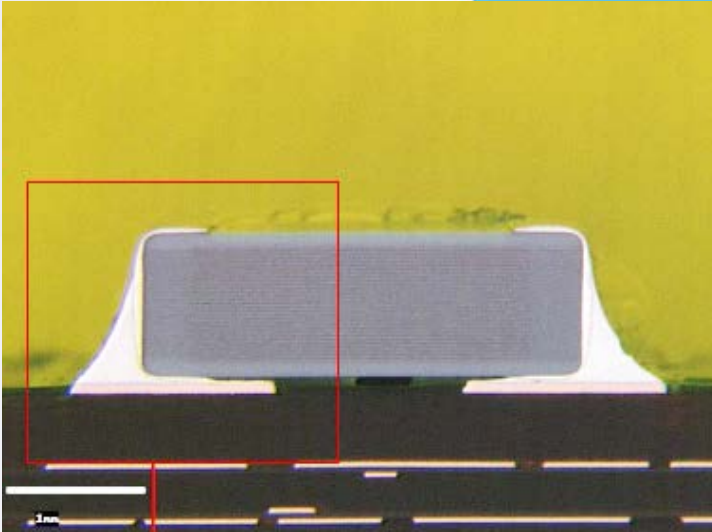
Ceramic Capacitors Delamination: Electrode/Ceramic



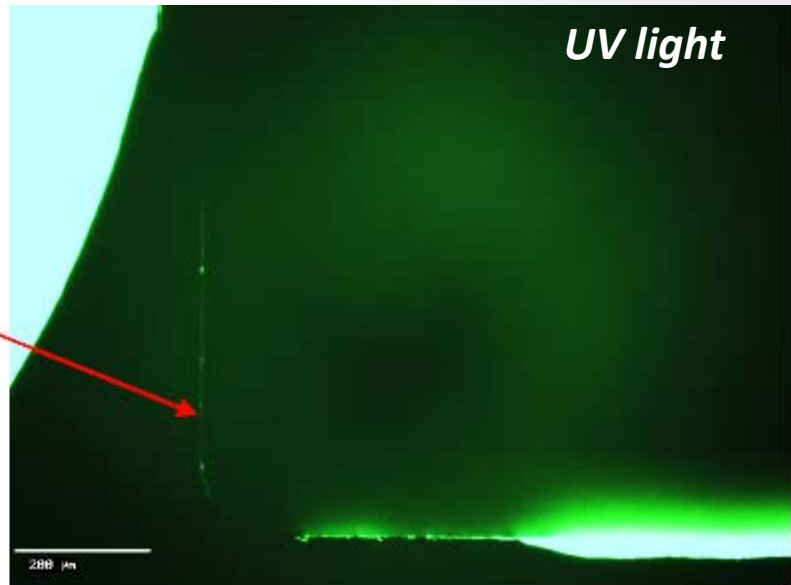
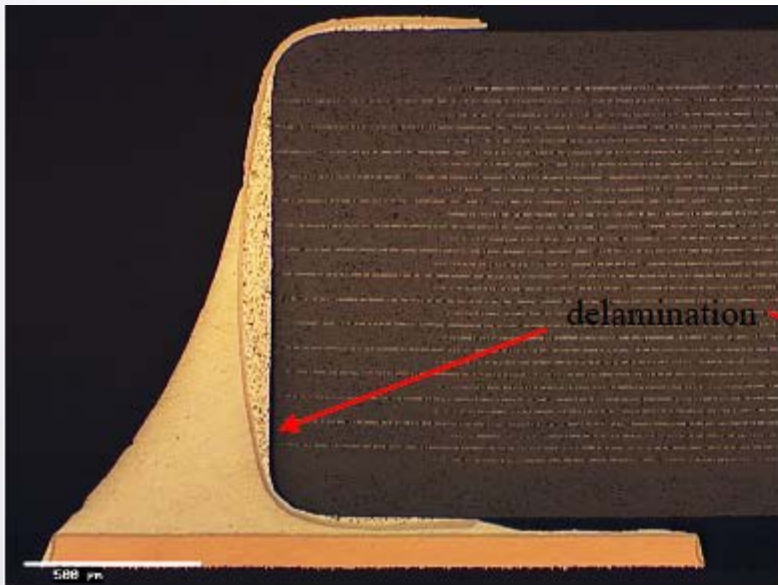
Delamination relative to the component process: Part lamination/sintering
→ **Results in insulation reduction up to Short circuit**

Ceramic Capacitors

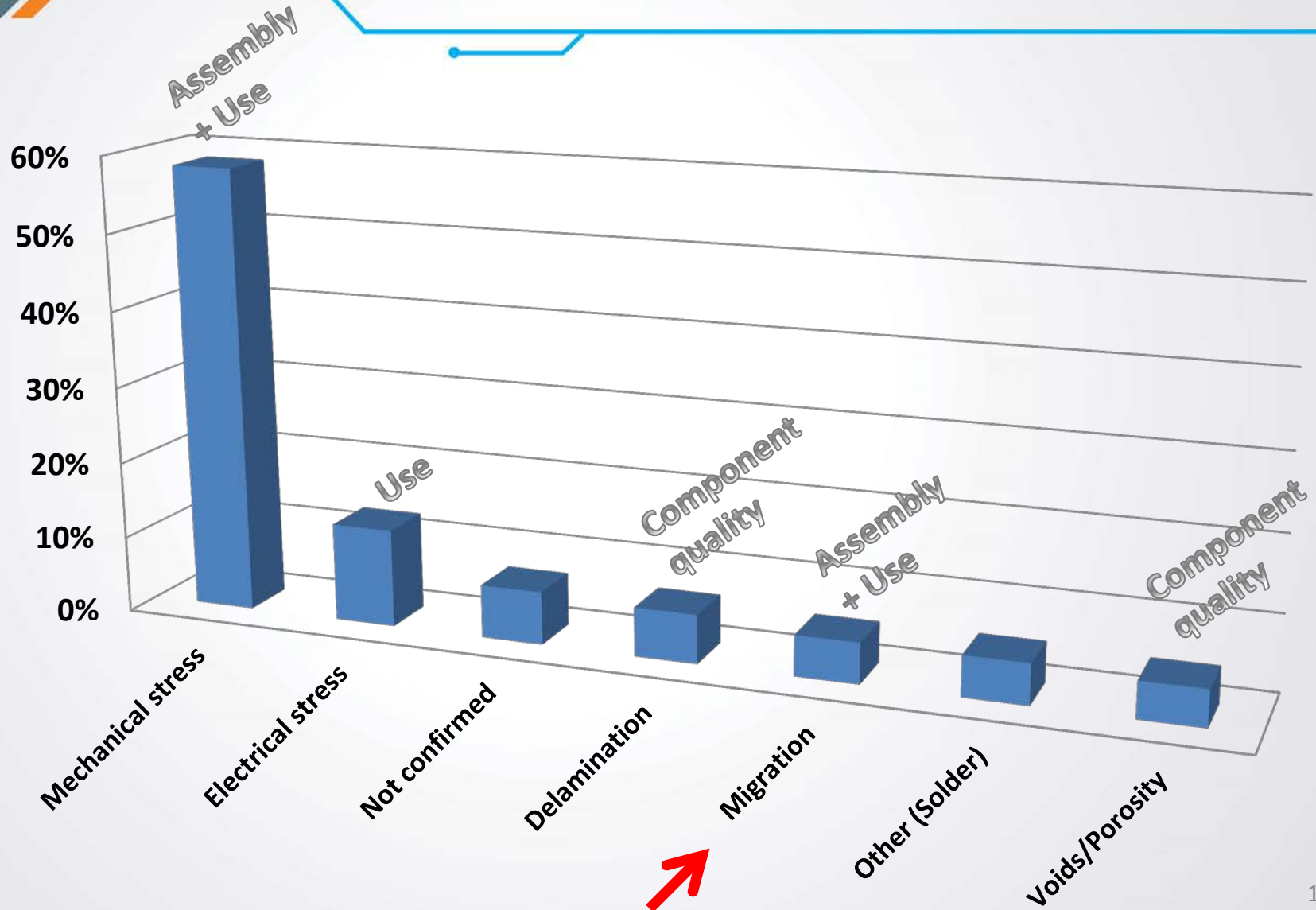
Delamination Electrodes/Termination



Soldering process + Component Weakness
(at termination)
Revealed after ageing test
→ results in loss of capacitance up
to Open circuit

