

Fritting

Experiences with non-ohmic contact resistance C_{RES} while wafer test probing

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Awarded "Best Overall Presentation at SWTW-2006"

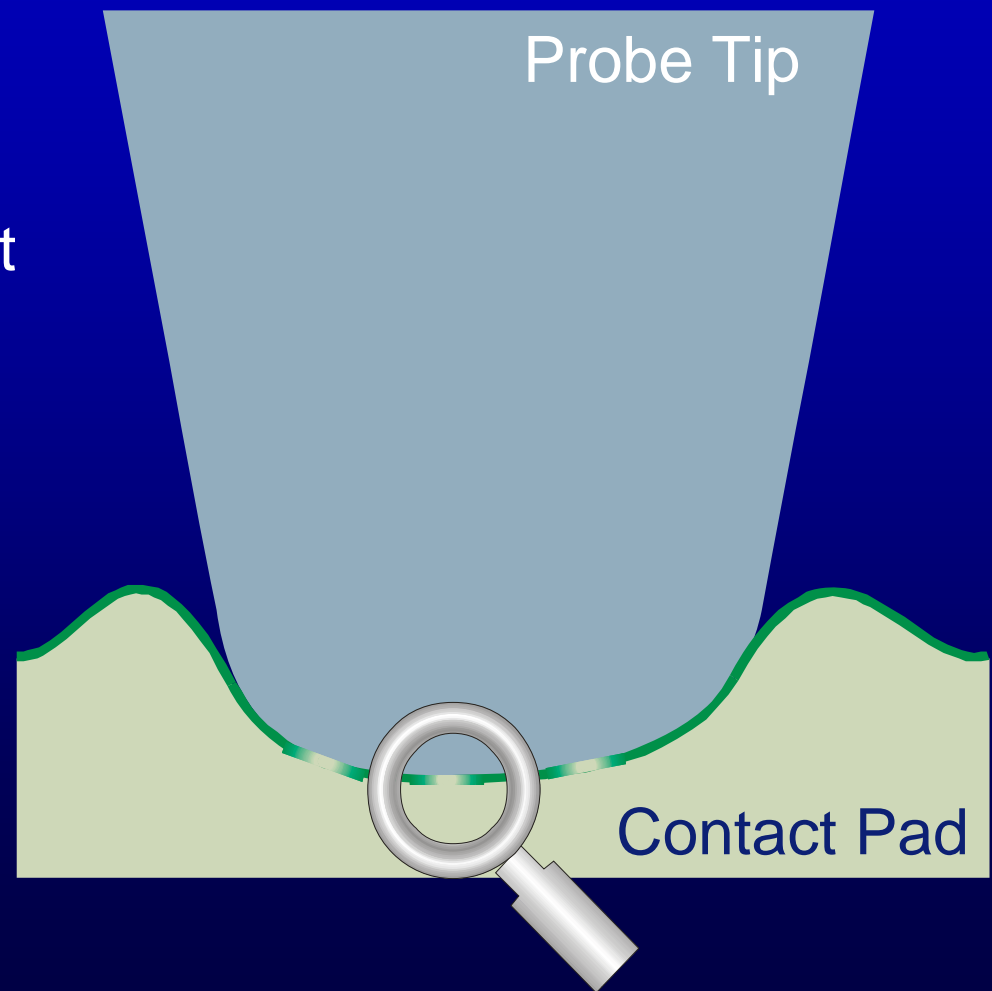
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Overview

- Fritting – What's that?
- Fritting – How to measure?
 C_{RES} measurements within production environment
- Definition of the Fritting ratio Φ
- Why measuring Fritting and not only C_{RES} ?
- Measurement results
- Summary and Outlook

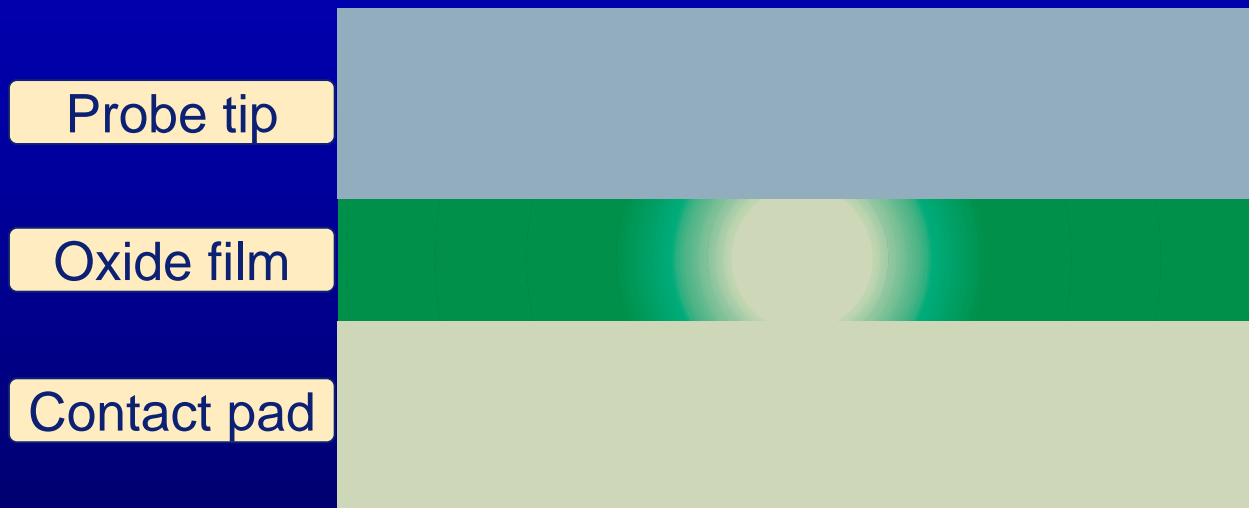
Fritting – What's that?

- The vertical Probe tip touches the contact pad.
- Depending on the contact pressure the oxide film is broken partly and electrical bridges arise.
- The number and size of the bridges is equivalent to the C_{RES} quality



Fritting – What's that?

