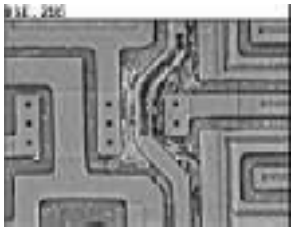
integrated solutions

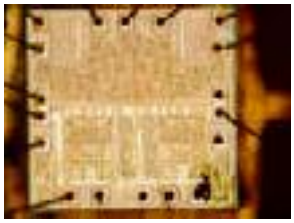
Reliability and failure analysis
- case studies and typical failure modes

Click on pictures below for enlarged views

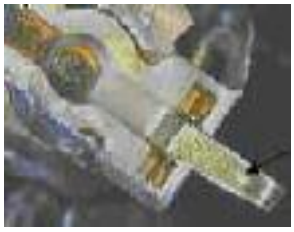


electrical over-stress in silicon IC

Back-scatter SEM image and false colour EDX data show loss of the surface aluminium layer (Al=red) and an increase in oxidation (O=Green) due to electrical over-stress in this protective circuit from a power switch IC.



Optical photograph of the surface of an integrated circuit after removal of the plastic case. Damage from the electrical overstress can be seen in the bottom right hand corner.



high resistance/broken contacts

A local build-up of debris on spring has resulted in high resistance values of the gold plated contact. EDX analysis showed that the debris was derived from board cutting or drilling operations.

Inside a failed electrolytic capacitor showing a broken positive connection at the right arrow and contamination around the rivet at the left arrow

Optical photograph of a cross section of a via in a printed circuit showing a break in the copper barrel at the arrows.

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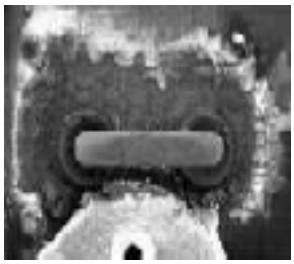
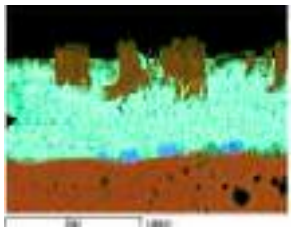


fire damage to surface of PCB

ERA has experience in burn damage investigations. In most cases the faults that have lead to the fire damage can be identified.

Fire damage to a printed circuit board caused by a faulty surface mount capacitor.



TVS diode failure

After protecting a circuit against many transient pulses copper has migrated from the header at the bottom through the solder (pale green) at the centre and penetrated the silicon (black) at the top. The blue regions are silver rich parts of the solder and the dark brown "teeth" are copper silicide.

corrosion in metal film resistor

A high value metal film resistor where the resistive film has been corroded and left an open circuit.

electrical breakdown of film capacitor

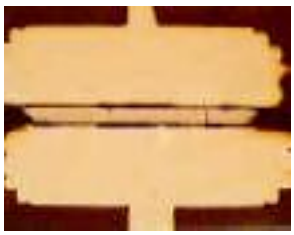
Film capacitors are designed to self-protect against over-voltage pulses. At a breakdown the current density is high enough to evaporate the film, isolate the fault and allow the capacitor to survive at a slightly lower capacitance.

corrosion due to sulphur

The ends of fine copper wires for a coil were corroded by sulphur where the lacquer had been removed by welding the wire to the pillar. Stress corrosion cracking of the copper has also occurred.
read the article about sulphide corrosion

cracked SMT capacitor

Cross section of a ceramic chip capacitor where the fault was manifested after only six months' use. The crack was caused during board assembly but was not visible at the surface of the capacitor.



cracked diode

Optical photograph of a cross section through a failed diode showing cracks in the chip next to the (black) voids in the solder either side of the chip.