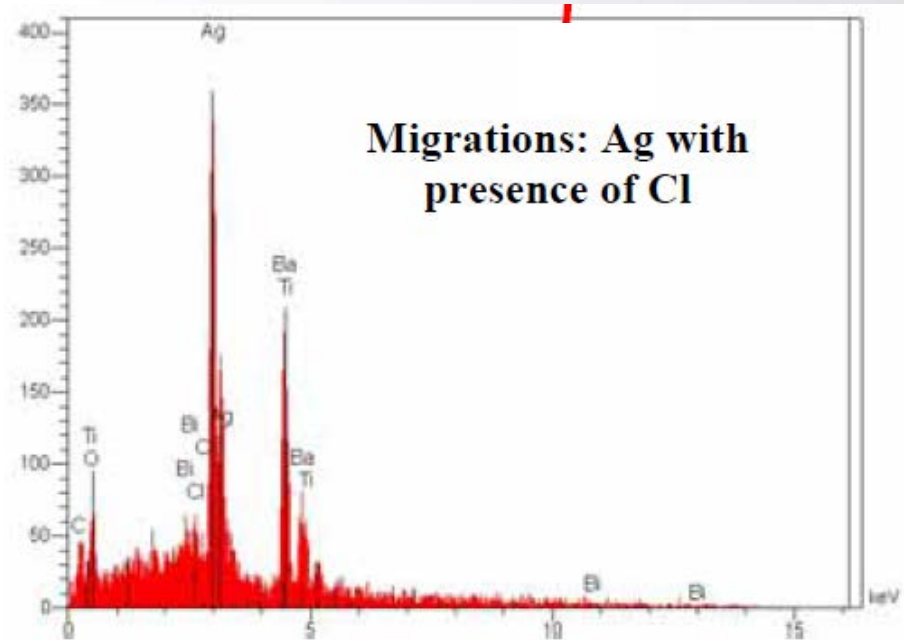


Ceramic Capacitors Main Defects



Ceramic Capacitors Migration

C3 capacitor before cleaning

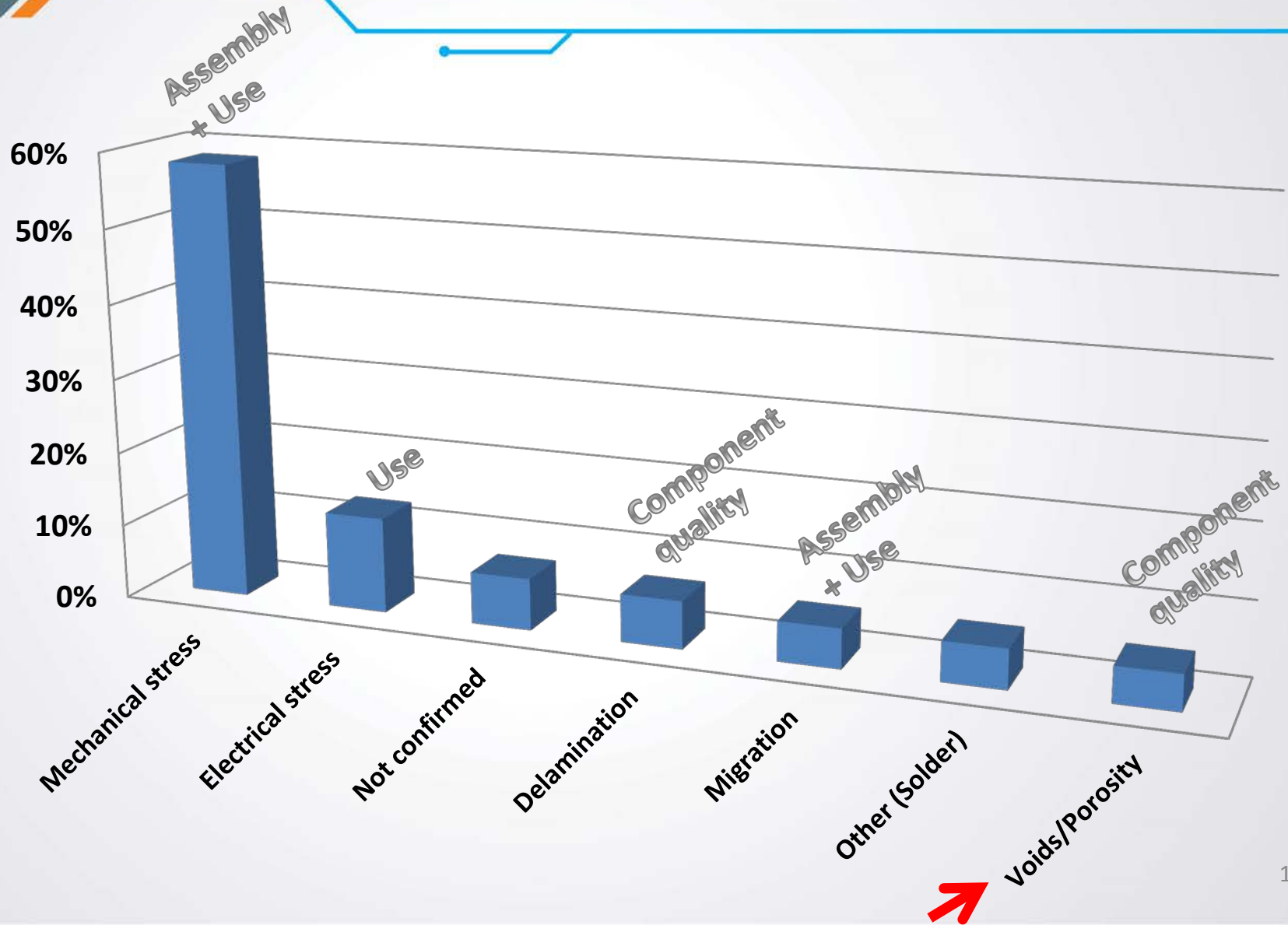


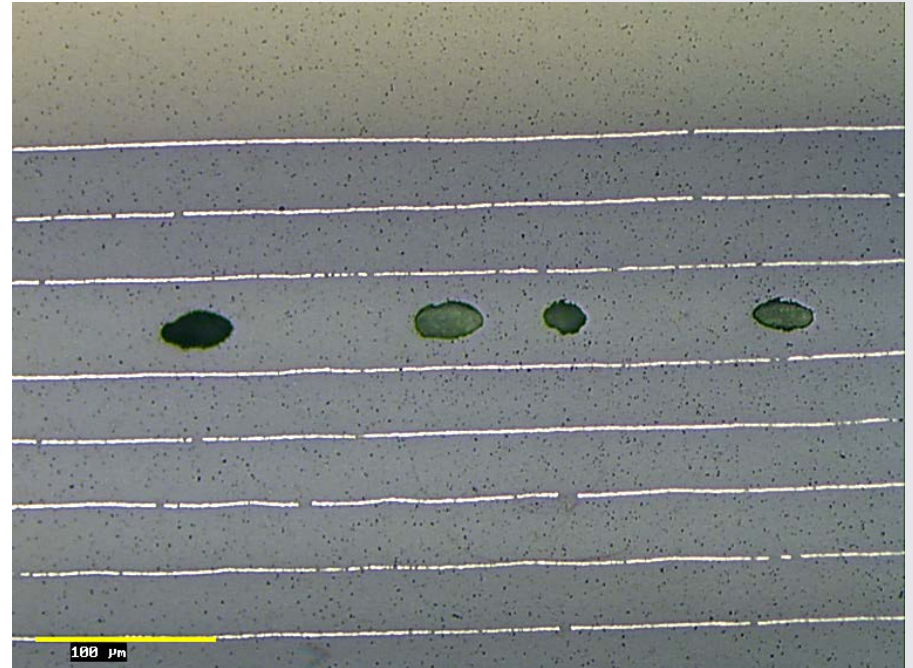
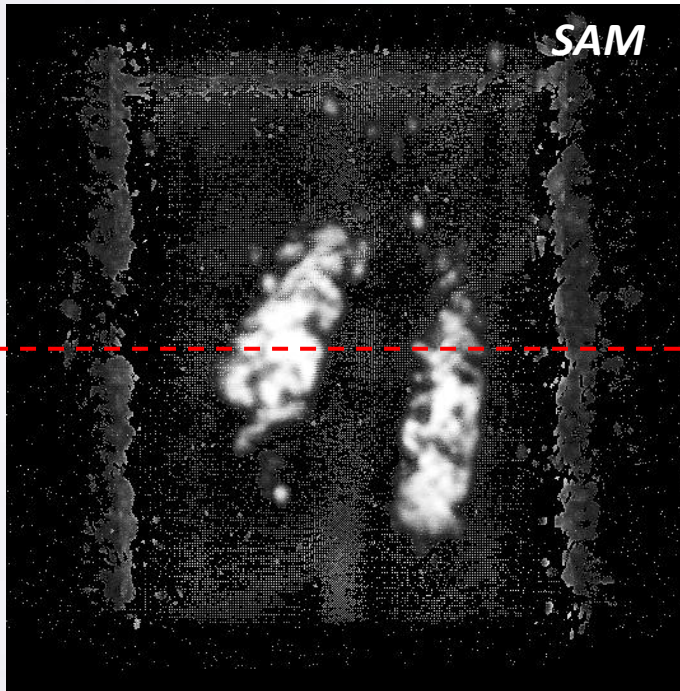
Failure occurred during Environmental tests:

