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#### Overview

- Fritting What's that?
- Fritting How to measure? C<sub>RES</sub> measurements within production environment
- Definition of the Fritting ratio  $\Phi$
- Why measuring Fritting and not only C<sub>RES</sub>?
- Measurement results
- Summary and Outlook

- 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<sub>RES</sub> quality



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



Small bridge through oxide film. Before high current flow.

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



High current flow situation: Black  $\rightarrow$  Lines of current flow. White  $\rightarrow$  Lines of equipotential surface.

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



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

igodol



stabilizing bridges through the oxide film, if the film was not mechanically broken completely.

Fritting is a kind of electrical breakdown at the

• 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.

Probe Tip

**Contact Pad** 

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#### Fritting – How to measure?

Needs:

- A C<sub>RES</sub> measurement is needed before and after fritting.
- The change of C<sub>RES</sub> is the indicator of occurence.

#### Implementation:

- C<sub>RES</sub> Monitor is installed twice within the production test program flow of a smart card measuring C<sub>RES</sub> 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<sub>RES</sub> per touchdown is collected and analyzed.

#### Fritting – How to measure?



#### Fritting – First data review



#### Definition of Fritting ratio $\Phi$



#### Fritting ratio $\Phi$ . Typical examples



# Why measuring Fritting and not only C<sub>RES</sub>?

- C<sub>RES</sub> 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 absolut  $C_{RES}$  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 Φ=0%

Gold is not oxidized. → No Fritting!

#### Probe tip refurbishment – How does it work?





Highly cross-linked polymeric material with spatially distributed abrasive particles. (Probe Polish<sup>™</sup>)



#### 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<sub>RES</sub> values during one touchdown.
- Fritting ratio  $\Phi$  was defined and used as  $C_{\text{RES}}$  quality indicator.
- Fritting contaminates probe tips.
- Fritting was prevented and yield was increased by using probe tip refurbishment techniques:
  - Probe Polish <u>www.inttest.net</u>
  - ➤ T.I.P.S. <u>www.tips.co.at</u>

# Outlook

- Fritting ratio Φ can indicate preventive maintenance of probe cards.
- 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?