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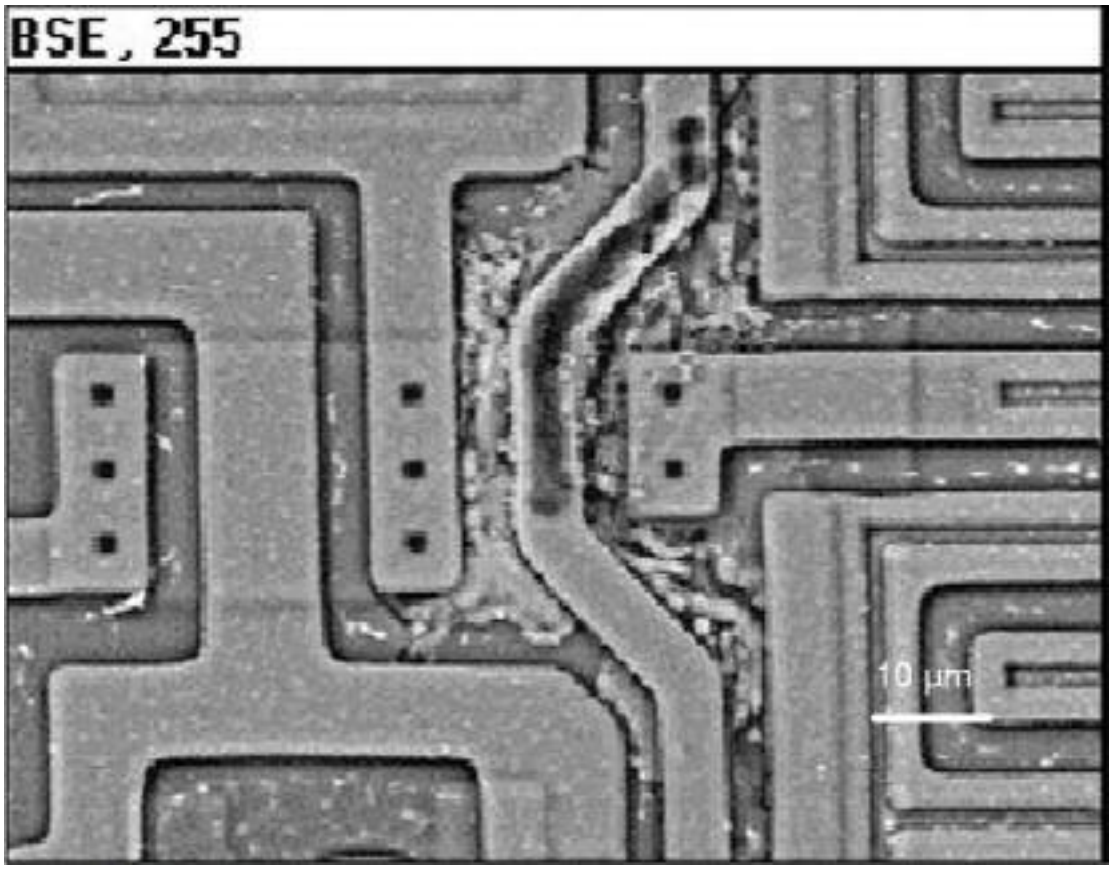

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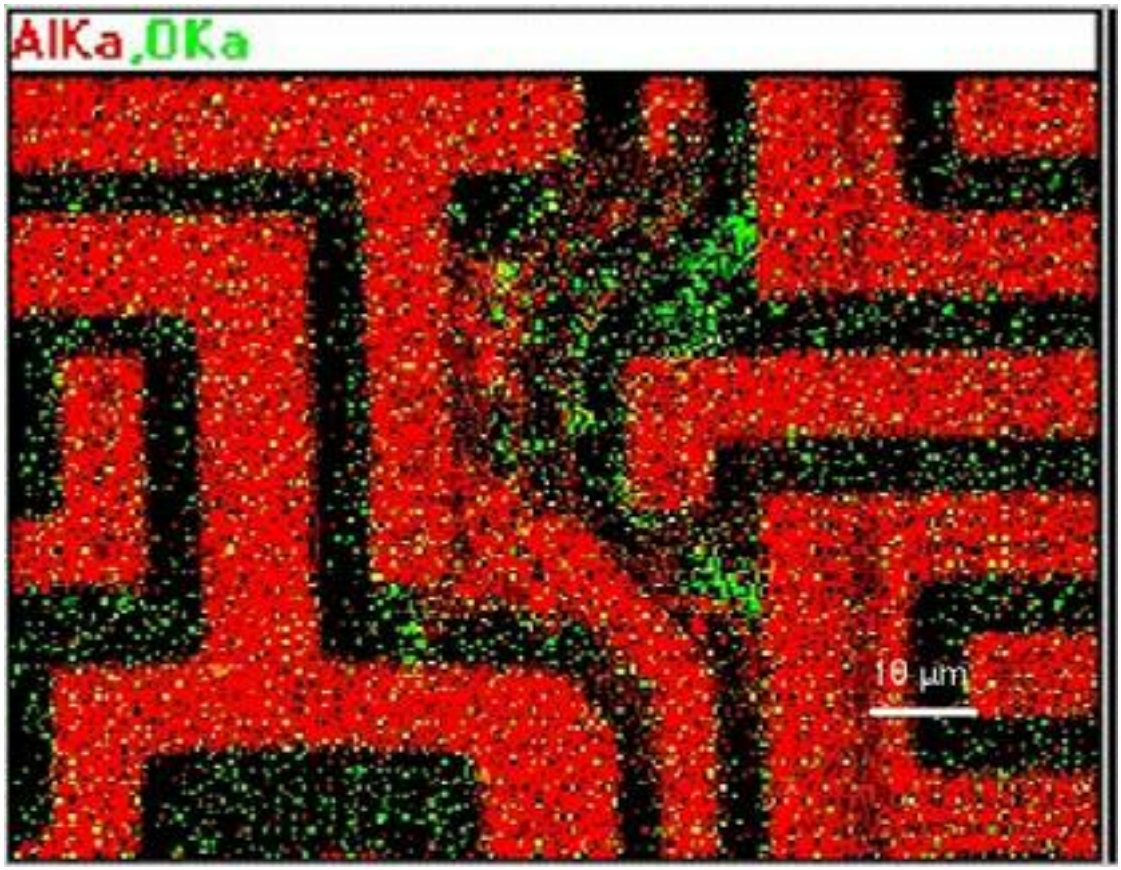