Moisture and contaminant (Cl,..) leading to Silver dendritic growth

→ **Short circuit**

Ceramic Capacitors Main Defects

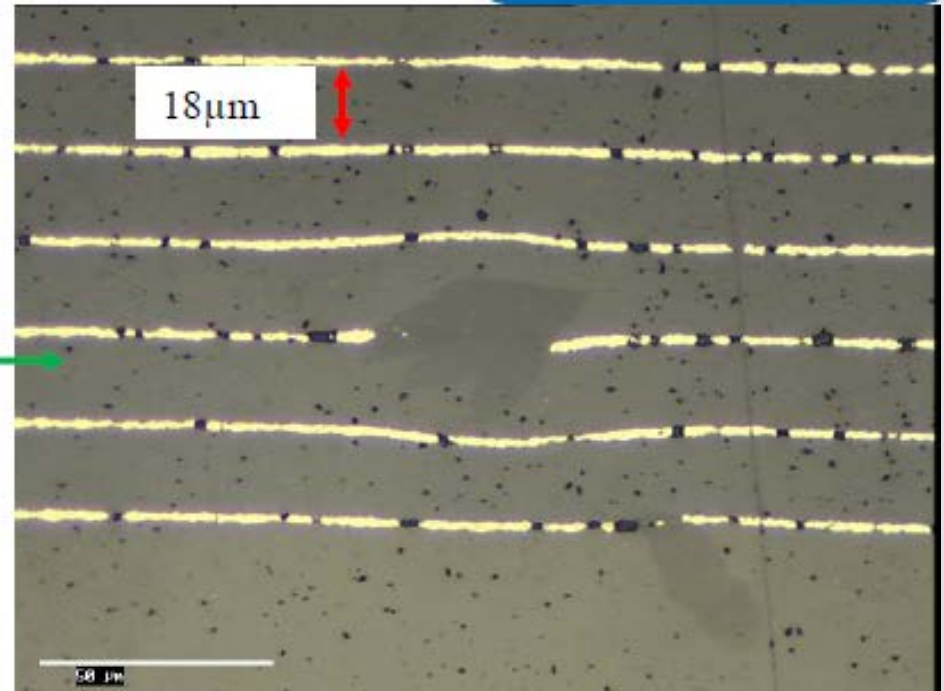
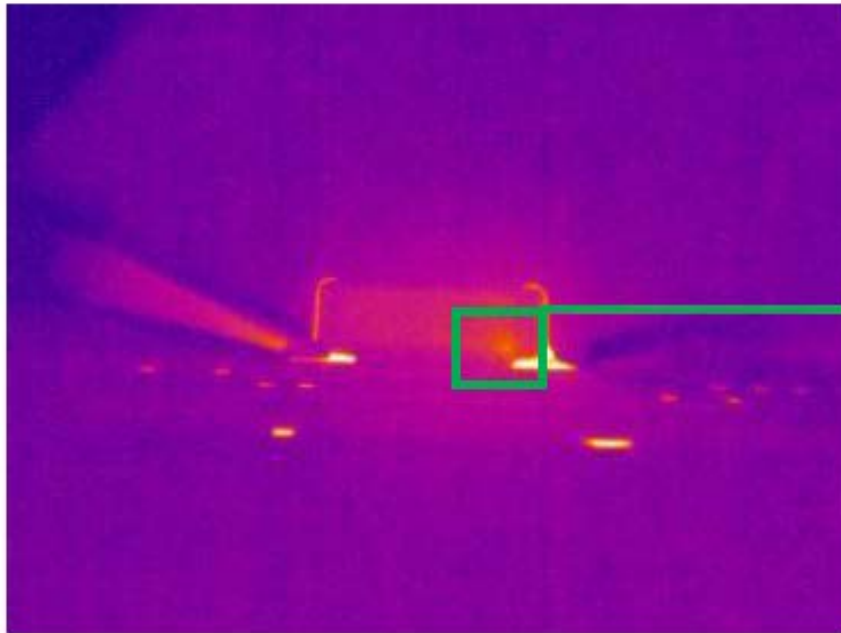




- Component quality
 - Ceramic preparation issue or organic/inorganic contamination
- **Insulation reduction up to short circuit**