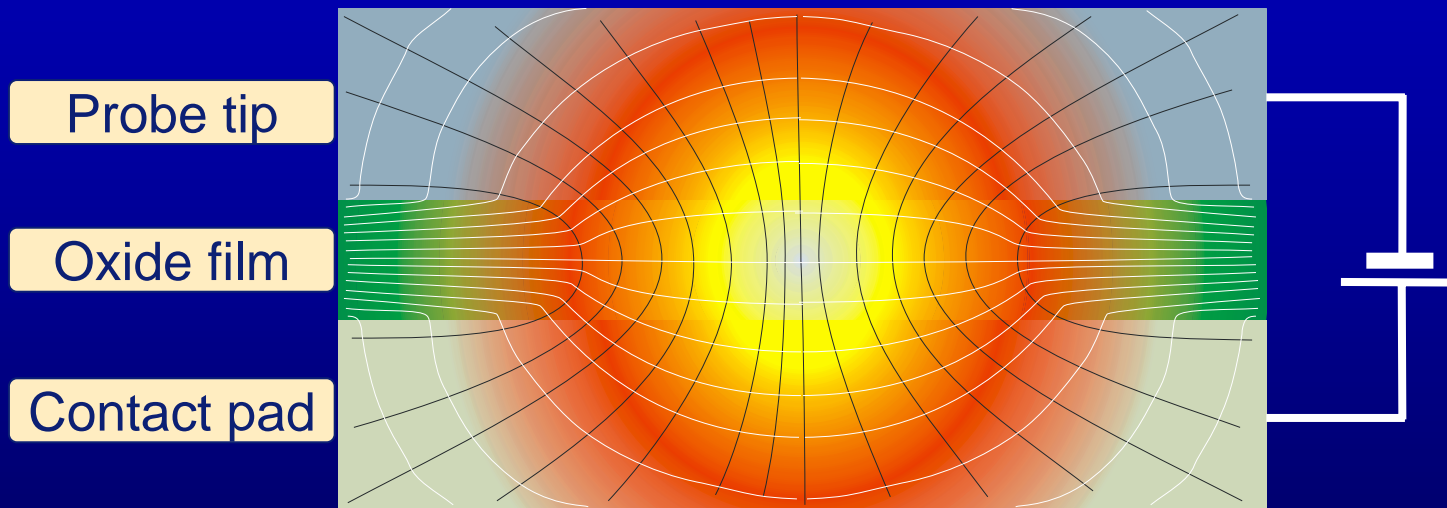
- What happens, if bridges are only few and small?



Small bridge through oxide film.
Before high current flow.

Fritting – What's that?

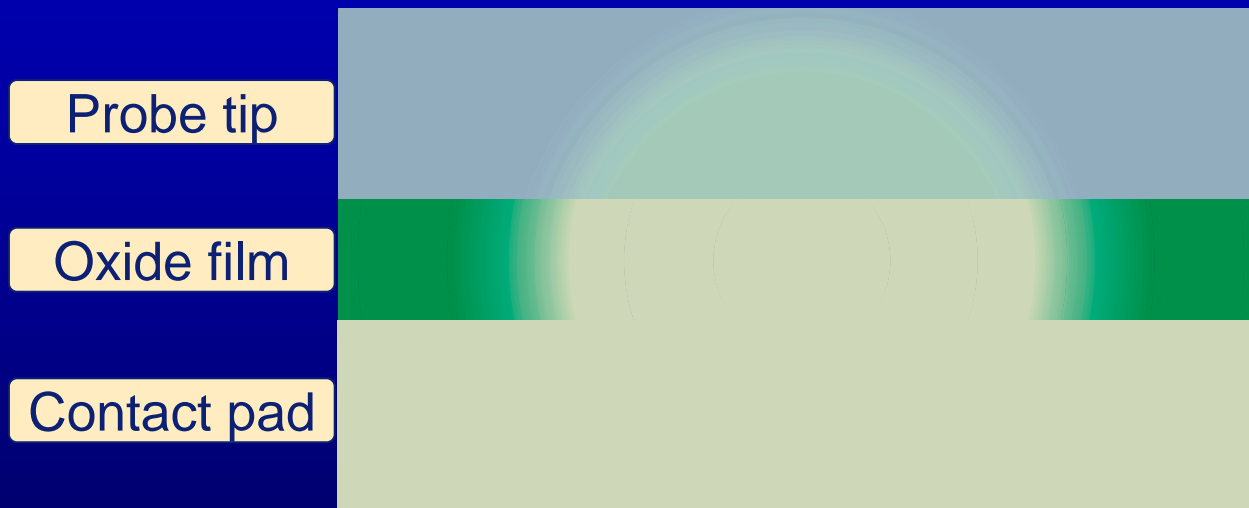
- Current must flow through small bridge.
- Bridge and neighbourhood are heated up
- Contact Pad material migrates to the bridge.



High current flow situation:
Black → Lines of current flow.
White → Lines of equipotential surface.

Fritting – What's that?

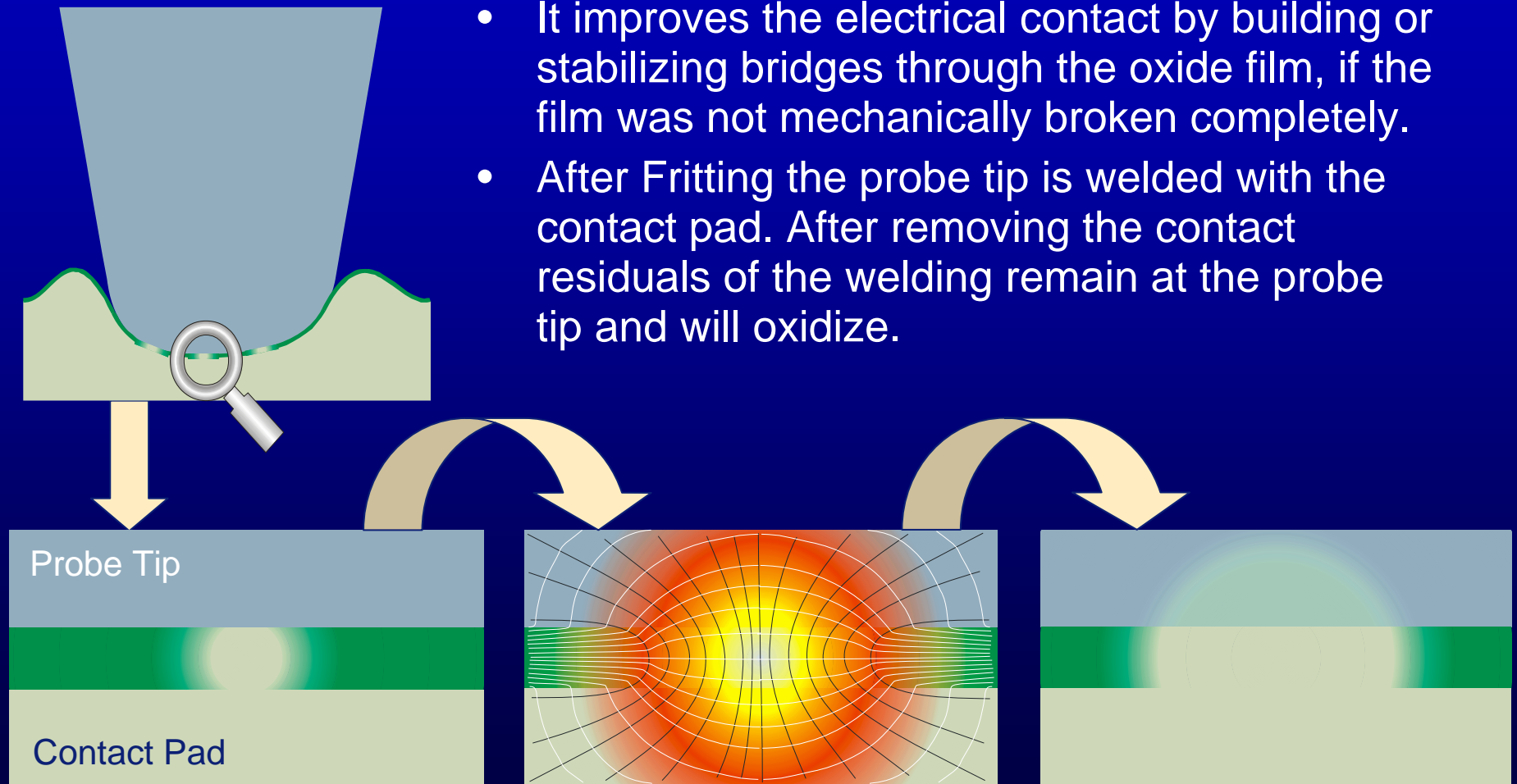
- Bridge is widened → C_{RES} decreased
- Contact pad material migrated to the bridge and tip surface



Wide bridge through oxide film.
After high current flow.
Tip surface is contaminated.