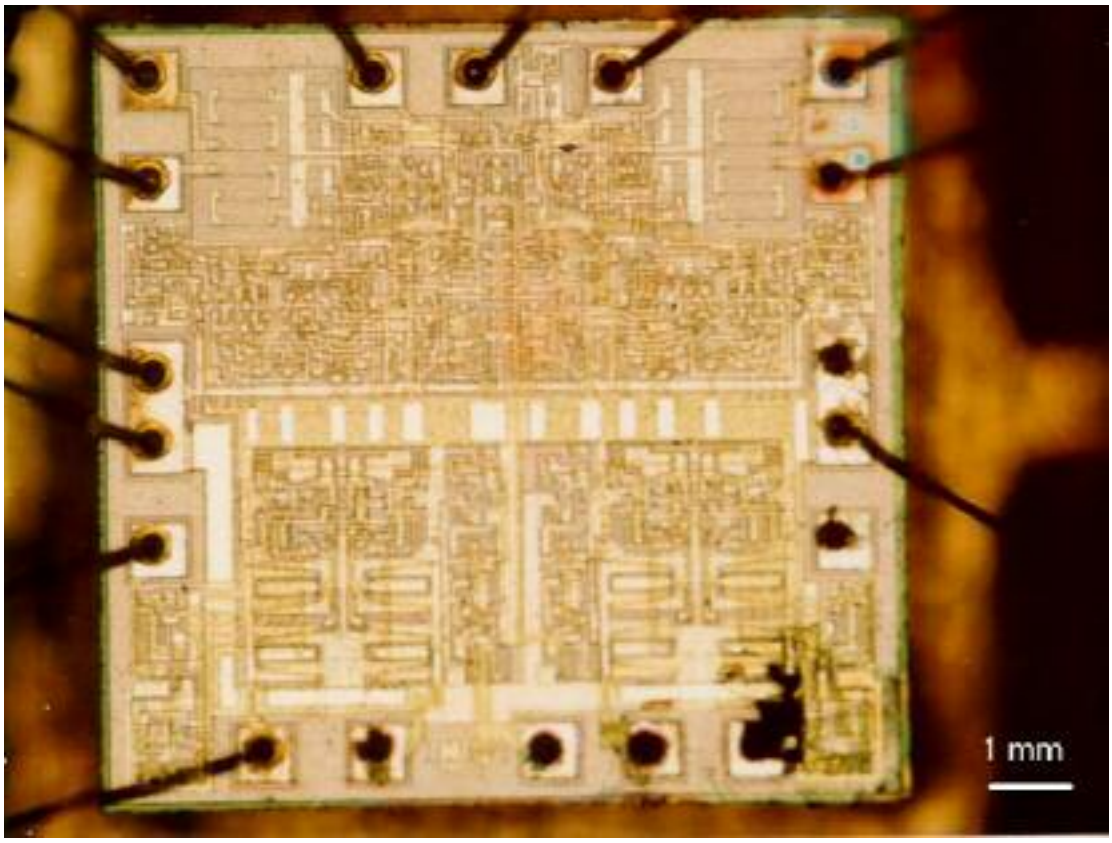

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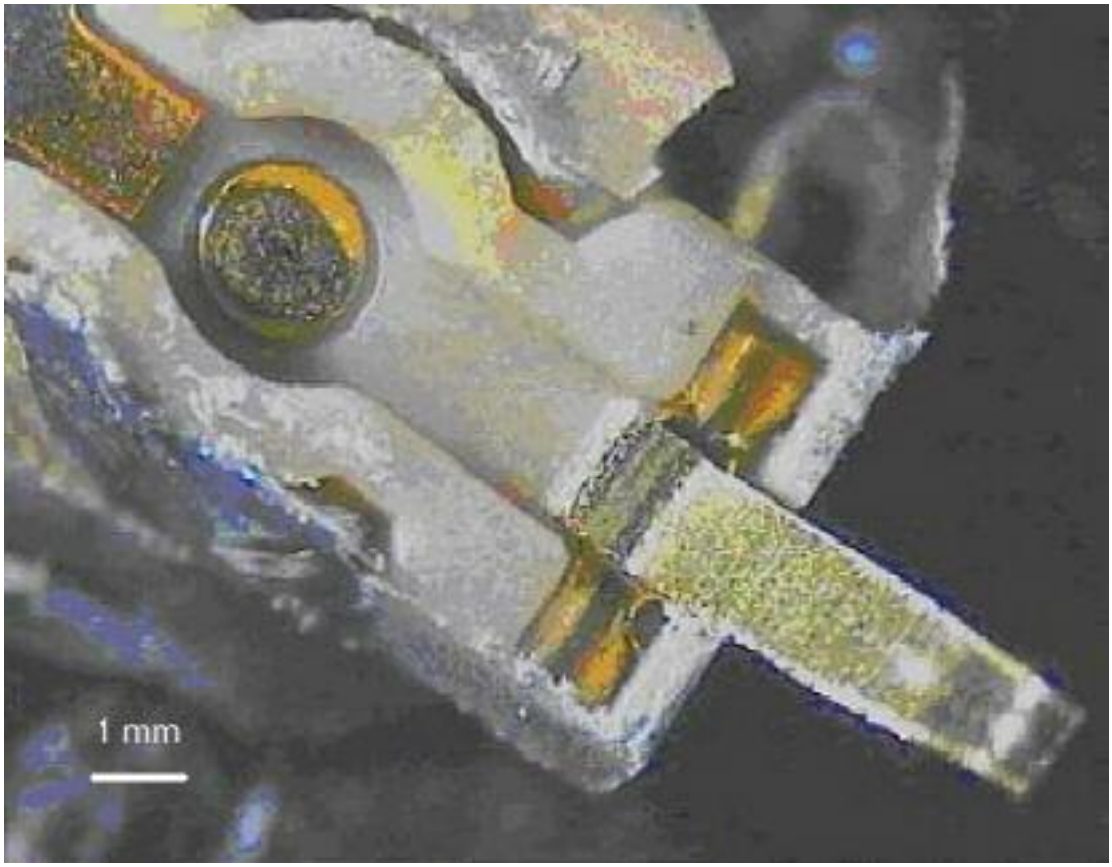