Particular Technique Voltage contrast coupled SEM

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



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

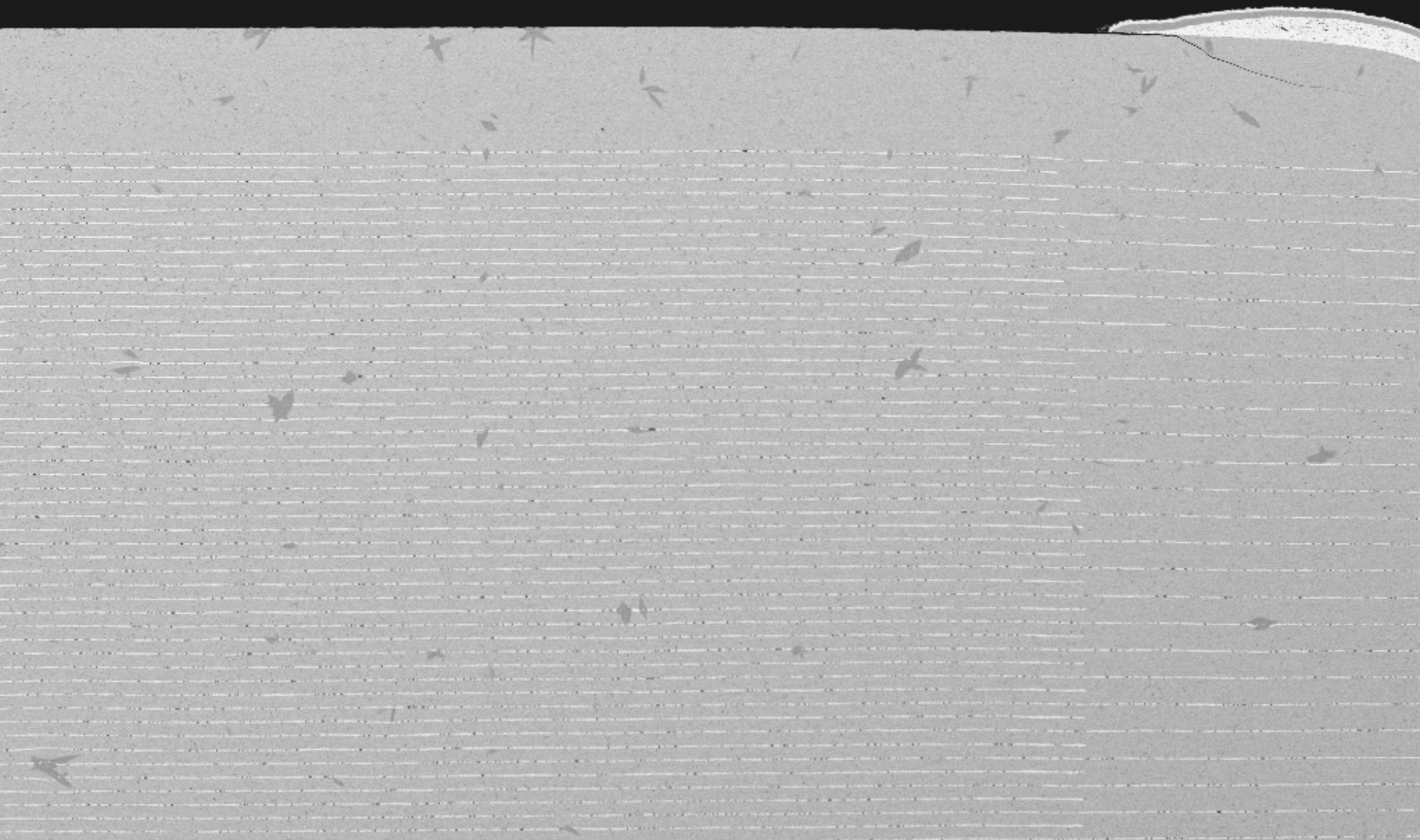
10µm

WD = 12 mm

EHT = 20.00 kV

Signal A = RBSD

*Classical SEM view
(Chemical contrast)*