Fritting – What's that?

- Fritting is a kind of electrical breakdown at the contact surface between the probe tip and the contact pad of the IC.
- It improves the electrical contact by building or stabilizing bridges through the oxide film, if the film was not mechanically broken completely.
- After Fritting the probe tip is welded with the contact pad. After removing the contact residuals of the welding remain at the probe tip and will oxidize.



Fritting – How to measure?

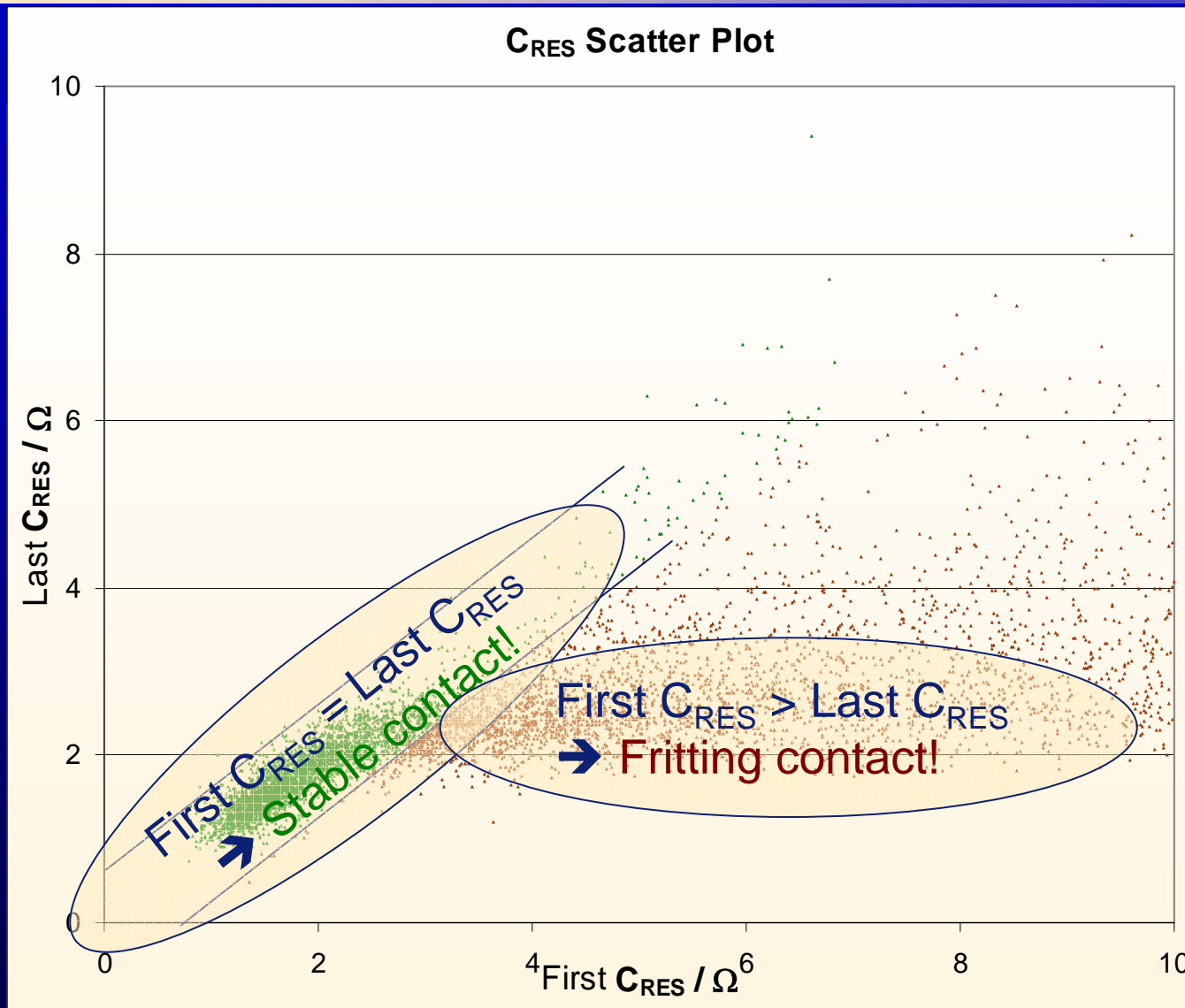
Needs:

- A C_{RES} measurement is needed before and after fritting.
- The change of C_{RES} is the indicator of occurrence.