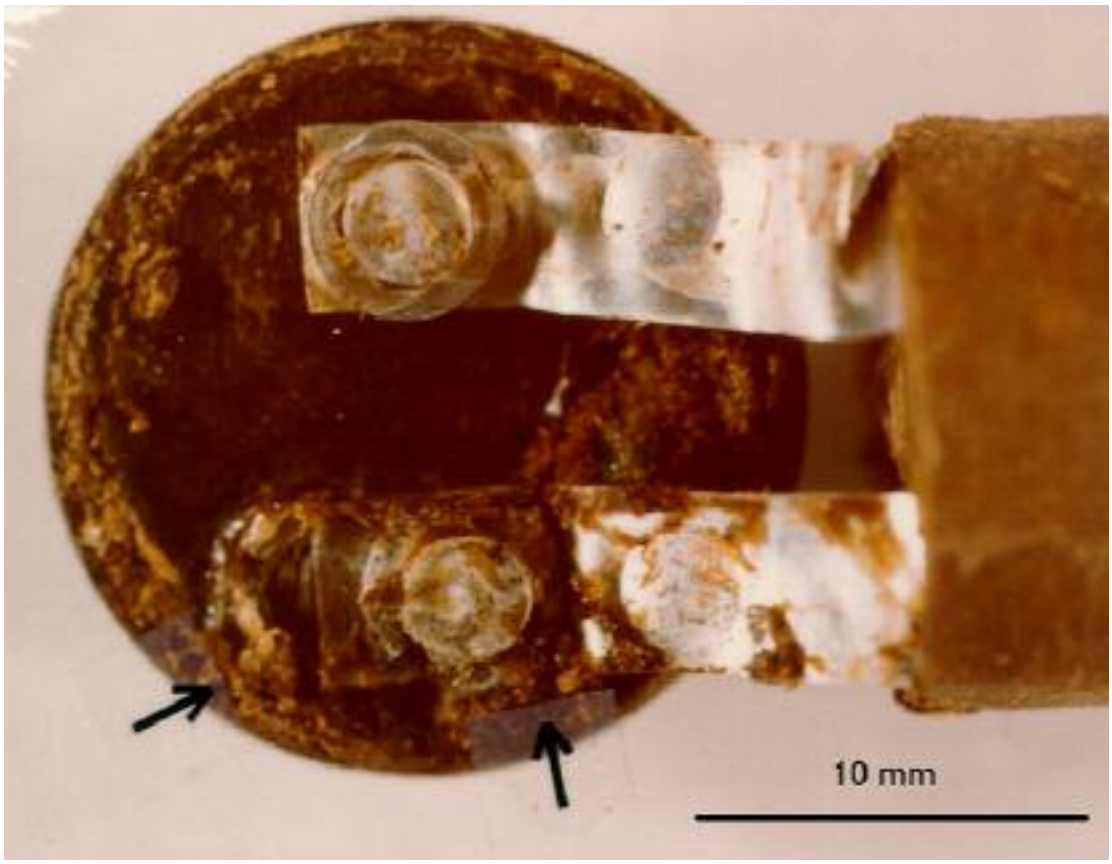

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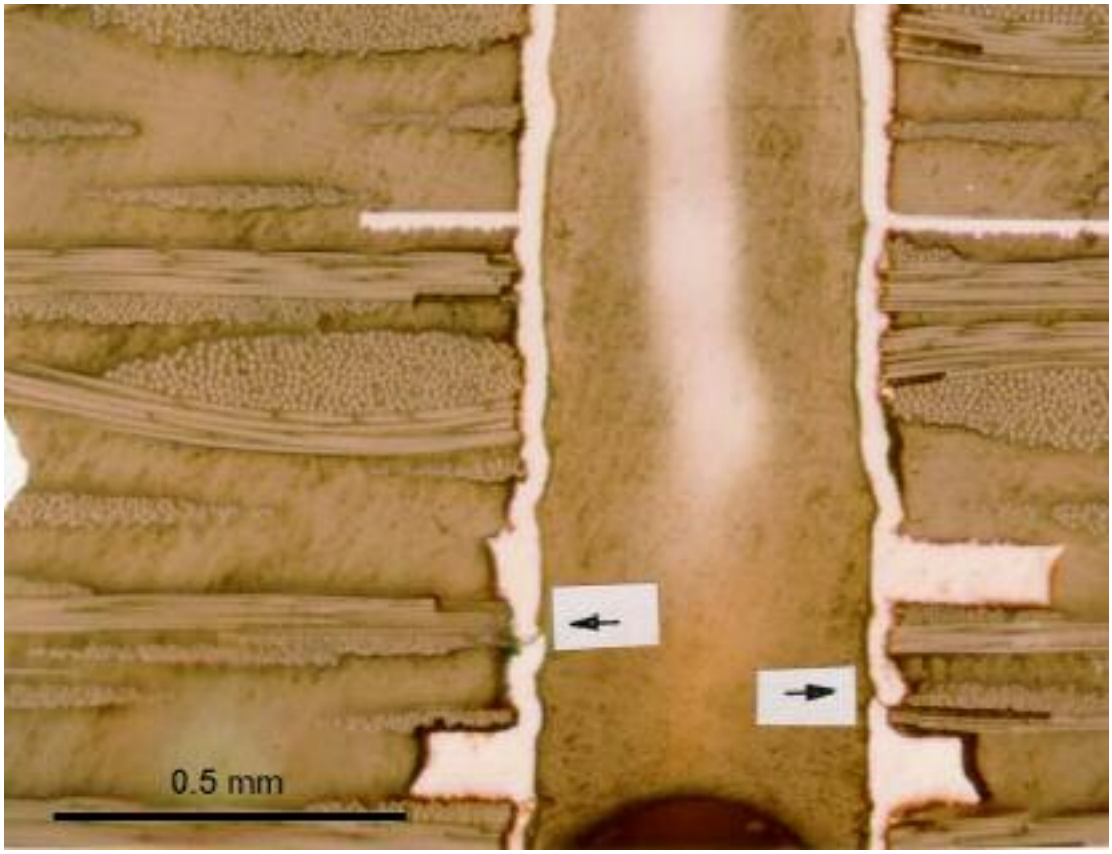