Mag = 55 X

200µm

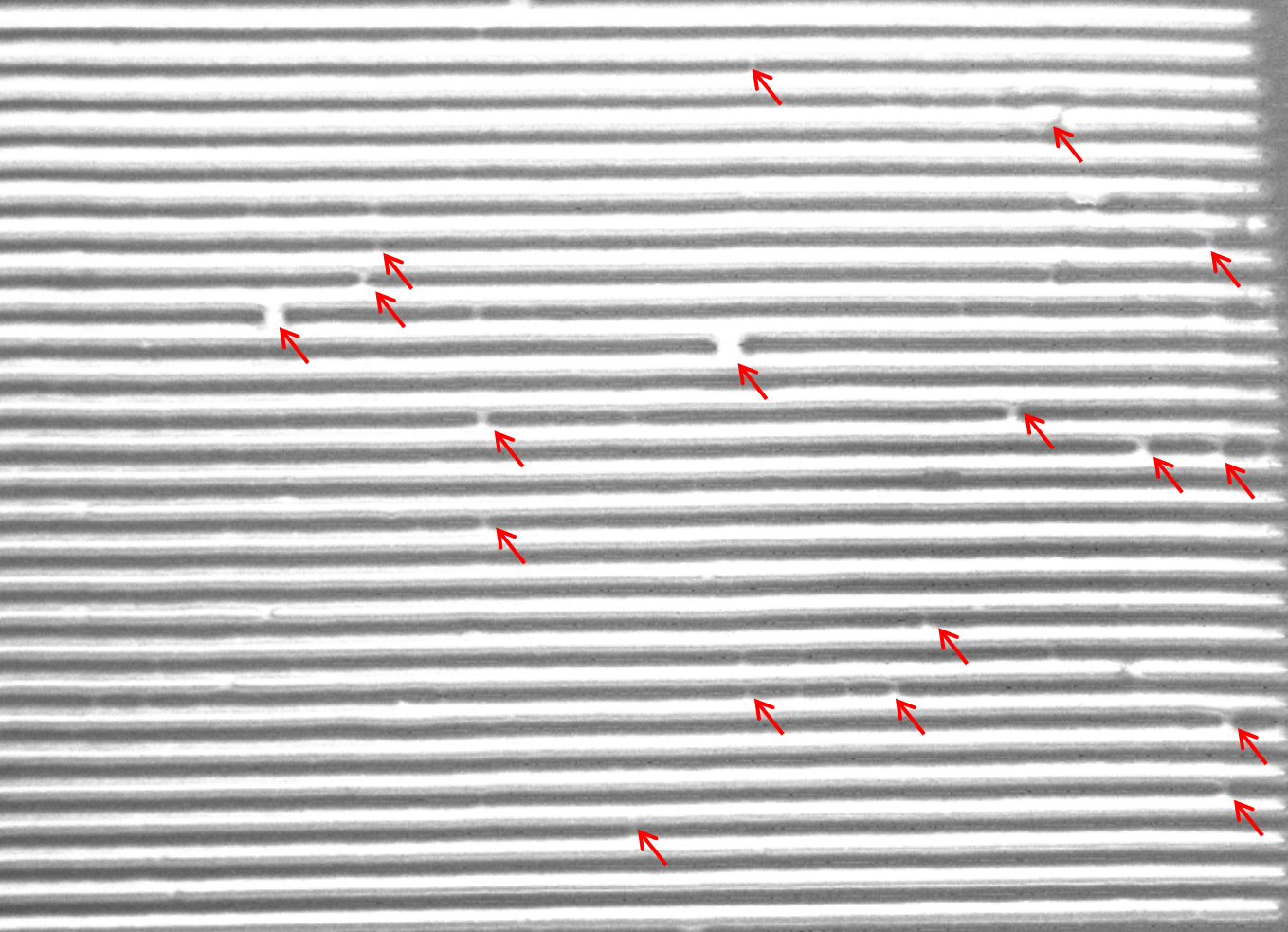


WD = 13 mm

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

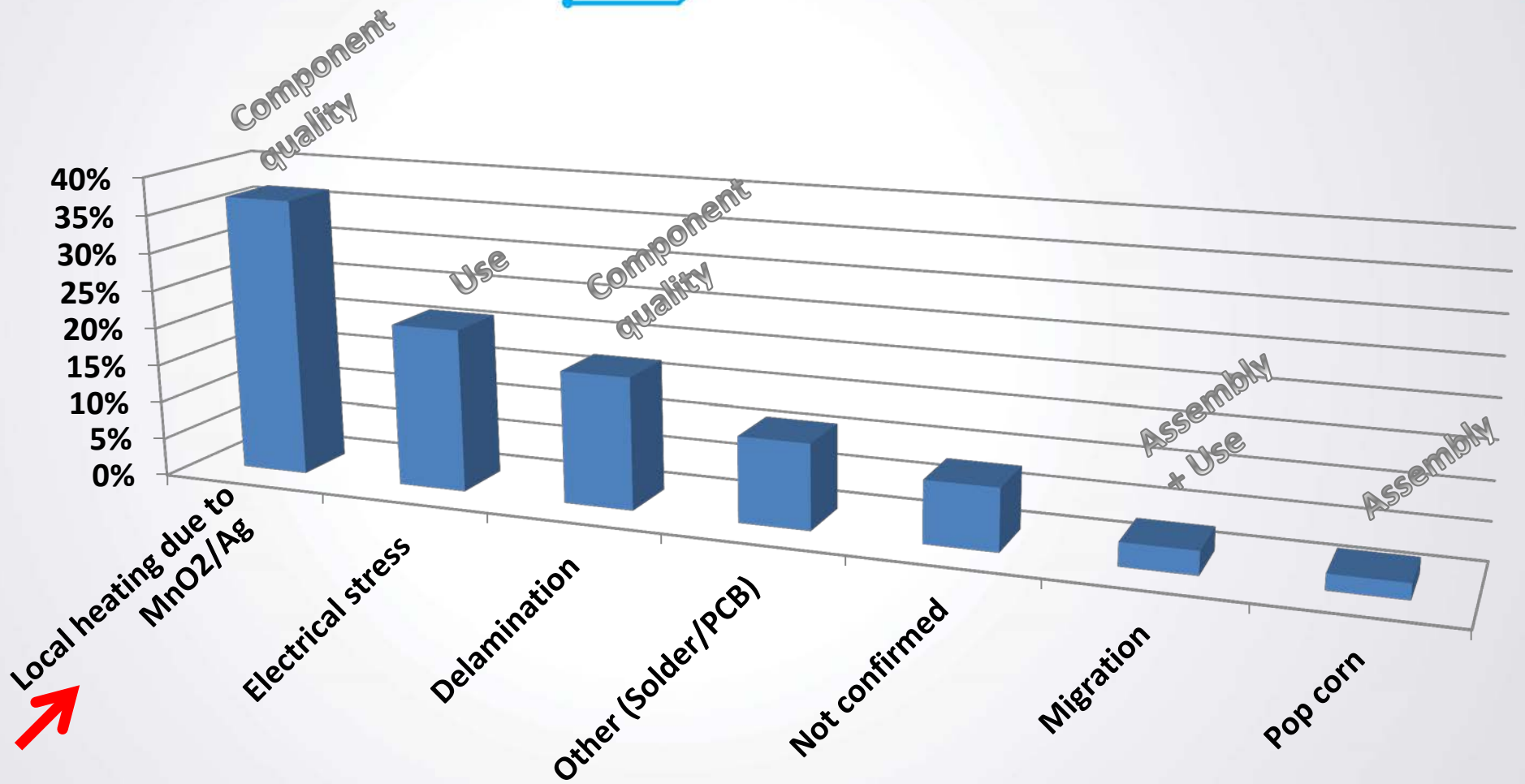
20µm


WD = 10 mm

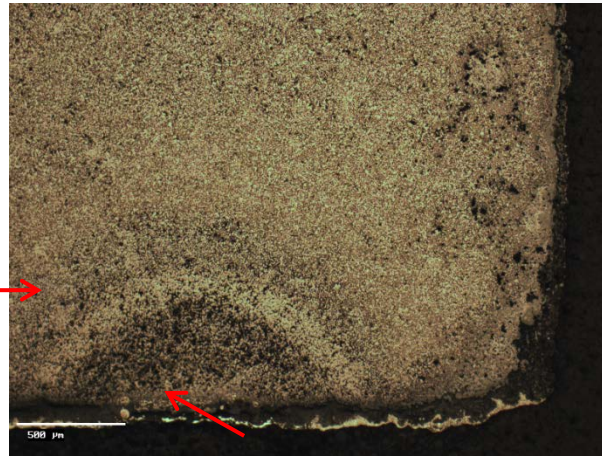
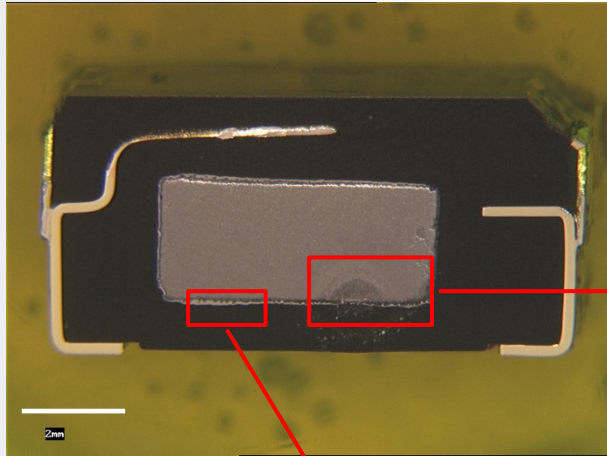
EHT = 5.00 kV