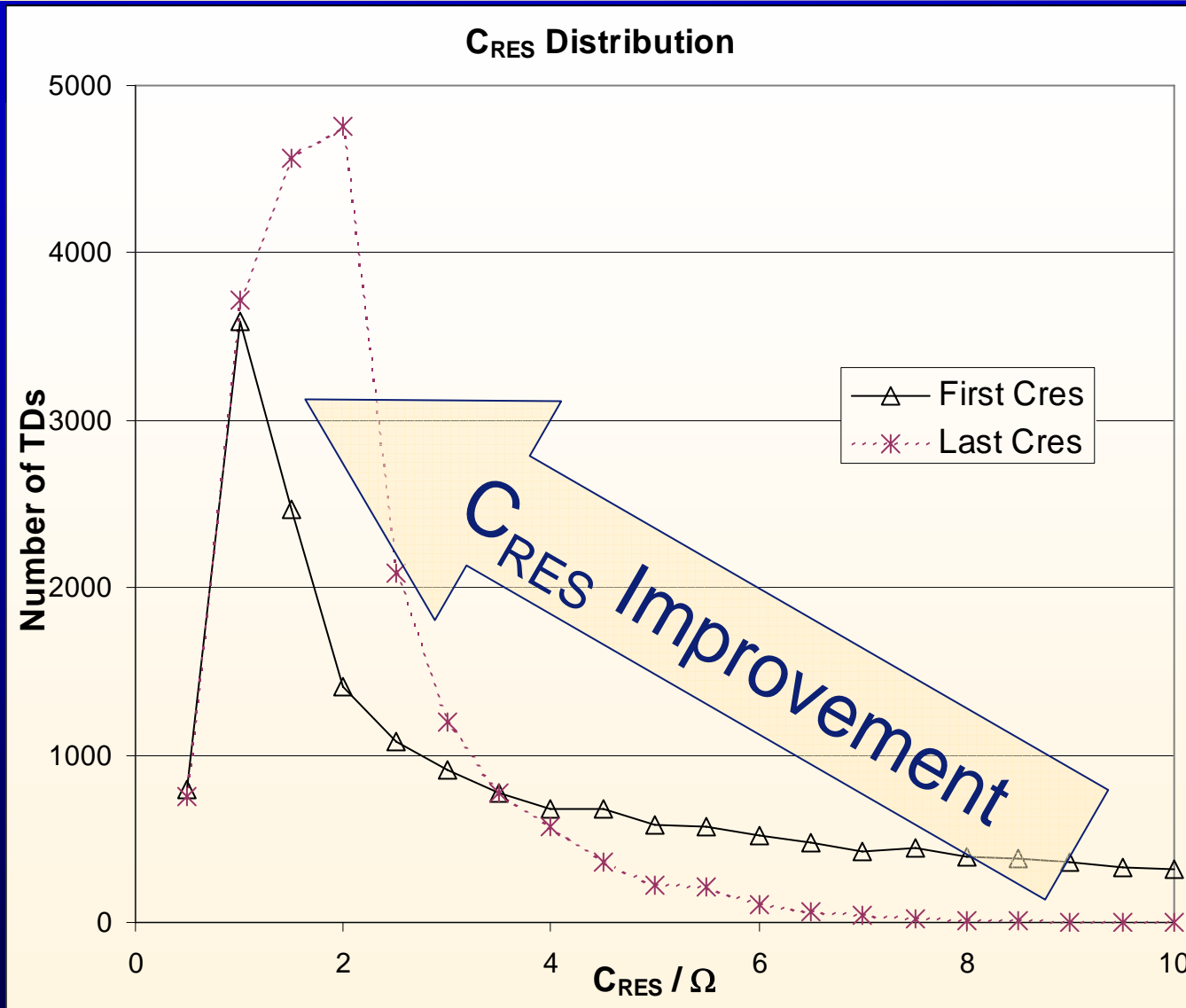
Implementation:

- C_{RES} Monitor is installed twice within the production test program flow of a smart card measuring C_{RES} on the power supply pin for every IC.
- First monitor at test program start, last monitor at the end.
- Hardware used is Teradyne J750, Accretech (TSK) prober UF200A and 32-multisite vertical probe card Viprobe from Feinmetall.
- Data of first and last C_{RES} per touchdown is collected and analyzed.

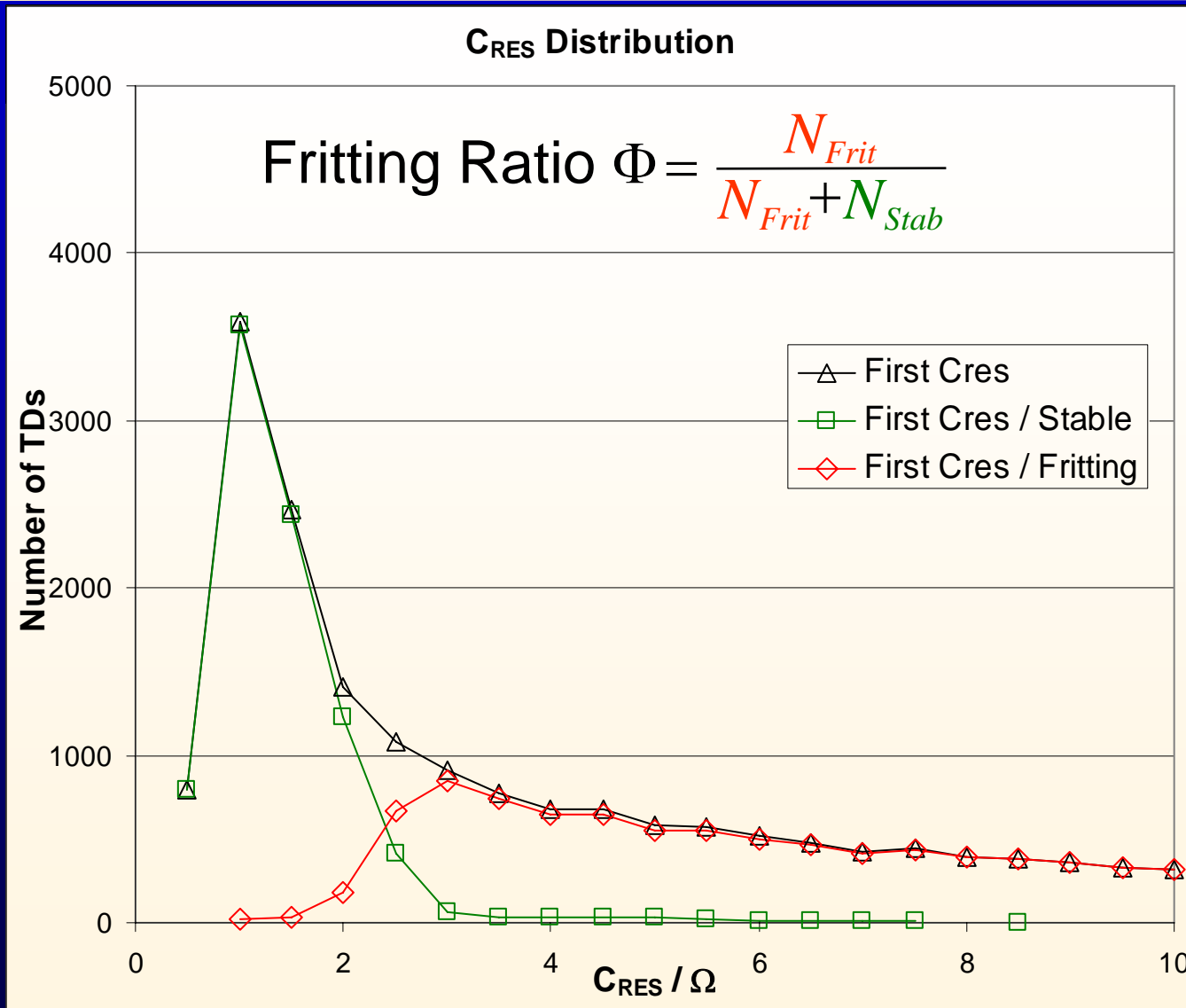
Fritting – How to measure?