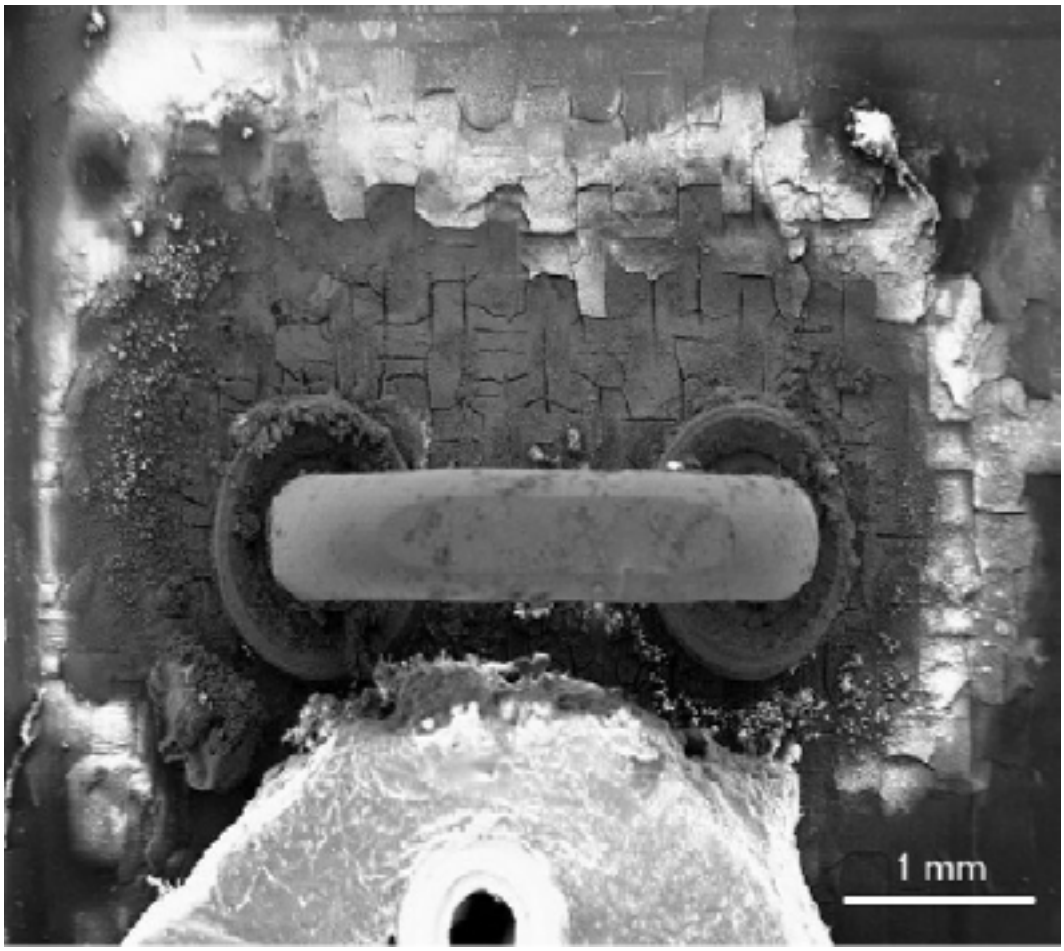

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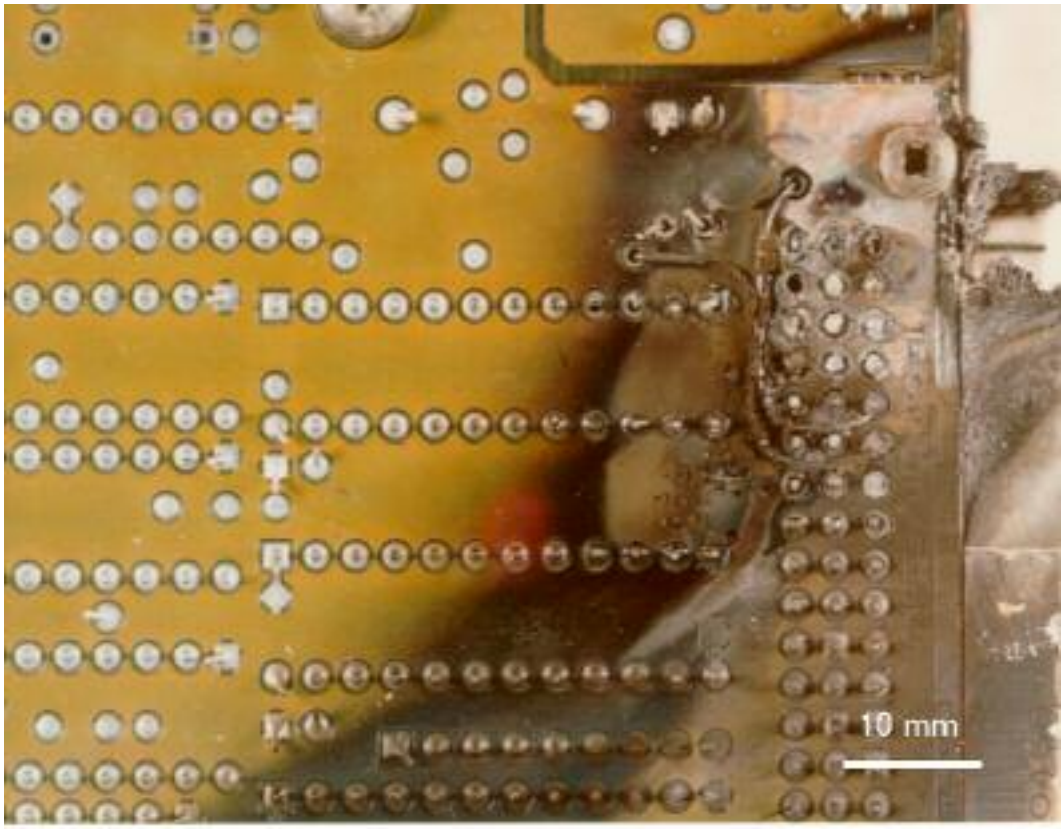