Signal A = InLens

Tantalum Capacitors Main Defects

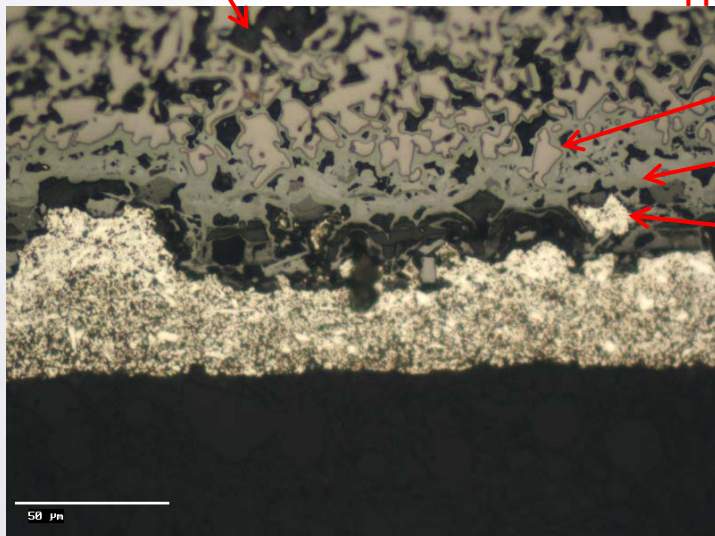


Tantalum Capacitor MnO₂ deposition



- Component quality
- MnO₂ layer thin and inhomogeneous
- Ag penetration

Heat affected area



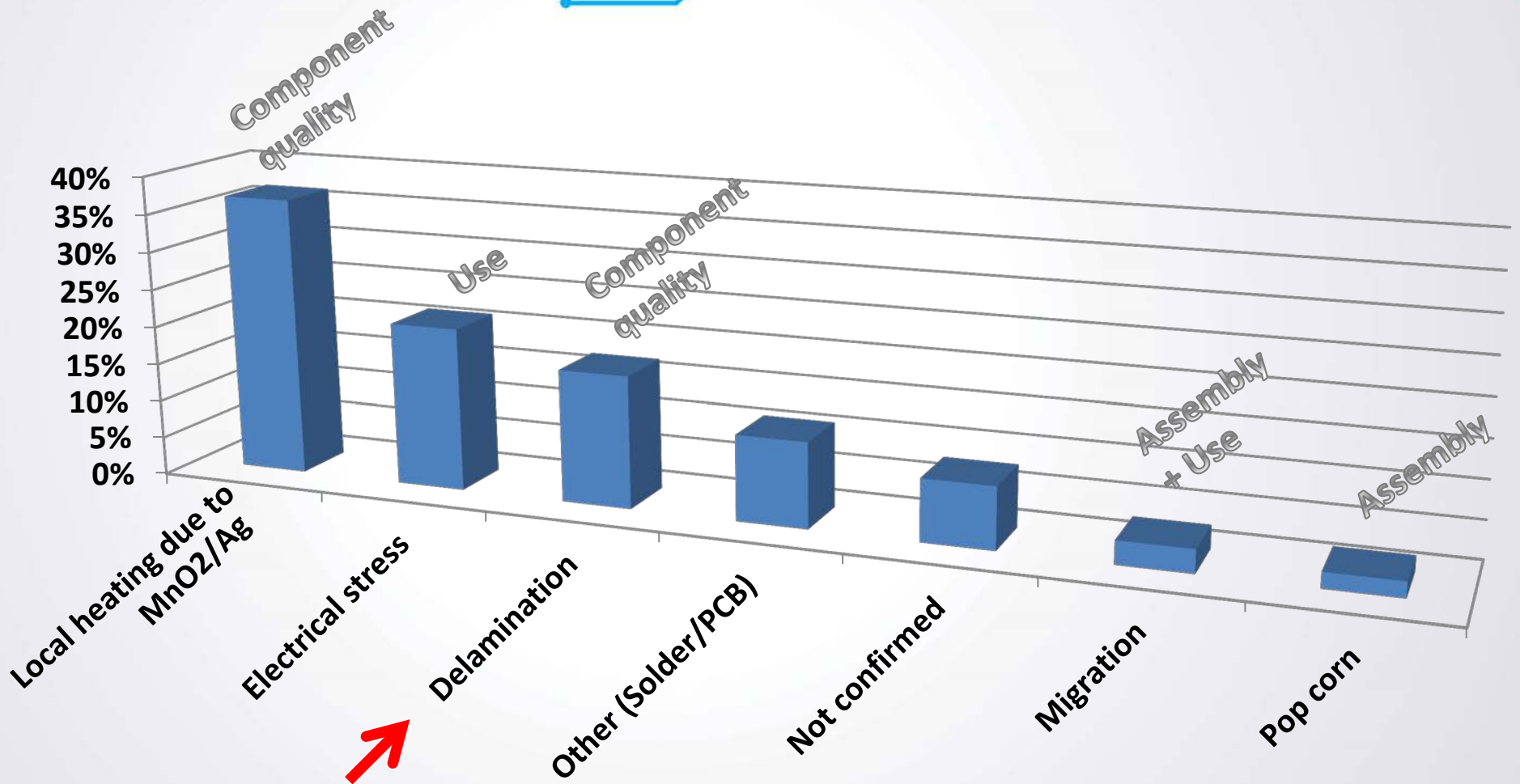
Ta

MnO₂

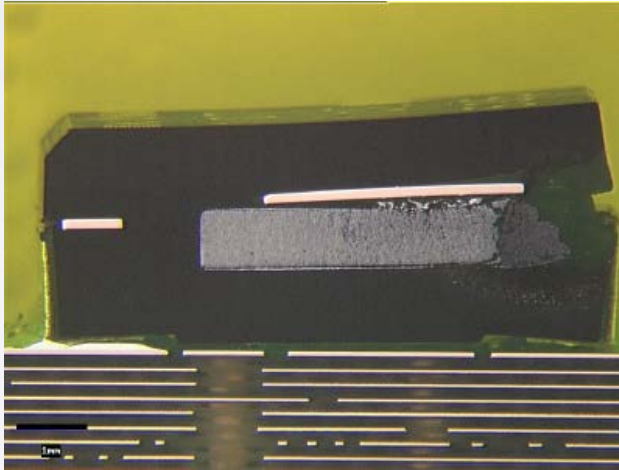
Ag

→ Local ESR reduced
→ Overheating
until short circuit

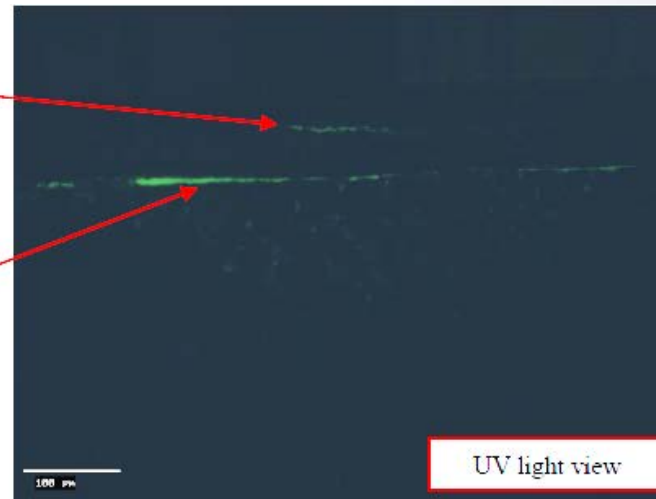
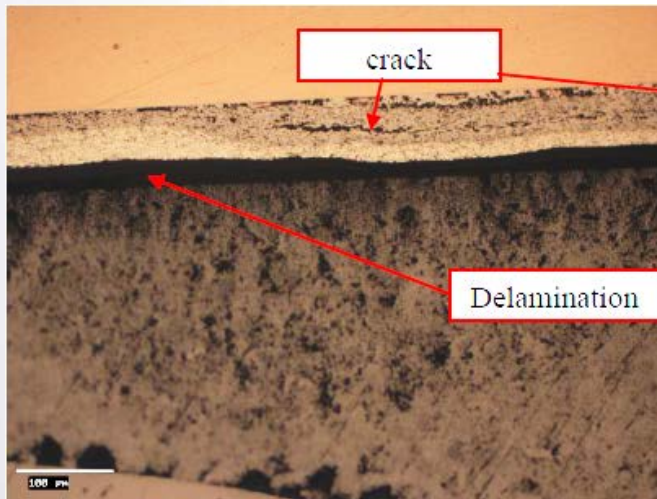
Tantalum Capacitors Main Defects