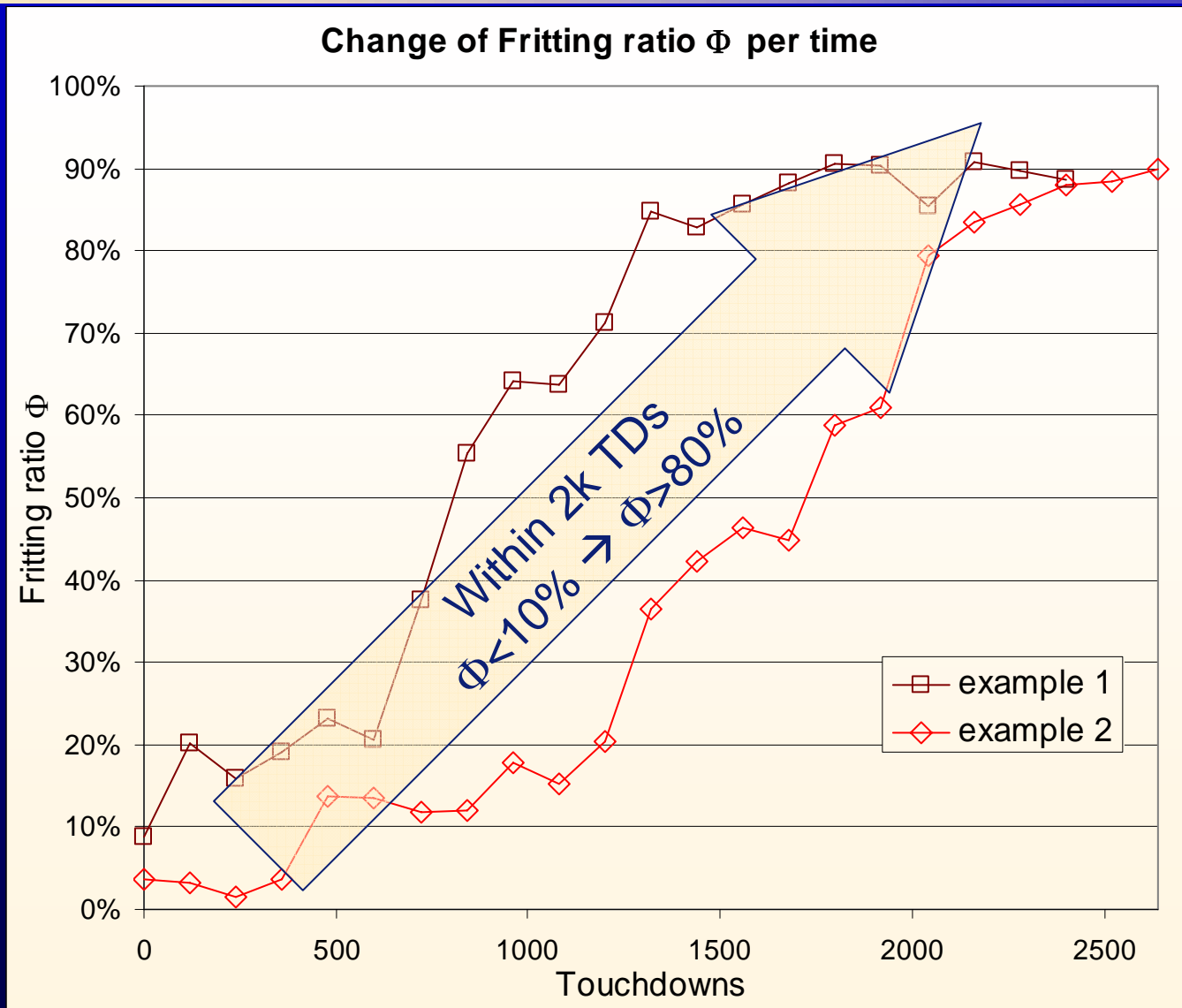
Fritting – First data review



Definition of Fritting ratio Φ



Fritting ratio Φ . Typical examples



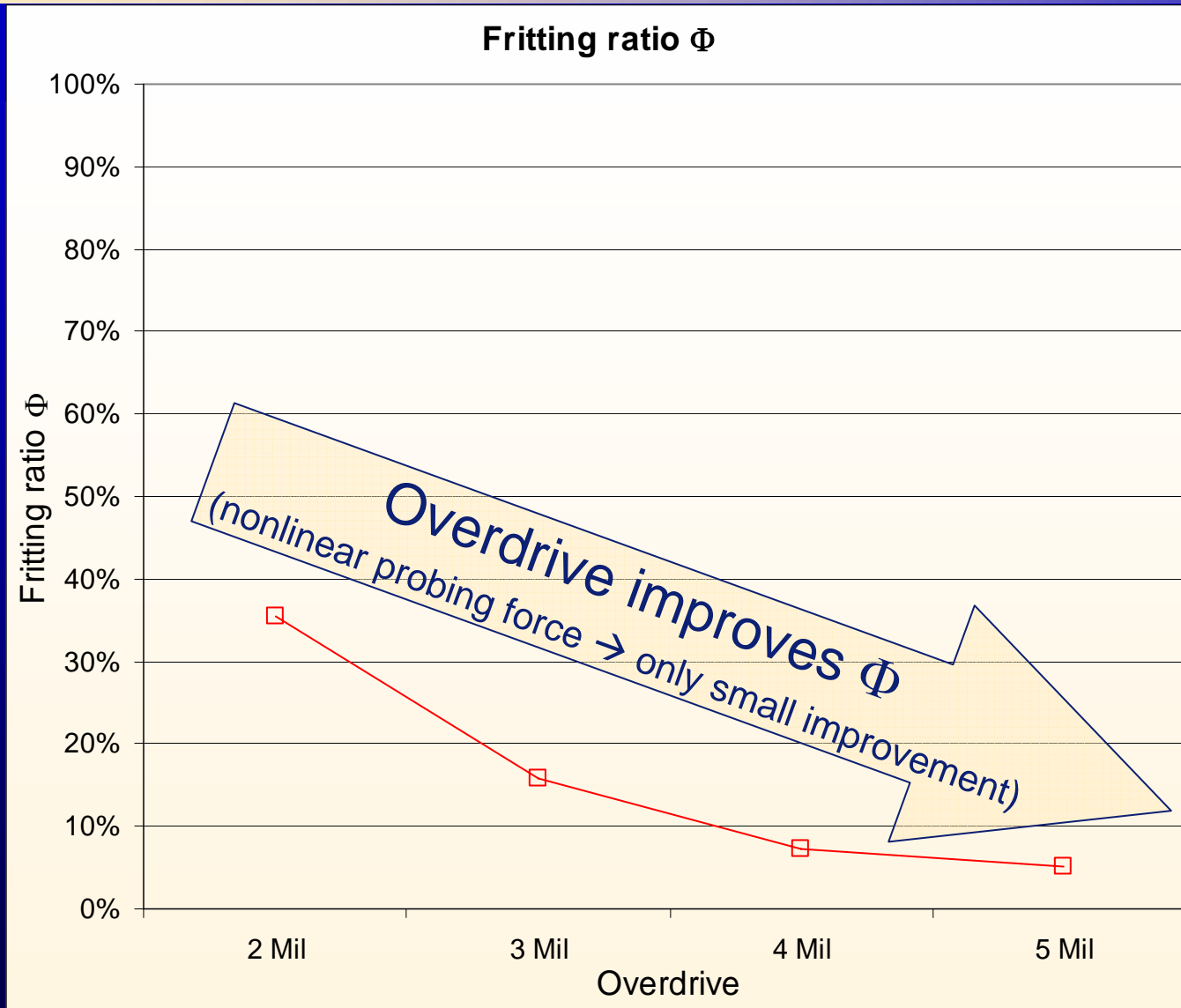
Why measuring Fritting and not only C_{RES} ?