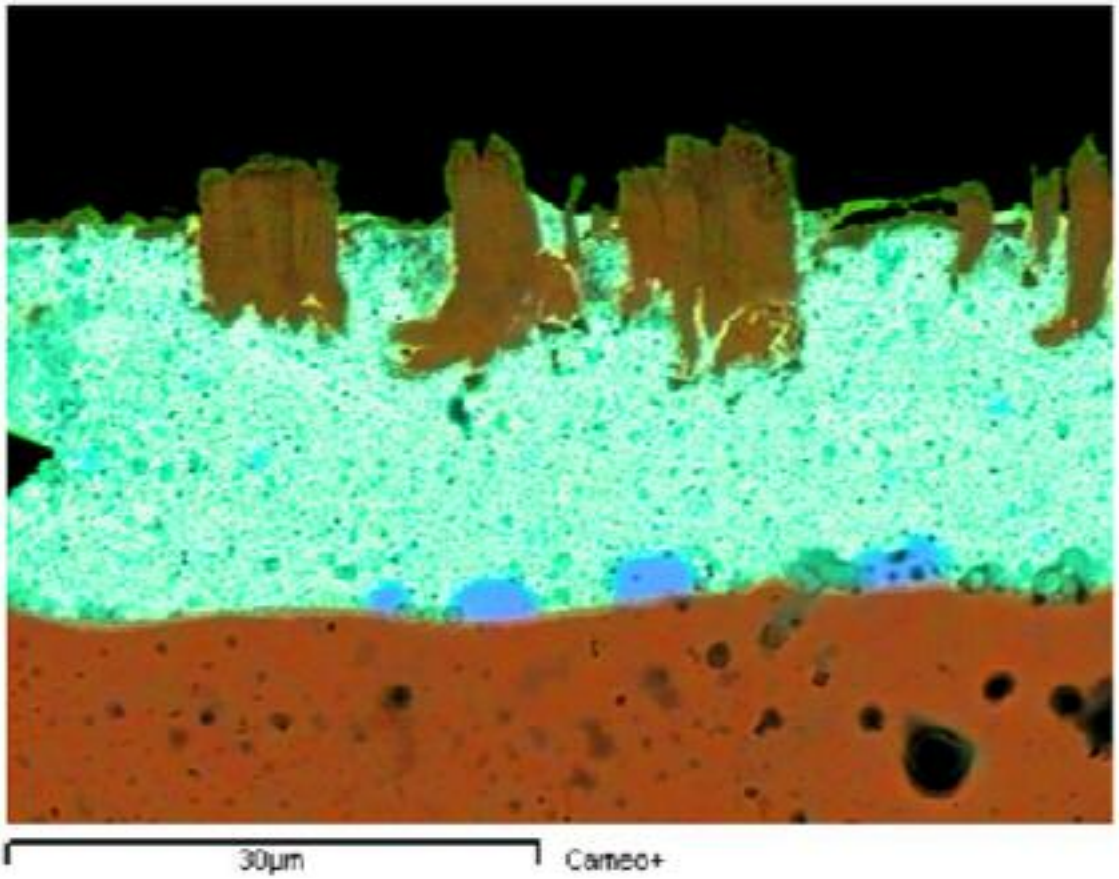

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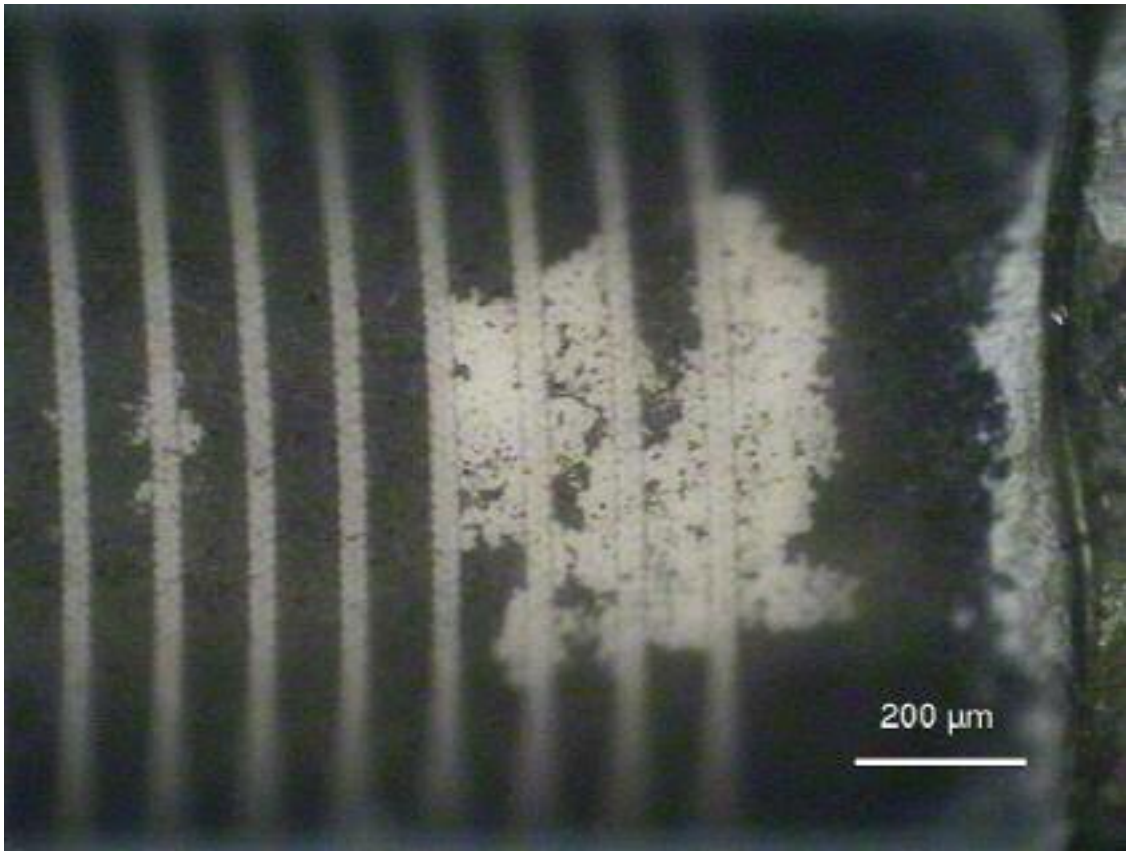