Tantalum Capacitors Delamination

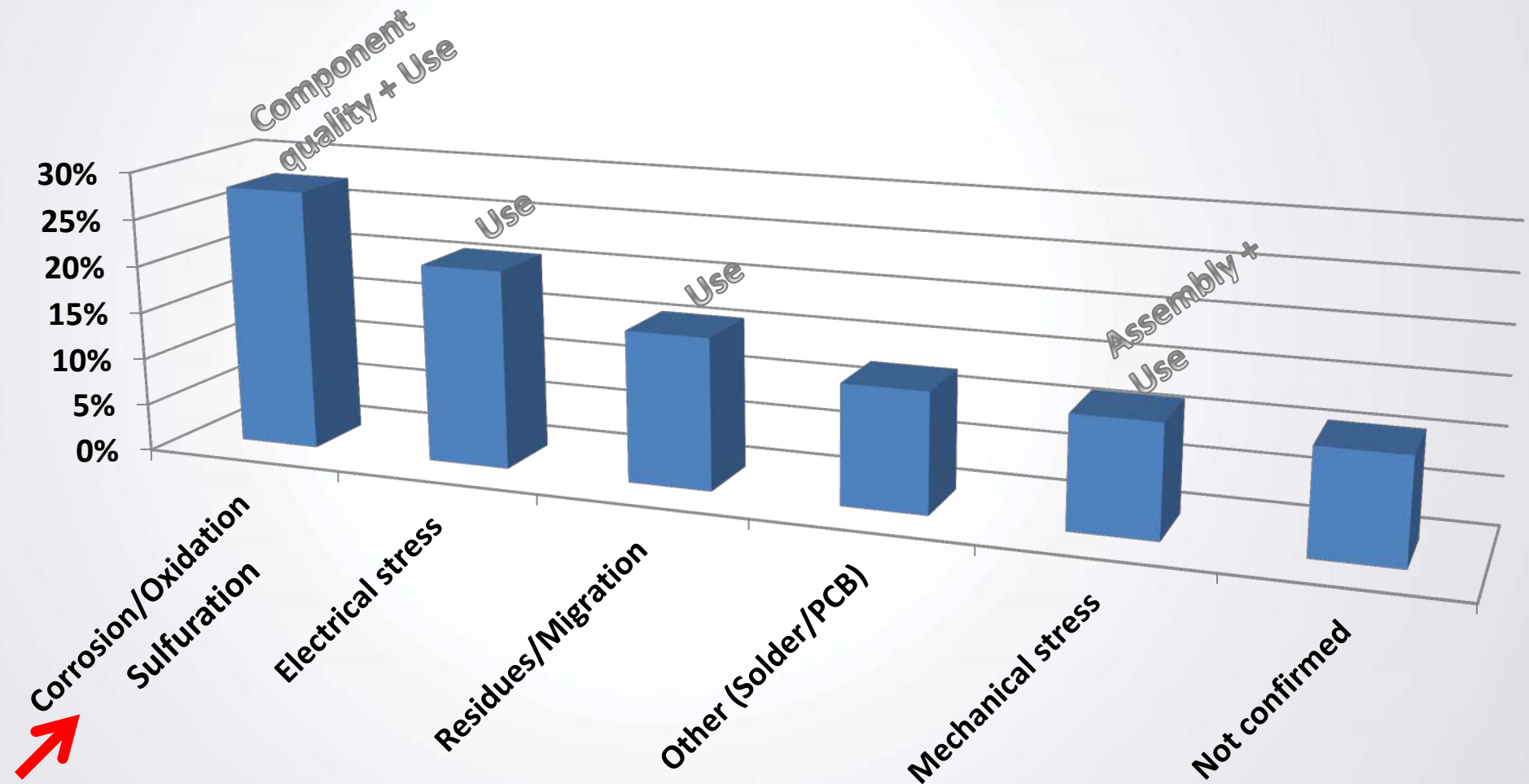


Delamination due to component quality or assembly process
→ ESR increase up to thermal runaway

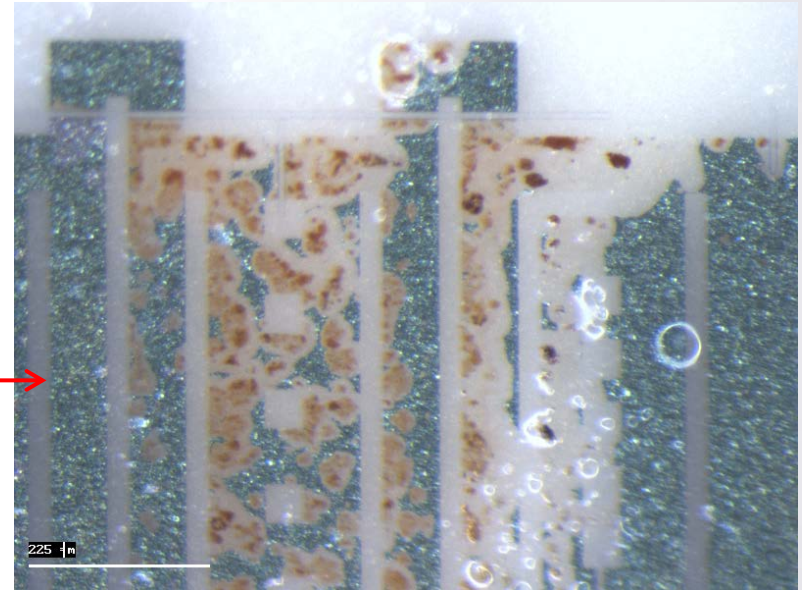
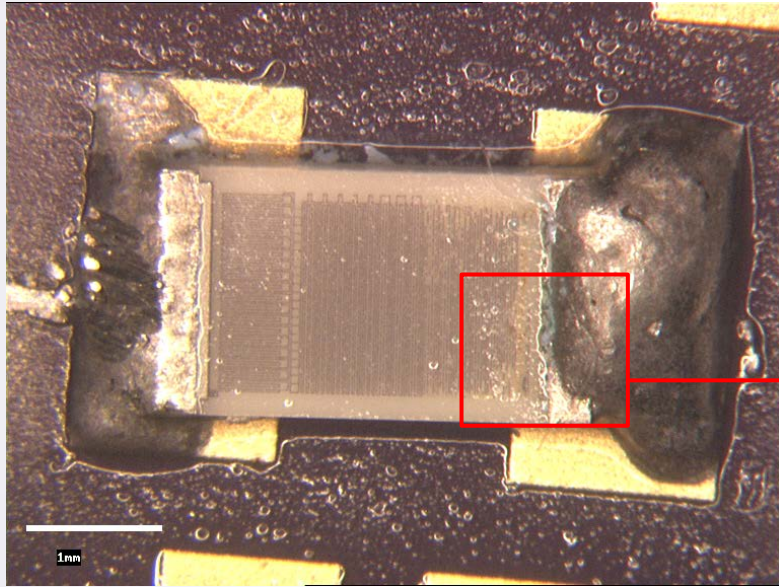


SMT Resistors (Thick+Thin film)