- C_{RES} measurement only indicates a problem in the signal path but doesn't answer where. Fritting measurement verifies a probe tip contamination.
- In cases where an absolute C_{RES} measurement is impossible, a relative C_{RES} decrease can still be measured.
- The fritting analysis is more convenient and simpler to analyze.

How influencing the fritting ratio?

- Changing overdrive
- Probing on gold bumps instead of aluminum
- Using refurbishment methods
 - Probe Polish (online cleaning)
 - T.I.P.S. (offline cleaning)

Changing overdrive

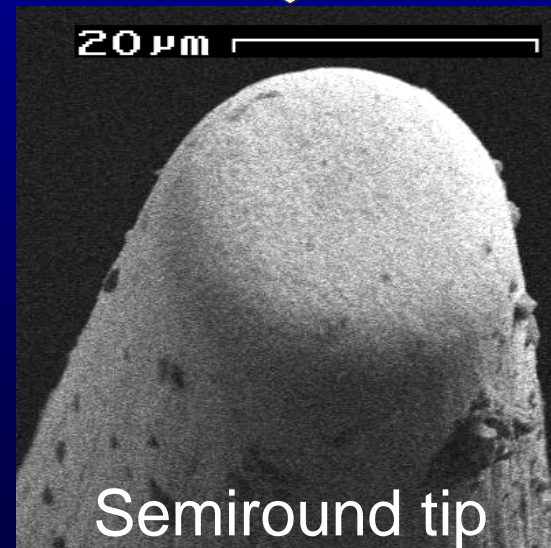
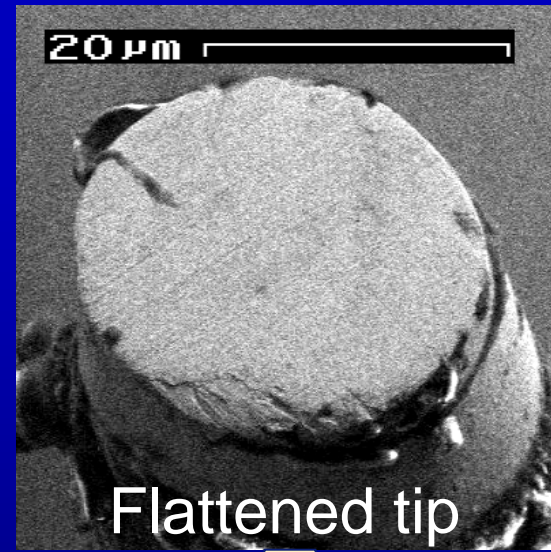
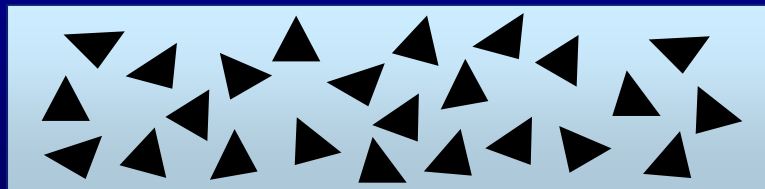
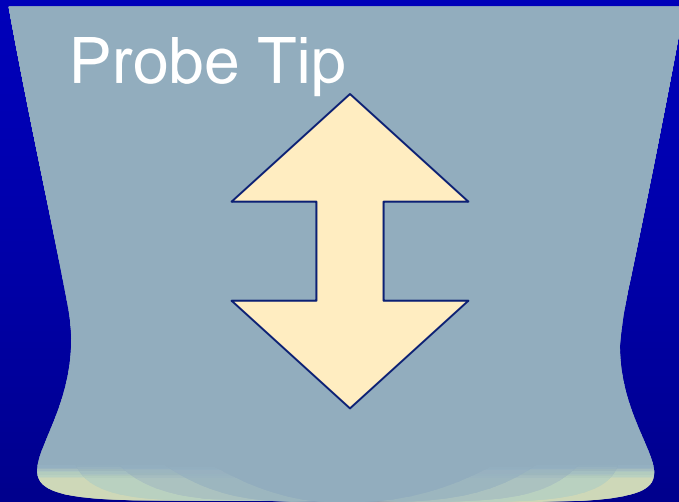


Probing on gold bumps (instead of aluminum)

- Searched in many production lots
- Fritting ratio always $\Phi=0\%$

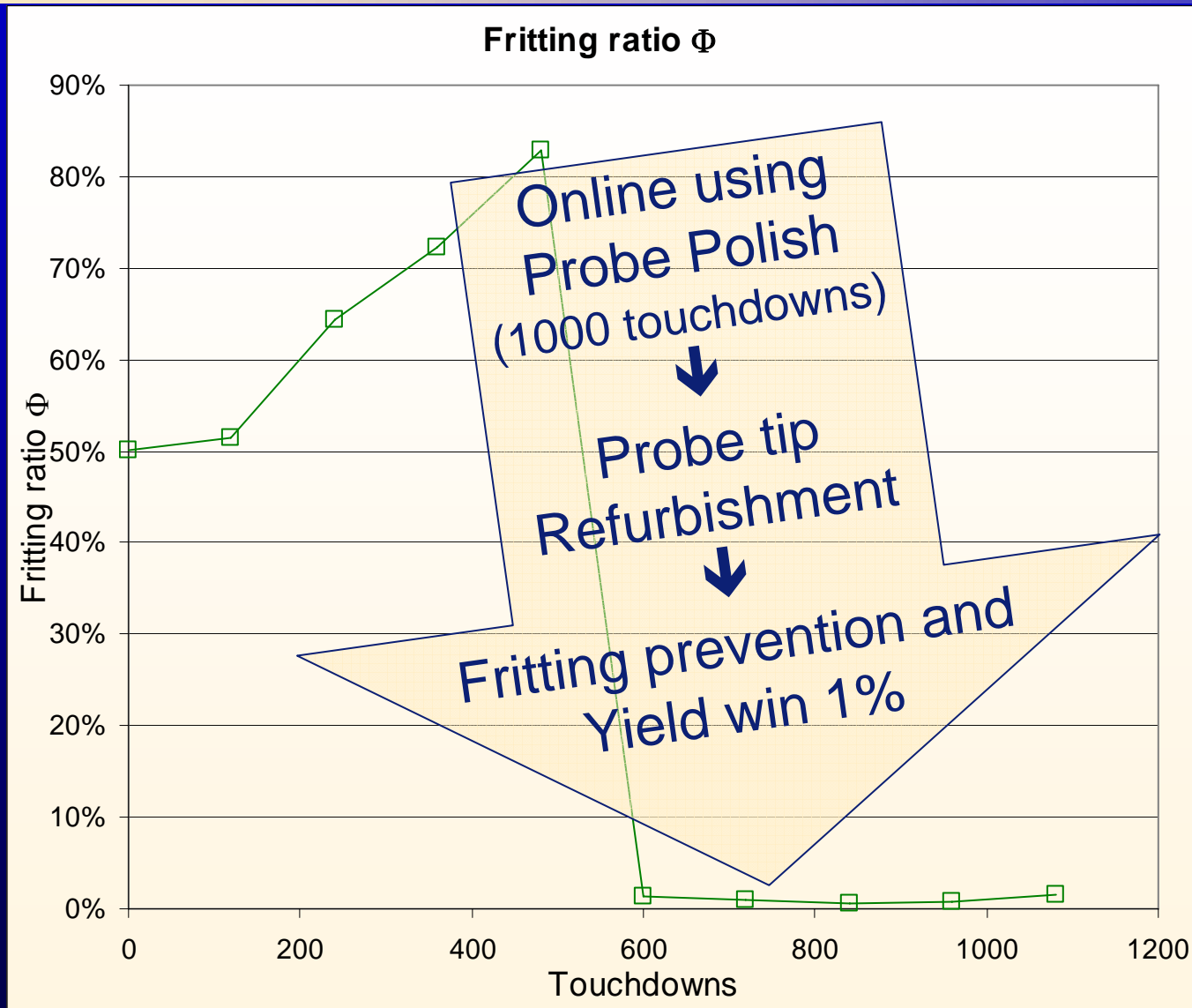
Gold is not oxidized.
→ No Fritting!