1 mm

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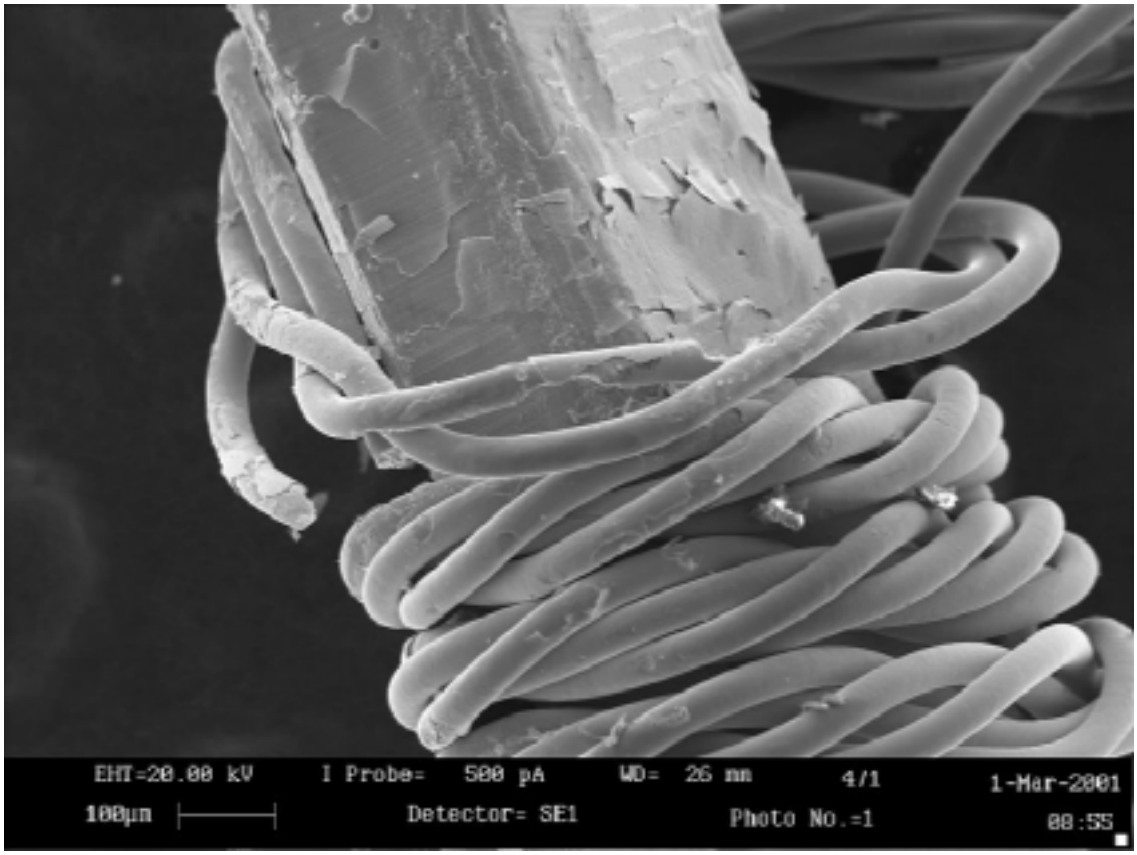
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