Main defects



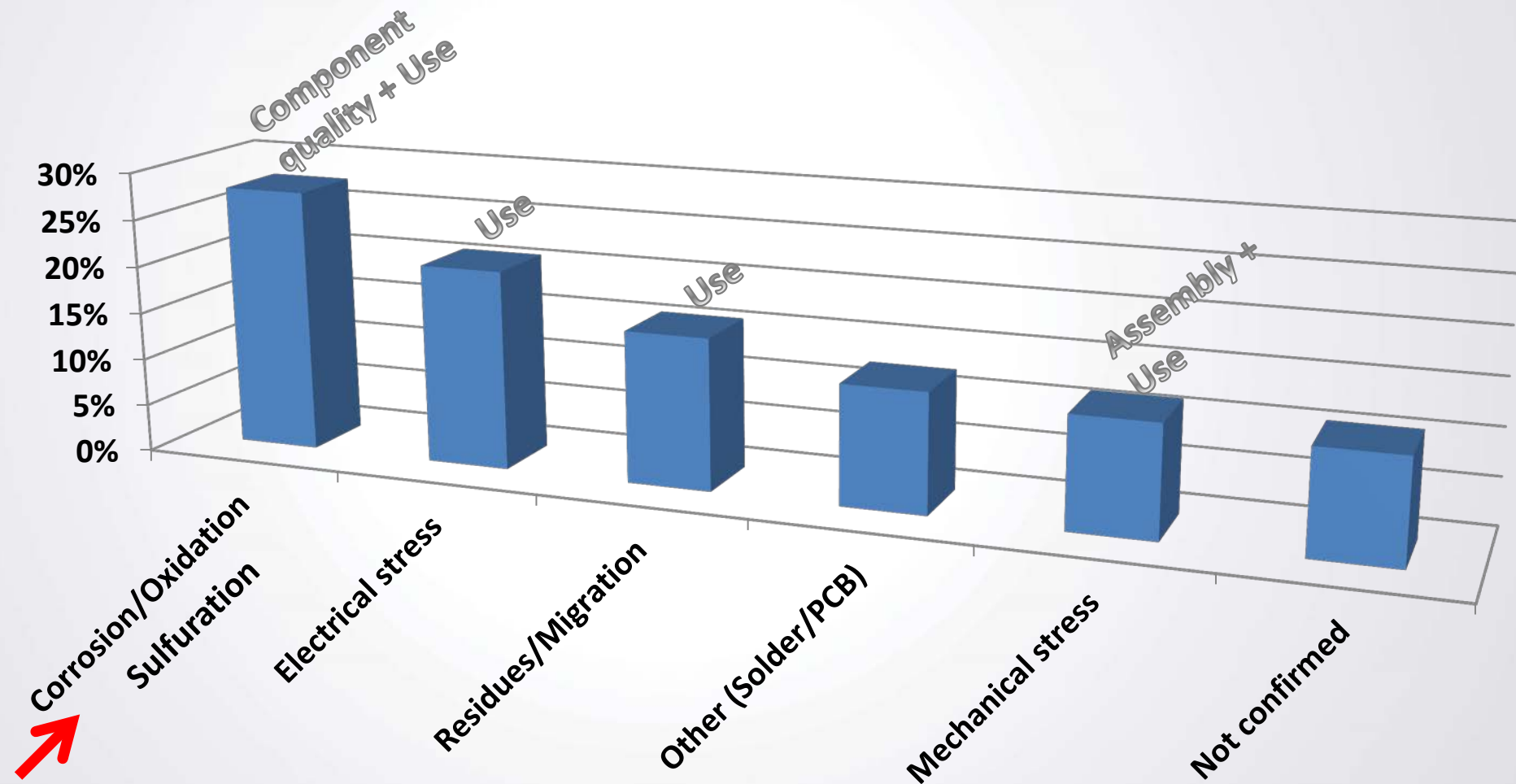
SMT Resistors (Thin film) Corrosion



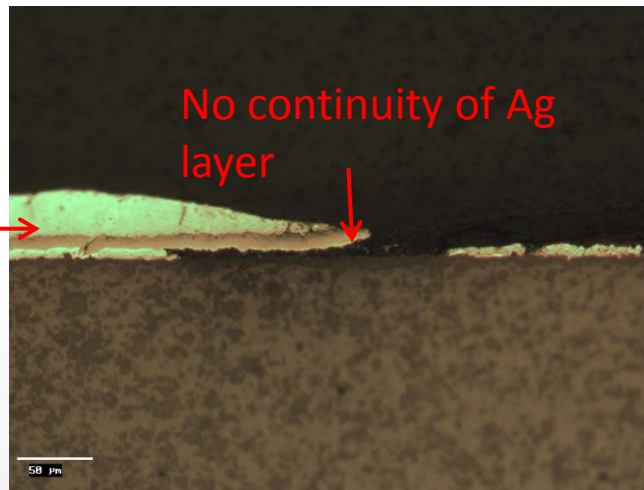
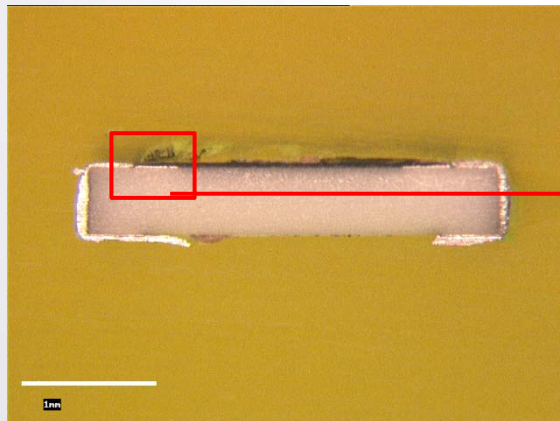
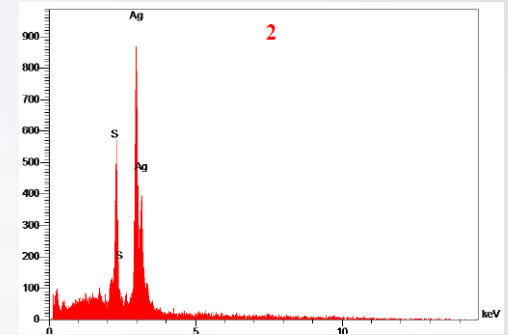
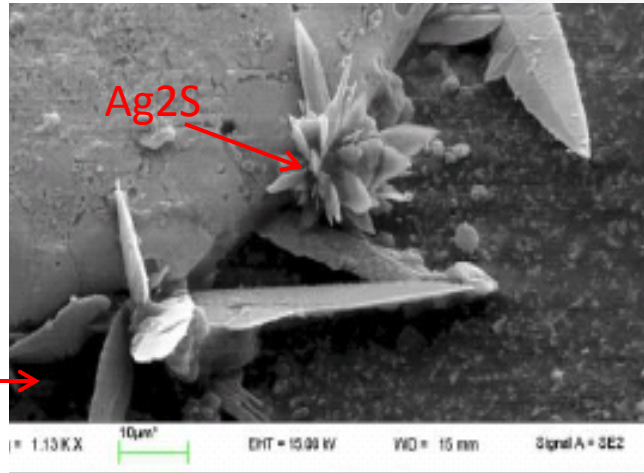
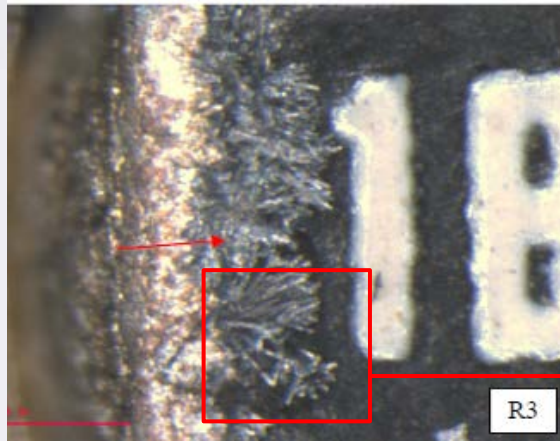
Oxidation of the resistive layer in presence of humidity
→ Resistance increases up to open circuit

SMT Resistors (Thick+Thin film)

Main defects



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**

Thank you



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