Probe tip refurbishment – How does it work?

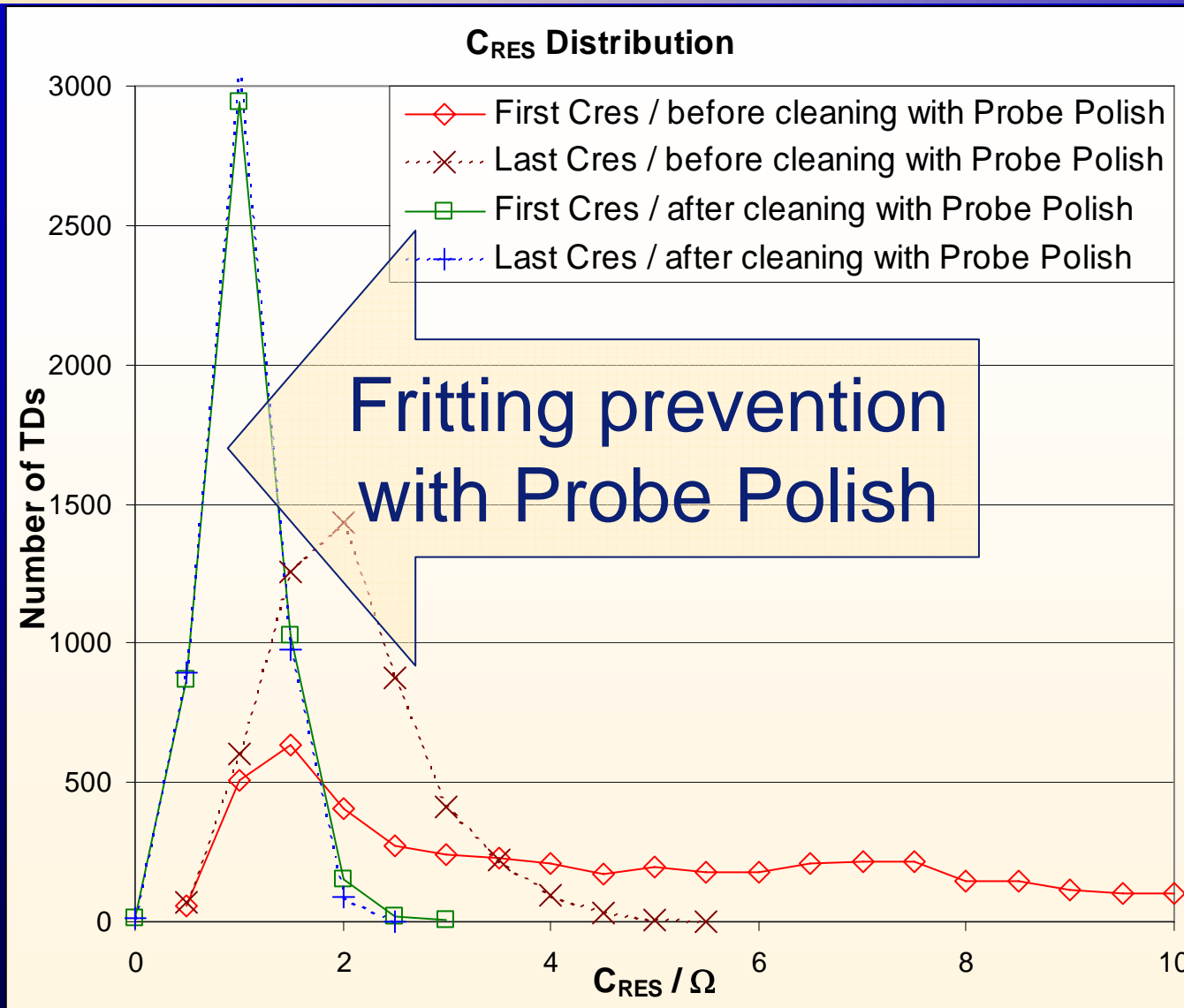


Pictures from T.I.P.S. Messtechnik GmbH

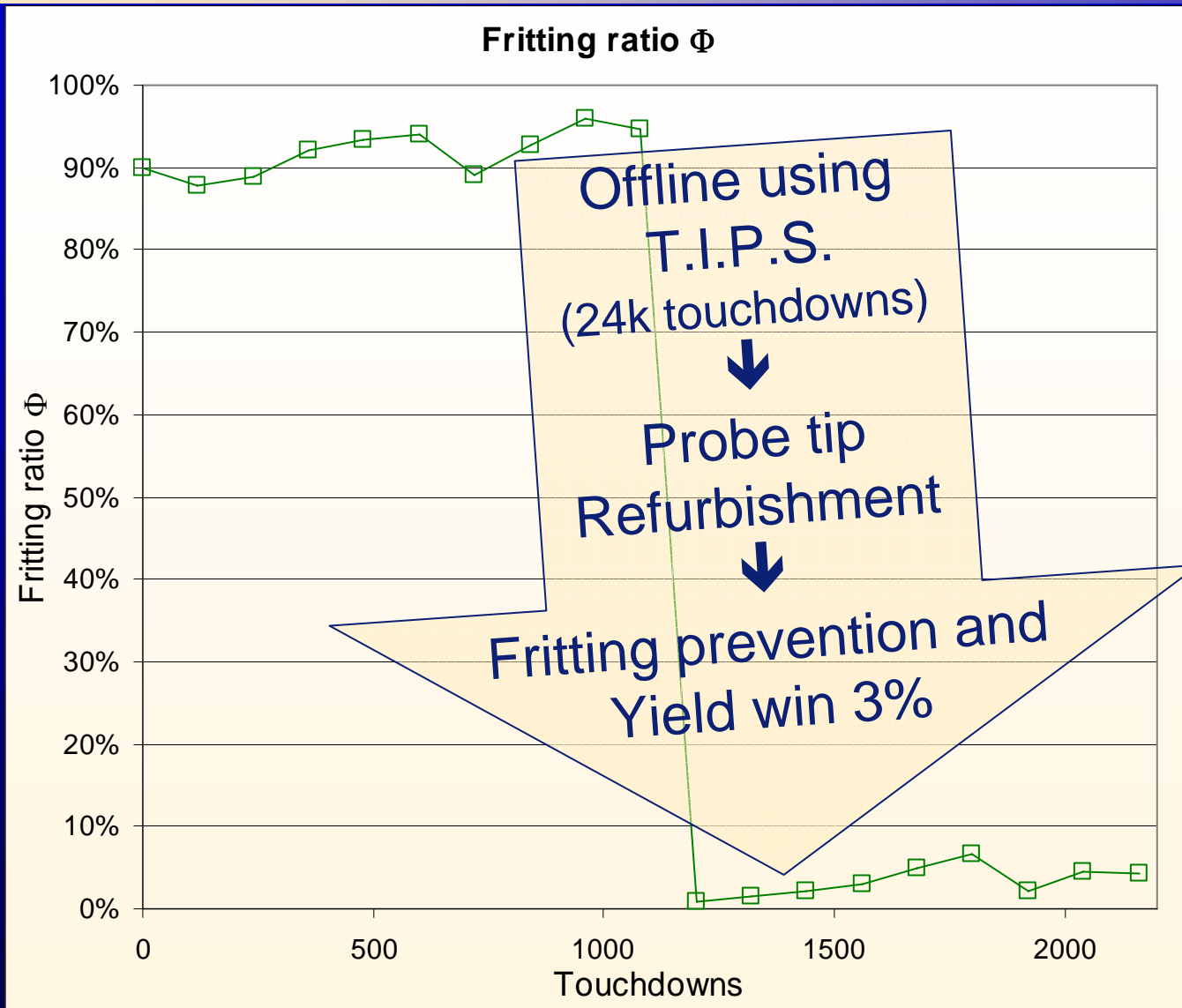
Online cleaning method: Probe Polish (ITS)



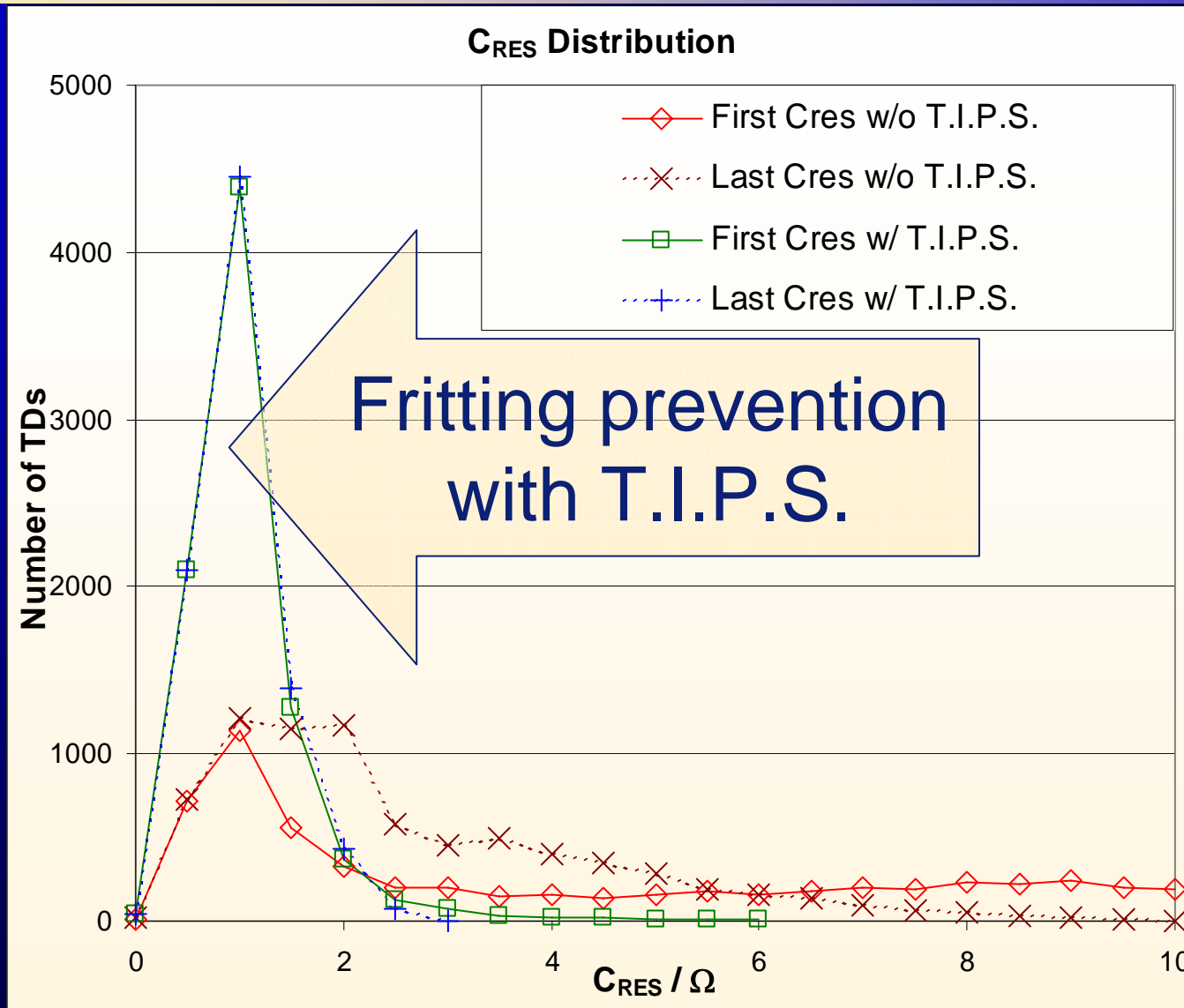
Fritting measurement and Probe Polish



Offline cleaning method: T.I.P.S.



Fritting measurement with T.I.P.S.



Summary

- Fritting was detected by comparing C_{RES} values during one touchdown.
- Fritting ratio Φ was defined and used as C_{RES} quality indicator.
- Fritting contaminates probe tips.
- Fritting was prevented and yield was increased by using probe tip refurbishment techniques:
 - Probe Polish www.inttest.net
 - T.I.P.S. www.tips.co.at

Outlook

- Fritting ratio Φ can indicate preventive maintenance of probe cards.
- Fritting ratio Φ can help to optimize cleaning setups.
- Fritting can help to identify and engineer (too) high current tests.
- Fritting could be an explanation for a fast abrasion of probe tip material.

Thank You!
Questions?