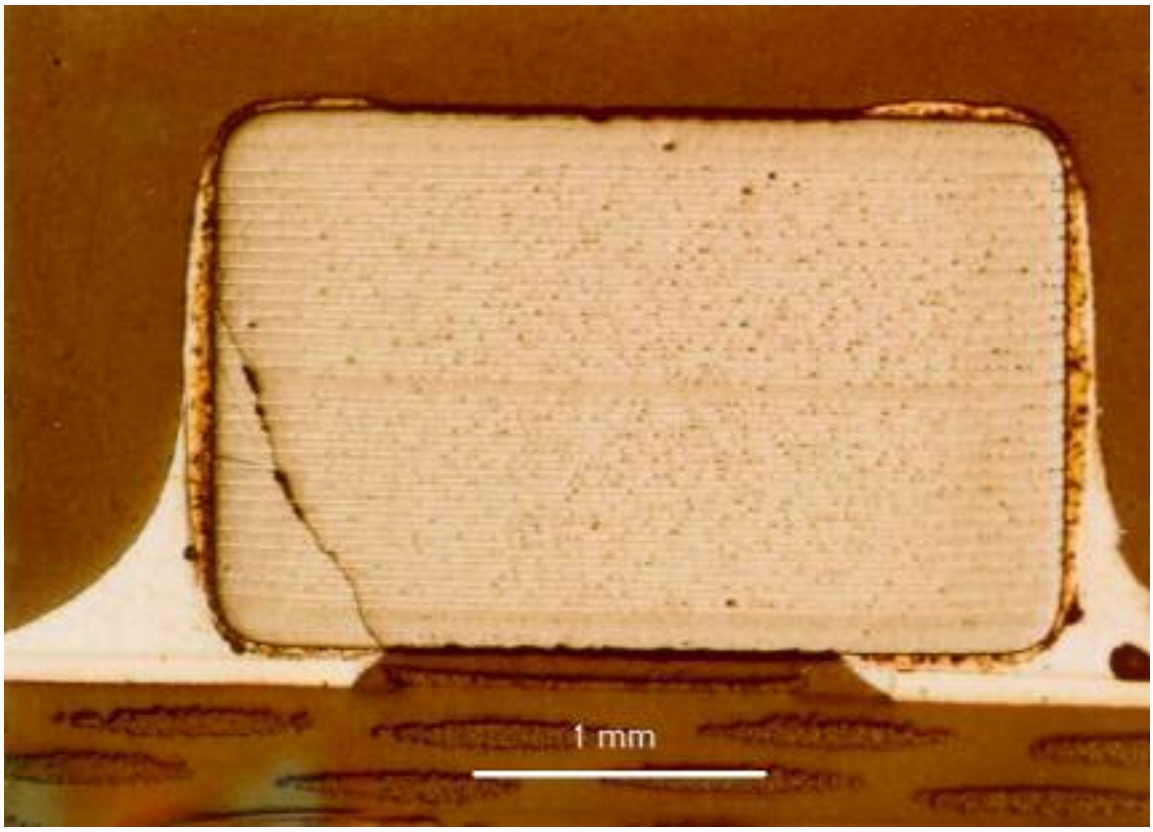
I Probe= 500 pA
WD= 26 mm
4/1
1-Mar-2001
100µm
Detector= SE1
Photo No.=1
08:55



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